

The graphic features white silhouettes of a woman, a young boy, and a young girl on the left, and a man on the right with his arms outstretched. A colorful ball is positioned above the letter 'O' in 'OBESITY'. The background is a dark blue map of Scotland.

CHILDHOOD OBESITY

IN SCOTLAND

INVESTIGATING TRENDS & EVIDENCE

Student report for Obesity Action Scotland

Student: Rosa Brunekreeft - 930321140060

Master programme: Communication, Health and Life Sciences

Specialization: Health and Society

Course code: HSO-70324

Supervisor Wageningen University: Caro-Lynn Verbaan

Supervisor internship: Anna Gryka-MacPhail

Date: January 24, 2020

Contents

Abbreviations	5
Abstract.....	7
1.1 Consequences of maternal and childhood obesity	9
1.2.1 Scottish Government	9
1.3 Prevention obesity	11
1.4 Problem.....	11
1.5 Aims.....	12
1.6 Research questions	12
2. Conceptual Framework	13
2.1 ANGELO framework	13
2.1.1 Environment scales.....	14
2.1.2 Environment domains.....	14
2.1.3 Previous research ANGELO framework.....	14
2.1.4 Application in current research ANGELO framework	14
3. Methods rapid review	16
3.1 Data and study selection	16
3.3 Data synthesis and analysis	19
3.4 Assessing citation quality	20
4. Results rapid review	21
4.1 Study quality	21
4.2 Intervention characteristics	21
4.3 Intervention effects	48
4.3.1 Home setting	49
4.3.2 Clinic setting.....	50
4.3.3 School setting	52
4.3.4 Childcare setting.....	53
4.3.5 Other settings.....	54
5. Methods investigating childhood obesity strategies NHS boards	56
5.1 Recruitment	56
5.2 Interview guide.....	56
5.3 Ethics.....	57
5.4 Data Analysis	57
5.5 Investigation situation boards	57

6.	Results interviews.....	59
6.1	Trends and current situation	59
6.2	Analysis NHS Boards.....	61
6.3	ANGELO Framework: Individual environment.....	66
6.3.1	Ayrshire and Arran: JumpStart.....	66
6.3.2	Ayrshire and Arran: JumpStart Choices	67
6.3.3	Ayrshire and Arran: Jump-Start one-to-one	67
6.3.4	Ayrshire and Arran: JumpStart 27.5 months.....	67
6.3.5	Lothian: Get Going.....	67
6.3.6	Lothian: Keep Going	68
6.3.7	Lothian: dietetic-led family intervention (clinic programme).....	68
6.4	ANGELO framework: Physical environment	68
6.5	ANGELO framework: Sociocultural environment	68
6.6	ANGELO framework: Economic environment.....	69
6.7	ANGELO framework: Political environment	69
6.8	Visual representation of all environments.....	70
6.9	Other codes	71
7.	Discussion	76
7.1	Main findings: rapid review.....	76
7.1.2	Main finding 2 & 3.....	77
7.1.3	Main finding 4 & 5.....	78
7.1.4	Main finding 6.....	78
7.2	Main findings interviews	78
7.3	Strengths and limitations	80
7.4	Recommendations for practical application.....	81
7.5	Recommendations for further research	82
7.6	Conclusion	82
	References	84
	Appendix 1: Search strategy	94
	Appendix 2: CASP to assess study quality	95
	Appendix 3: Intervention components categorised in the ANGELO framework by setting ..	116
	Appendix 3.1: School setting.....	116
	Appendix 3.2: Home setting	120
	Appendix 3.3: Childcare setting	125

Appendix 3.4: Clinic setting	129
Appendix 3.5: Other settings	135
Appendix 4: Interview guides	138
4.1 Interview guide NHS Ayrshire and Arran	138
4.2 Interview guide NHS Lothian	139
Appendix 5: Interviewee information	140
Appendix 6: Informed consent	141
Appendix 7: Visual timeline NHS Ayrshire and Arran	142
Appendix 8: Visual timeline NHS Lothian	143
Appendix 9: Promotional poster JumpStart	144

Abbreviations

Abbreviations	Explanation
6SQuiD	Six Steps in Quality Intervention Development
ANGELO	Analysis Grid for Environments Linked to Obesity
C	Control (group)
CASP	Critical Appraisal Skills Programme
CI	Confidence Interval
BMI	Body Mass Index
MI	Motivational Interviewing
MVPA	Moderate-to-vigorous Physical Activity
NHS	National Health Services
OECD	The Organisation for Economic Co-operation and Development
PA	Physical Activity
PICOS	Problem, Intervention, Comparison, Outcome, Setting/Study Design
RCT	Randomized Controlled Trial
SES	Socio-economical Status
SD	Standard Deviation
SSB	Sugar-Sweetened Beverage
VPA	Vigorous Physical Activity

Preface

Dear Reader,

This MSc report is written for my internship at Obesity Action Scotland and as the final part of my study Communication, Health and Life Sciences, specialization Health and Society. This report discovers the effect of childhood obesity prevention programmes on children's BMI, diet and physical activity level, for which a rapid review was conducted. Besides this, several types of current childhood obesity prevention programmes offered by two Scottish NHS boards were assessed during two interviews.

I am very grateful for the opportunity that I could be a part of the team of Obesity Action Scotland. In four months, I was able to experience the devotion of the organization to tackle obesity nationally. Next to that, building a life in another country was great for my personal development. I would like to thank every staff member of Obesity Action Scotland for making me feel welcome and valued.

Most of all, I would like to thank my supervisor, Anna Gryka-MacPhail, for her support and guidance throughout the entire internship and during the process of writing this report. Also special thanks to Obesity Action Scotland's Programme Lead Lorraine Tulloch, for her support and kindly allowing me to carry out this project in Glasgow.

I would also like to thank my supervisor from Wageningen University, Caro-Lynn Verbaan, for motivating me to deliver this report at an academic level. Next, I would like to thank the interviewees for their time and interest to participate.

Last but not least, I thank my family, friends from home, and new friends in Glasgow for their support.

Rosa Brunekreeft – 's-Hertogenbosch, January 2020

Abstract

Introduction Since official records began, Scotland holds one of the highest levels of childhood obesity among OECD countries. In 2019, the inequality gap between deprivation and obesity is the widest since records began. Children with obesity have a higher risk to develop several diseases and conditions. There is no comprehensive summary yet that explores components of effective childhood obesity prevention (primary, secondary and tertiary) interventions that can be implemented in Scotland. The following research questions were formed: “What is the effect of childhood obesity prevention programmes on children’s BMI, diet and physical activity level, among children from conception to five years of age, in comparison to children (or their parents) not exposed to childhood obesity prevention programmes?” and “What types of obesity prevention programmes for children until five years of age are offered in Scottish NHS boards?”

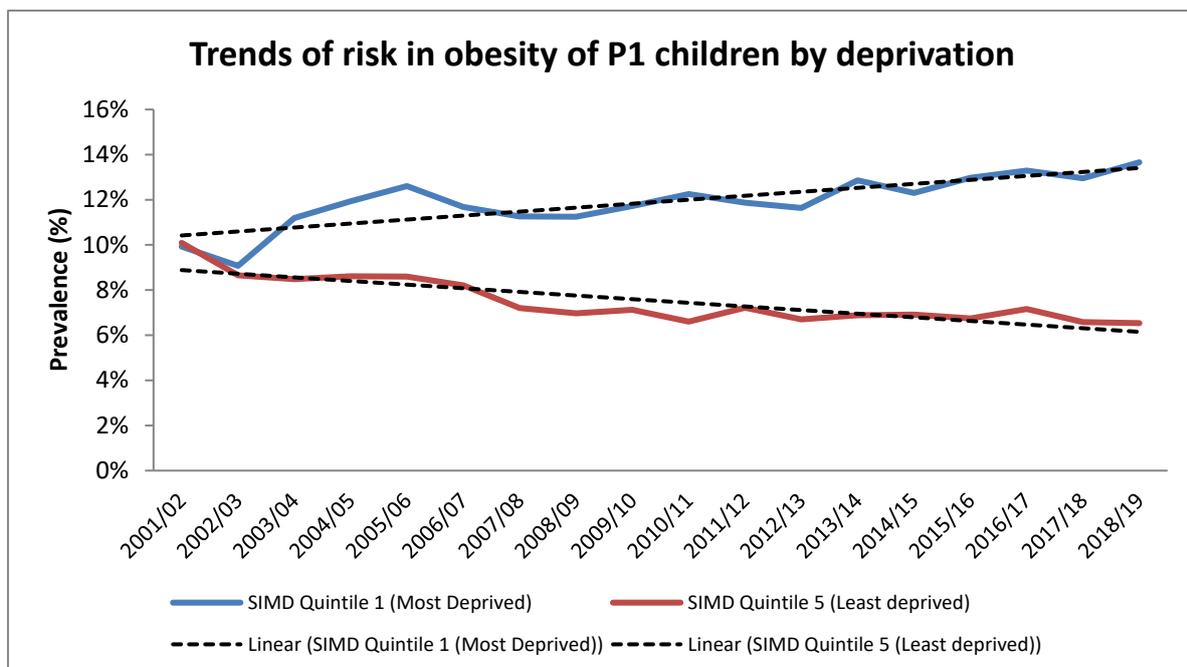
Methods A rapid review was conducted to answer the first research question. Records were searched in PubMed and screened and assessed against inclusion- and exclusion criteria. Included studies were rated on their quality with the Critical Appraisal Skills Programme (CASP). Next to that, interviews were conducted with representatives of NHS boards to assess childhood obesity prevention programmes to answer the second research question. Interview questions were based on information retrieved from the rapid review. The Analysis Grid for Environments Linked to Obesity (ANGELO) framework consists of multiple micro- and macro environments and was used to categorize intervention components assessed in the rapid review and during the interviews.

Results The search of the rapid review identified 43 citations, from which 23 were rated as having a strong study quality by CASP. Results were: i) 29% of the interventions that measured BMI showed a positive effect in children’s BMI; ii) Involving both children and their parents, instead of only targeting parents or their children, is likely most successful; iii) Surprisingly, no evidence was found that starting the intervention during pregnancy or at infant or toddler age is more effective than when starting the intervention at a later age; iv) Interventions in school settings and childcare settings generally lead to short-term increases in physical activity and decreases in BMI, but less changes in diet; v) Role modelling and habit formation in families may be highly effective at influencing child’s dietary intake, especially in a home setting; vi) There is some evidence that interventions conducted in multiple environments are more effective than interventions conducted in a single environment; Interventions in a clinic setting may be most effective for tertiary prevention and when multiple disciplines and both children and their parents are involved. Although there is no evidence that a clinic setting is the most promising setting to reduce children’s BMI; vii) There is evidence that training teachers to conduct the interventions is more effective than researchers conducting the interventions in a childcare and school setting; and viii) Multiple studies hypothesised that using motivational interviewing would be an effective intervention strategy; this was not seen in this rapid review. The two interviews resulted in a compact overview of some of the childhood obesity prevention programmes that were offered by NHS boards in Scotland. Currently, both one-to-one programmes for children and their families are offered and group-based programmes for children and their families.

Conclusion This study provides insight in possible effective components of lifestyle interventions for children below the age of five to prevent obesity. The effect of childhood obesity prevention programmes on BMI, diet and physical activity can be very promising when executed properly. The ANGELO framework suggests that an intervention that addresses different micro-environments is likely to be more effective than one environment only. Ideally, macro-environments should also be addressed to influence an unhealthy lifestyle. The challenge is to be innovative in creating interventions in different environments that are cost-effective and that can be sustained and evaluated over a longer period of time. Two boards were interviewed to find out which obesity prevention programmes for children they employed. Both boards offered one-to-one sessions and group sessions for children and their families, in which they were taught to eat healthy and perform physical activity while having fun. The effects of these programmes will become evident in future years.

1. Introduction

Obesity is currently one of the most serious health challenges worldwide (Arroyo-Johnson & Mincey, 2016). Among OECD countries, Scotland consistently has one of the highest levels of obesity (Bradshaw & Hinchliffe, 2018). In 2018, the Scottish Health Survey reported that 65% of the adults in Scotland were overweight, from which 28% suffered from obesity. Next to that, the proportion of children aged 2-15 at risk of overweight or obesity was 29%, from which 16% were of obesity specifically¹ (Scottish Government, 2019c). Other data of all children in their first year in primary school (Primary 1), aged 4-5, is measured yearly. In school year 2018/19, 22% were at risk of overweight or obesity, from which 10% were at risk of obesity specifically (ISD Scotland, 2019). Children living in most deprived areas of Scotland have a higher risk to develop overweight and obesity compared with the least deprived areas. Figure 1 shows the percentage Primary 1 children at risk of overweight or obesity by deprivation. The Scottish Index of Multiple Deprivation (SIMD) quintile of one stands for the most deprived areas, the SIMD quintile five stands for the least deprived areas. As the Figure shows, inequality between deprivation and overweight and obesity has been widening (NHS Health Scotland, 2019), and is in 2019 the widest since records began (Obesity Action Scotland, 2019a). The prevalence of the risk of overweight and obesity in children in Scotland has remained relatively stable since the last two decades (Martin & Greci, 2019). A lifestyle with little physical activity and a high-fat diet with excess caloric intake is one of the greatest risk factors for the rise in childhood overweight and obesity (Bocca et al., 2012). The overconsumption of fat and sugar in the Scottish diet has contributed most to the obesity epidemic in Scotland (Martin & Greci, 2019). This is the result of an environment where high energy foods are widely available at a low cost, and where there is less need to perform physical activity in daily life (Parkes et al., 2012).



¹ Epidemiological BMI thresholds are used. Children with a BMI between the 85th and 95th percentile are at risk of overweight, and children in the 95th percentile of BMI or higher are at risk of obesity.

Figure 1: Percentage of Primary 1 children at risk of overweight or obesity by deprivation between 2001/02 to 2018/19 (formed with data from Information Services Division Scotland) (Information Services Division, n.d.)

1.1 Consequences of maternal and childhood obesity

Overweight or obesity during pregnancy can result in a higher infants' birth weight. Children with a higher birth weight have in turn an increased risk to have overweight and obesity (Cnattingius et al., 2012). Children with obesity are more prone to develop conditions such as type 2 diabetes, hypertension and asthma (Martin & Greci, 2019). Later in life, they are more likely to become adults with obesity, which is associated with the development of conditions such as some types of cancer, type 2 diabetes and cardiovascular disease (Kothandan, 2014).

Because obesity and overweight are a risk factor for various conditions, often medical care is needed. Economic costs of overweight and obesity are difficult to measure because of the many possible consequences of excess weight. Nonetheless, it is certain that overweight and obesity place a substantial and growing burden on the National Health Service (NHS) in Scotland and the Scottish economy as a whole (Castle, 2015). Health care costs for people with severe obesity are generally at least twice as high, compared to people with a normal weight (Castle, 2015). Estimated is that the economic costs of overweight/obesity to NHS Scotland was around £5.1 billion (€5.9 billion) in 2006-07, which accounts for almost 12% of total NHS costs (Scarborough et al., 2011).

1.2 Local and national actions

The consequences for individuals and Scotland as a whole underscore a need for the implementation of effective childhood obesity prevention programmes. Nowadays, this often forms a priority amongst Scottish practitioners and policymakers (Bradshaw & Hinchliffe, 2018). The following three paragraphs explain actions of the Scottish government, NHS boards, and the advocacy group Obesity Action Scotland to tackle (childhood) obesity in Scotland.

1.2.1 Scottish Government

In July 2018, the Scottish government published the Scotland's Diet & Healthy Weight Delivery Plan. The plan consists of five key outcomes that will be worked towards to, with over 60 actions. These key outcomes entail:

- "Children have the best start in life - they eat well and have a healthy weight
- The food environment supports healthier choices
- People have access to effective weight management services
- Leaders across all sectors promote healthy weight and diet
- Diet-related health inequalities are reduced" (The Scottish Government, 2018).

Their guiding ambition is to halve childhood obesity in Scotland by 2030. Because obesity is a complex health challenge in which many stakeholders should be involved, the Scottish government emphasizes that action against obesity needs cross-sectional leadership. Collaboration and commitment from the public, private, third and community are essential to address (childhood) obesity (The Scottish Government, 2018).

1.2.2 NHS boards

The 14 regional NHS boards in Scotland are responsible for the provision of healthcare in their region (Information Services Division, 2017). The boards provide for all children and their families in Scotland the so called Child Health Programme. This consists of regular scheduled contacts with health visitors, school nurses and other health professionals for various elements such as routine childhood immunizations and formal screening for specific medical problems. Also included are weight and height measurements, from which the body mass index (BMI) can be calculated. Since the schoolyear of 2011/12, all boards use the national information system called the Child Health Surveillance Programme – School (CHSP-S) to record BMI of the Primary 1 children (Information Services Division, 2017).

Health Scotland performed a mapping exercise of weight management services across Scotland in 2017/18, and found that weight management services conducted across NHS boards varied greatly. They concluded that the methods and implementation of weight management services should be more consistent across the boards (NHS Health Scotland, 2019). That is why in 2019, NHS Health Scotland published the *Standards for the delivery of tier 2 and tier 3 weight management services in Scotland* (hereafter: Standards). These Standards can be incorporated in existing or new programmes of the NHS boards and therefore creates more consistent weight management services across Scotland. The Standards support Scotland's Diet & Healthy Weight Delivery Plan to reduce obesity and associated health inequalities (NHS Health Scotland, 2019).

1.2.3 Obesity Action Scotland

A prominent advocacy group on overweight and obesity in childhood and adulthood in Scotland is Obesity Action Scotland, formed in 2015. This organization is funded by a grant from the Scottish Government, and includes a Steering Group of members across various disciplines involved in tackling obesity (Obesity Action Scotland, n.d.). Their main aims are: "To raise awareness and understanding of what drives obesity and the health problems associated with obesity and overweight with health practitioners, policy makers and the public; to evaluate current research and identify strategies to prevent obesity and overweight based on the best available evidence; to work with key organisations in Scotland, the rest of the UK and worldwide, to promote healthy weight and wellbeing" (Obesity Action Scotland, n.d.). With campaigns such as *Make the Healthy Choice the Easy Choice*, and *Eating Out, Changing the Game*, they raise awareness and provide evidence-based information to policy makers, health professionals, the Scottish Government and the general public how eating healthier should be easier. Since obesity is a complex problem that influences many sectors, Obesity Action Scotland collaborates with other arms such as in human rights and environment (Obesity Action Scotland, n.d.). Furthermore, they have set up the Scottish Obesity Alliance in December 2018 which provides an independent voice that aims to create a society where healthy food and physical activity is the norm for all (Scottish Cancer Prevention Network, 2019).

1.3 Prevention obesity

Since the proportion of children at risk of obesity significantly increases with age in Scotland (Cheong et al., 2019) prevention starting from a young age are most effective to reduce the risk of obesity both during childhood and adulthood (Mustila et al., 2018), and there is strong evidence that prevention programmes aimed at children which are maintained later in life can be able to secure a healthy childhood and adulthood (Brown et al., 2019; Rohde et al., 2017). Appropriate evaluation of such prevention programmes is essential to determine the effectiveness and points of improvement (Spence et al., 2013). The proportion of children at risk of obesity significantly increases with age (Cheong et al., 2019).

This report focuses on the prevention of childhood obesity. Three types of prevention are included in this definition: primary prevention, which aims to avoid overweight and obesity in children; secondary prevention, to detect the beginning of overweight or a lifestyle that contains risk factors for overweight; and tertiary prevention, which aims to reduce weight for children with overweight or obesity.

1.4 Problem

Children and adults with obesity are likely to develop comorbidities (Martin & Greci, 2019; Kothandan, 2014). Children with overweight and obesity run a high risk to remain having an unhealthy weight in the future. Children from adults with obesity in turn, are more at risk to develop obesity themselves (Cnattingius et al., 2012). Scotland has one of the highest rates of children and adults that suffer from obesity among OECD countries (Bradshaw & Hinchliffe, 2018). Prevention of childhood obesity may contribute breaking the vicious cycle of obesity across generations (Cnattingius et al., 2012). Based on the fact that childhood overweight and obesity rates in Scotland have not changed the past two decades (Martin & Greci, 2019), and that inequality gap in children's BMI has been widening (NHS Health Scotland, 2019), urgent action needs to be taken. Obesity Action Scotland remarks that "Scotland has a long way to go if we are to reach the Government's ambition of halving childhood obesity by 2030. Currently, we are not on track and swift, ambitious action is required if we are to make any progress towards the target" (Obesity Action Scotland, 2019b).

Evidence states that obesity prevention programmes that start early in life are most effective (Mustila et al., 2018). Specified for Scotland, there is not yet a comprehensive summary that discovers which components of an obesity prevention programme are most effective in different settings, in maintaining an healthy BMI and reducing a BMI that is too high. Moreover, NHS boards offer or are in the process of developing prevention and weight management programmes for children (NHS Health Scotland, 2019). Programme components and programme types for the prevention of childhood obesity of NHS boards in Scotland have not yet been summarised and described.

This report contributes to the existing literature on effective childhood obesity prevention programmes in different settings, and contributes towards the understanding of the current childhood obesity

situation in Scotland.

1.5 Aims

The overall aim of this report is to broaden the understanding of effective childhood obesity prevention programmes and to understand the current childhood obesity situation in Scotland. This overall aim can be reached with the use of two key aims. The first, most important aim of this report is to provide a comprehensive understanding which childhood obesity prevention programmes have a positive effect on BMI, diet, and/or physical activity levels. Evidence suggests that starting obesity prevention strategies early in life is most effective; therefore this review focuses on evidence from conception to the age of five. The second key aim is to give a brief overview of different types of obesity prevention programmes offered by Scottish NHS boards for children below the age of five.

1.6 Research questions

Taking into account the problem statement and aims of this report, two research questions were formed.

The **first research question** is based on the first key aim, and forms the basis of this report:

What is the effect of childhood obesity prevention programmes on children's BMI, diet and physical activity level, among children from conception to five years of age, in comparison to children (or their parents) not exposed to childhood obesity prevention programmes?

The **second research question** is based on the second key aim, and can be seen as an useful addition to this report:

What types of obesity prevention programmes for children until five years of age are offered in Scottish NHS boards?

2. Conceptual Framework

This chapter explains the conceptual framework that guides this report. The used theory is the ANGELO framework by Swinburn, Egger, & Raza (1999). Reason to include this framework is because it has proven itself useful to present a structured overview of intervention components and to compare them. Also, it shows in a clear and convenient way the potential of those components in various settings and sectors to prevent childhood obesity (De Meester et al., 2009).

The ANGELO framework was deemed appropriate because it shows in a clear and convenient way the different components of interventions in various settings and sectors. This way, potential intervention settings and strategies can be identified (De Meester et al., 2009).

2.1 ANGELO framework

The Analysis Grid for Environments Linked to Obesity (ANGELO) framework was developed in 1999 by Swinburn, Egger, & Raza to identify obesogenic factors in the environment. This was based on the suggestions that the environment contributes to the development of obesity. The ANGELO framework is a 2x4 grid which divides obesogenic environments in two scales of environment on one axis (micro and macro), and four domains of environment on the other axis (physical, economic, policy and sociocultural environment). Interventions are further categorized in whether they influence “diet” or “physical activity” (Swinburn et al., 1999). See Table 1.

Table 1: ANGELO framework with examples as adopted from Swinburn et al. (1999).

Domain	Scale	
	Micro-environment <i>(e.g. childcare centre, household)</i>	Macro-environment <i>(e.g. food production, sports industry)</i>
	Diet related / physical activity related	Diet related / physical activity related
Physical	What is available? <i>(e.g. availability of training opportunities, supermarkets, schools, nutrition labels, product demonstrations, and sports grounds)</i>	
Economic	What are the costs? <i>(e.g. incentives and disincentives, taxes, financial support for health promotion programs, gym membership subsidy, funding health campaigns)</i>	
Policy	What are the “rules”? <i>(e.g. school nutrition policy and rules related to food and physical activity, family rules about food, and food industry policies and standards)</i>	
Sociocultural	What are the attitudes and beliefs? <i>(e.g. cultural norms in communities, mass media, teacher’s attitude towards physical activity)</i>	

2.1.1 Environment scales

A **micro-environmental** setting relating to obesity is one where people come together and which typically involves food, physical activity, or both. Examples are schools, workplaces, hospitals, and parks. **Macro-environment** sectors entail factors or policies, operating at different levels. These are for example an education and health system, food distribution system and the sports industry. Micro-environments are in turn influenced by the overarching macro-environments (Swinburn et al., 1999). For example, schools (micro) are influenced by education systems (macro), and supermarkets (micro), are influenced by food production, distribution and marketing (macro).

2.1.2 Environment domains

The **physical domain** refers to “what is available”, both including visible and less tangible factors (Swinburn et al., 1999). Examples are the availability of sport centres and nutrition education. The **economic domain** includes monetary costs that may affect food intake and engagement in physical activity. Examples for food are food production, distribution and marketing and a sugar tax, and an example for physical activity is a subsidy for a gym membership. The **policy domain** refers to rules related to food and physical activity. For example, nutrition and physical activity policies at a childcare centre, family rules of dinner eating in front of the television, and regulations of labels on foods. Lastly, the **sociocultural domain** typical entails the attitudes and values related to food and physical activity associated with a community or society. Examples are perceptions on body size in specific cultures and the values of a school on participation in physical activity.

2.1.3 Previous research ANGELO framework

The ANGELO framework has been used by several researchers and for several projects since it was launched in 1999. Mooney et al. (2015) conducted a policy analysis of a plan of the Scottish Government from 2011 to prevent obesity. Assessed was the appropriateness and likely impact of the balance of the proposed intervention measures by allocating intervention components to the environmental domains. Another study explored nutrition policies in schools in Canada, and used the ANGELO framework to extract themes from the physical and sociocultural domain (Vine & Elliott, 2014). Other studies used the framework as a classification system for systematic reviews of the obesogenic environment in children and adolescents in relation to physical activity (De Meester et al., 2009; Ferreira et al., 2007; Wendel-Vos et al., 2007) and diet (Johnson et al., 2015; Van Der Horst et al., 2007). The framework has also been used as a part of the priority setting process for obesity prevention to develop community action plans (Simmons et al., 2009; World Health Organization, 2012) and as a guide to understand individual factors leading to obesity (Egger et al., 2007). Lastly, the framework was used as a way to analyse interviews by exploring participants’ perceptions of the influence of micro- and macro level community environmental factors on physical activity and diet (Nieuwendyk et al., 2016).

2.1.4 Application in current research ANGELO framework

In this report, the framework will be used for both research questions. For the first research question, the ANGELO framework will be used as a tool to organize and summarise components of childhood obesity prevention programmes derived from a rapid review. Thus, assessing the effectiveness of

interventions itself will not be determined based on the ANGELO framework. It can however provide insight into the environments and settings that predict the best intervention effects. The second research question will use the ANGELO framework to assess components of childhood obesity prevention programmes that Scottish NHS boards offer. The methods (Chapter 3 and 5) will explain in more detail how the ANGELO framework was used.

3. Methods rapid review

A rapid review was conducted to answer the first research question: *‘What is the effect of childhood obesity prevention programmes on children’s BMI, diet and physical activity level, among children from conception to five years of age, in comparison to children (or their parents) not exposed to childhood obesity prevention programmes?’* A rapid review assesses what is already known about a specific topic, by using systematic review methods in a way that is less time consuming (Grant & Booth, 2009). The five steps outlined in the *Rapid Review Guidebook* from Dobbins (2017) were used to guide the development of the methods. As Dobbins states, the purpose of the Guidebook is to provide guidance to conduct a rapid review, and it is understood that the process of a rapid review can differ from the suggested steps due to time limitations. Steps may be skipped or completed less thoroughly (Dobbins, 2017). For this rapid review, most steps were considered and completed as thoroughly as possible considering time and resource limitations. This chapter outlines the methods of the rapid review in accordance with the guidelines by Dobbins (2017).

3.1 Data and study selection

The data for this review were obtained in September 2019 by searching PubMed, because of the database’s focus on life sciences. The search terms were developed by keeping in mind the first research question, which was formulated with PICO as suggested in the first step of Dobbins (2017). The population of interest (children from conception to five years of age), the intervention (childhood obesity prevention programmes), the comparator (children or their parents not exposed to childhood obesity prevention programmes) and the outcomes (BMI, diet and physical activity) were identified. Chosen is to also include studies that deliver interventions to one or both parent(s), as long as outcomes on physical activity, diet and/or BMI are (also) reported on their children. Reason for this was that valuable information of interventions during pregnancy and aimed children at a very young age, was still included in the rapid review. BMI percentile and BMI z-scores (BMIz) were both included as outcomes (hereafter BMI and BMIz are defined as ‘BMI’). PICO was used and further refined by adding Setting and Study design as components (Dobbins, 2017) for the search term selection (Table 2).

Table 2: Search term selection using PICOS

Domain	Search term
Problem	Obesity
Population	Children from conception to 5 years old (and their parents)
Intervention	Lifestyle programmes that prevent obesity
Comparison	Other programmes that do not focus on lifestyle (diet and/or physical activity) to prevent obesity, such as programmes that focus on sleep
Outcomes	BMI, diet, physical activity
Setting	High income countries
Study design	Randomised controlled trials

PICOS is useful for the search strategy when time and resources are limited (Methley et al., 2014). The setting was described as high-income countries, because results may be applied to settings in Scotland. Scotland is a high-income country, although 20% of the residents lived in relative poverty in 2015-18 (Scottish Government, 2019b). This was also reflected in some retrieved papers in the rapid review conducted in high-income countries, with low-income communities. Moreover, the study design focused on Randomized Controlled Trials (RCTs), to include only the highest quality of evidence. Thus, studies that were a secondary analysis were not included. Lastly, only lifestyle interventions that aimed to influence physical activity and/or diet were included. On the basis of the search term selection of PICOS, steps of the search strategy (Appendix 1) were formed. Dobbins (2017) suggests to have a librarian conduct the search in the second step, because they can retrieve more citations by having access to additional sources next to electronic databases. Due to the nature of this project, chosen was to conduct the search alone. Suggested in step two is also to conduct a search for all available evidence on the topic. This step is often skipped when there is limited time to conduct a rapid review (Dobbins, 2017); that is the reason this rapid review does not conduct an exhaustive search beforehand.

On the basis of PICOS and the search terms, the inclusion- and exclusion criteria were formed (Table 3). Added in these criteria were that obtained citations were limited to the publication date of maximum ten years, to focus on the most up to date information. Furthermore, added were only citations in English language and citations that conducted interventions with human species. Lastly, the age groups infant- and pre-schoolers were selected as a limitation within PubMed. Titles and abstracts of all citations obtained from PubMed were viewed against the inclusion and exclusion criteria. A flow diagram of the selection process was developed, based on the PRISMA template (Figure 2) (Moher, Liberati, Tetzlaff & Altman, 2009).

Table 3: Inclusion and exclusion criteria

Domain	Inclusion criteria	Exclusion criteria
Problem/ population	Children from conception to five years old at the start of study ² , without developmental or intellectual disabilities, or parents of those children (with study outcomes on their children)	Children/parents of children that are more than five years old at start of study, and children with developmental or intellectual disabilities
Intervention	RCTs investigating the effect of overweight/obesity prevention programmes	Other studies and RCTs that do not focus on lifestyle programmes to prevent overweight/obesity

² Citations with subjects with a wider age range (e.g. 2 – 6 years), were only included when 50% of the subjects or more, were aged below 5 years at baseline.

Outcomes	BMI or physical activity or diet	Outcomes which do not relate to BMI, physical activity levels or diet
Study design	Randomised controlled trials	Studies other than randomised controlled trials
Other variables	Studies conducted within the last 10 years, in English language, with human subjects, in high income countries	Studies published over 10 years ago, non-English language papers, subjects other than human, low and middle income countries

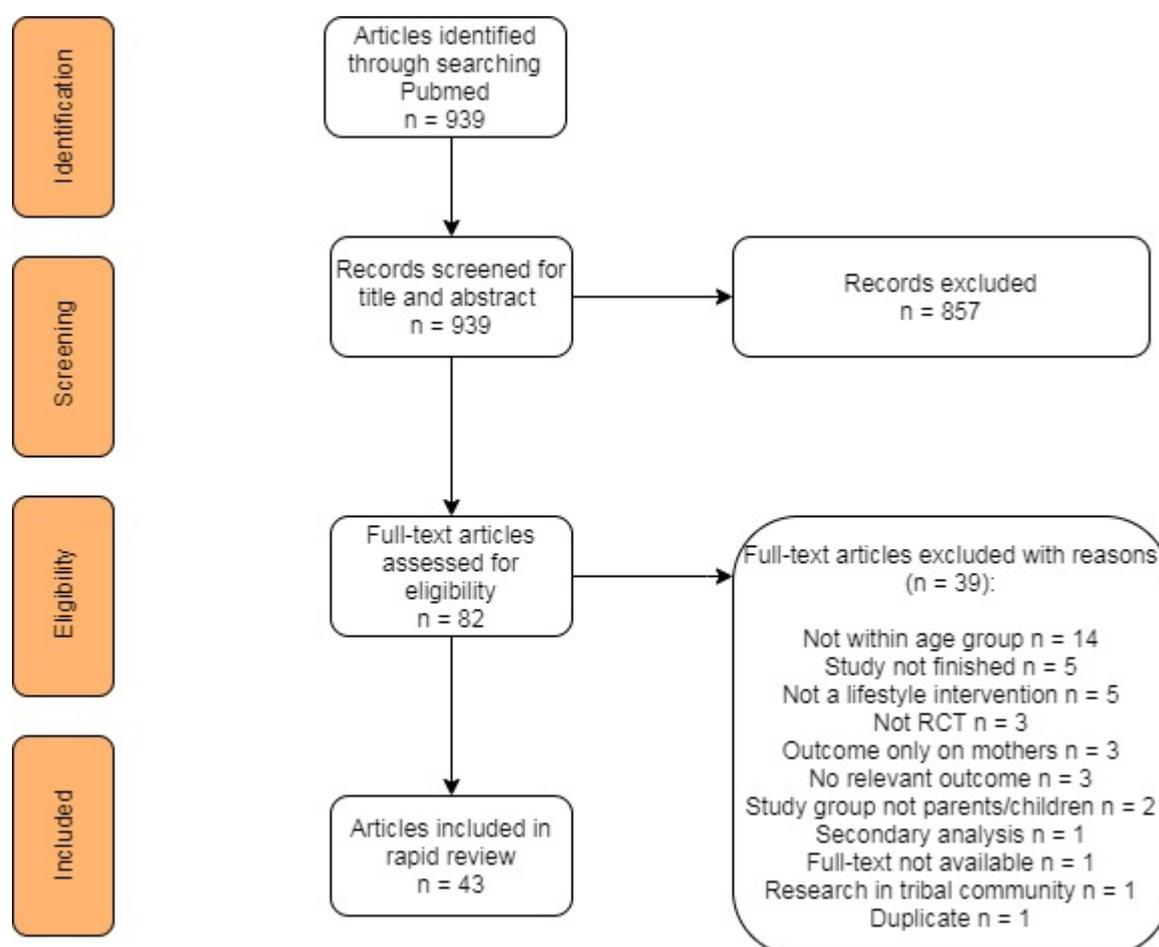


Figure 2: PRISMA Flow-chart of study selection

The search identified 939 articles published in English between September 2009 and September 2019. Of these, 82 records passed the initial screening of the title and abstract review and were assessed for eligibility (see Figure 2). Excluded were 39 records after screening the full-text, with the following reasons: sample was not within age group, study was not finished, study was not a lifestyle intervention, study was not an RCT, outcome(s) were only on mothers of the children and not on the children themselves, study had no relevant outcome (BMI/diet/PA), there was no relevant study group (parents/children), study was a secondary analysis, full-text was not available, study was a duplicate and study was researched in a tribal community. The latter was conducted in a high-income country,

but due to the distinct lifestyle of a tribal community the study was excluded. To conclude, a final sample of 43 papers were included in this rapid review.

3.3 Data synthesis and analysis

The following data was extracted from the articles included in the rapid review: study, setting, sample size at baseline and at last measurement, sample child age, length of intervention/follow-up, outcomes (BMI/diet/PA), intervention method and results. This data was organized in a data extraction table as suggested by Dobbins (2017) in the fourth step.

The ANGELO framework was used to categorise the interventions by setting (home, childcare, school, day care, clinic-based and other). If an intervention took place in more than one setting (e.g. at home and in a childcare setting), the intervention was categorized in the most prominent delivery setting. Settings were defined beforehand by own interpretation (Table 4).

Table 4: Settings for categorising the results of the rapid review

Setting	Description for this report
Home setting	Intervention that was conducted in the family home. Includes e.g. face-to-face, telephone-based and internet-based.
School setting	Intervention that was conducted in a school. Includes e.g. primary school and Head Start school.
Childcare setting	Intervention that was conducted in a setting where young children stay during the day and are supervised and cared for by a person other than a parent or caregiver. Includes kindergartens and day care centres.
Clinic setting	Intervention that was conducted in a setting where parents and their children go once in a while for check-ups on their child's health or lifestyle. Includes hospitals, university clinics, maternal and child services, and paediatric practices.
Other	A setting that cannot be categorized as a home, school, childcare or clinic setting.

Next, intervention components of the different settings were categorized in physical, economic, policy or sociocultural environments as in the ANGELO framework. The 'individual' environment was added as an extra component of the framework. This was adopted from a systematic review that identified interventions promoting physical activity among teenagers (De Meester et al., 2009), that also used the ANGELO framework to categorize interventions. The individual environment consists of the body of the interventions aimed at individuals, instead of changing the physical, economical, sociocultural or political environment. Since the rapid review only reviewed RCTs, hypothesised was that general descriptions of all interventions fit in the individual environment.

Lastly, interventions were categorised in effectiveness. Interventions were categorised as "effective" when all outcomes considered (diet, physical activity and/or BMI) in that paper (and follow-up if

applicable) were significantly positively affected. An intervention was considered as “medium effective”, when multiple outcomes were considered but when not all outcomes showed a significant positive intervention effect. Interventions that did not have any positive intervention effect on the outcomes, were categorised as “not effective”.

The data extraction table, together with the categorization in the ANGELO framework and the effectiveness of the studies were used to organize results and to draw main findings. Results were described with a narrative synthesis. The final step for a rapid review is was to answer the question: “Can this research be used with our population?” (Dobbins, 2017). In order to answer this, meetings should be held with stakeholders and research members of the rapid review (Dobbins, 2017). This step was skipped because the rapid review was conducted by one person. The Discussion however, will briefly discuss this.

3.4 Assessing citation quality

One of the steps of a rapid review is performing a critical appraisal (Dobbins, 2017), and for the current review the Critical Appraisal Skills Programme (CASP) method was used. CASP allows to systematically assess the trustworthiness, relevance and results of studies with the use of a checklist (Critical Appraisal Skills Programme, 2018). CASP has checklists for eight study designs, one of which specifically to assess the quality of RCTs. Data from all studies was inserted in a table. Developers of CASP refrain from using a scoring system (Critical Appraisal Skills Programme, 2018). Chosen was to instead, use a rating system to assess study quality adapted from a systematic review that used CASP for various study types (Fullen et al., 2008). If seven to nine questions were scored “Yes”, the paper was rated as “strong”, four to six “Yes” scores rated the paper “moderate”, and with three or less “Yes” answers, the paper was rated as having a “poor” quality.

4. Results rapid review

All studies were RCTs and included a lifestyle intervention to prevent (primary, secondary and/or tertiary prevention) obesity among children from conception to five years of age in high-income countries, and included as an outcome BMI, physical activity level and/or diet of the children. Some studies were a follow-up of others. One paper (Bocca et al., 2014) was a follow-up to an intervention reported in an earlier paper (Bocca et al., 2012), and another paper (Daniels et al., 2012) had two follow-ups (Daniels, Mallan, Nicholson, Battistutta, & Magarey, 2013; Daniels et al., 2015) that were included in this rapid review. Lastly, the intervention from Moir et al. (2016) was followed-up by Taylor et al. (2018). Thus, in total there were 43 citations obtained from which 39 interventions were delivered.

4.1 Study quality

Study quality was assessed of each for the 43 papers with the CASP checklist tool for appraising RCTs (Critical Appraisal Skills Programme, 2018). Appendix 2 presents the results of the checklist in a table.

In total, 23 papers were rated as having a strong study quality (Barkin et al., 2018; Bocca et al., 2012, 2014; Bonis et al., 2014; Campbell et al., 2013; Daniels et al., 2012; De Bock et al., 2012; Doring et al., 2016; Fitzgibbon et al., 2011; Handel et al., 2017; Helle, Hillesund, Wills, & Øverby, 2019; Iaia et al., 2017; McGowan et al., 2013; Natale, Lopez-Mitnik, et al., 2014; Nystrom et al., 2017; Ostbye et al., 2012; Paul et al., 2018; Rohde et al., 2017; Roth et al., 2015; Skouteris et al., 2016; Taylor et al., 2018b; Zask et al., 2012). A total of 15 papers were rated as a moderate quality (Alkon et al., 2014; Annesi et al., 2013a, 2013b; Daniels et al., 2013, 2015; Fisher et al., 2019; Haines et al., 2018; Lumeng et al., 2017; Moir et al., 2016; Natale, Messiah, et al., 2014; Reifsnider et al., 2018; Rifas-Shiman et al., 2017; Spence et al., 2013; Stark et al., 2018; van Grieken et al., 2017). Lastly, five papers were rated as a poor quality (De Coen et al., 2012; Jouret et al., 2009; Mirota et al., 2018; Schroeder et al., 2015; Verbestel et al., 2014).

4.2 Intervention characteristics

Study characteristics, sample characteristics and findings are presented in Table 5. The duration of intervention programmes ranged from eight weeks to four years. A total of eight studies had interventions that took place in less than six months and 31 studies examined intervention programmes that were six months to four years in length. An intervention length of six month was most common, with prevalence in eight studies.

The majority of conducted interventions (16) were conducted in the United States of America (USA). These also included interventions from low in-come communities with people from African/American, Latino or Hispanic origin (Annesi et al., 2013a, 2013b; Barkin et al., 2018; Fisher et al., 2019b;

Natale, Messiah, et al., 2014; Reifsnider et al., 2018). Five studies were conducted in Australia and two studies in Denmark, the Netherlands, Germany, Belgium, Sweden, and Canada. The following countries included one study: Norway, Italy, France, New Zealand, and the United Kingdom (UK).

The majority with 19 interventions were targeted at both children and their parents. A total of 17 interventions were targeted at parents only, and three interventions were delivered to children without involvement of the parents.

The results are categorised by settings in Appendix 3, based on the ANGELO framework (Critical Appraisal Skills Programme, 2018). Categorization of all codes in the framework took place in several settings in the micro-environment. Most interventions were conducted in a home setting (11). Other settings were a clinic setting (10), a school setting (8) and a childcare setting (6). Four studies were categorised in "other settings". All interventions were conducted in the individual environment; 17 interventions were conducted in the individual environment only. The next most occurring is the combination in the individual- and socio-cultural environment and a combination of three or more different environments. The most occurring combination of settings and environments are interventions conducted in home and school settings, in the individual environment only. See Figure 3 for a summary of the environments addressed in the different settings.

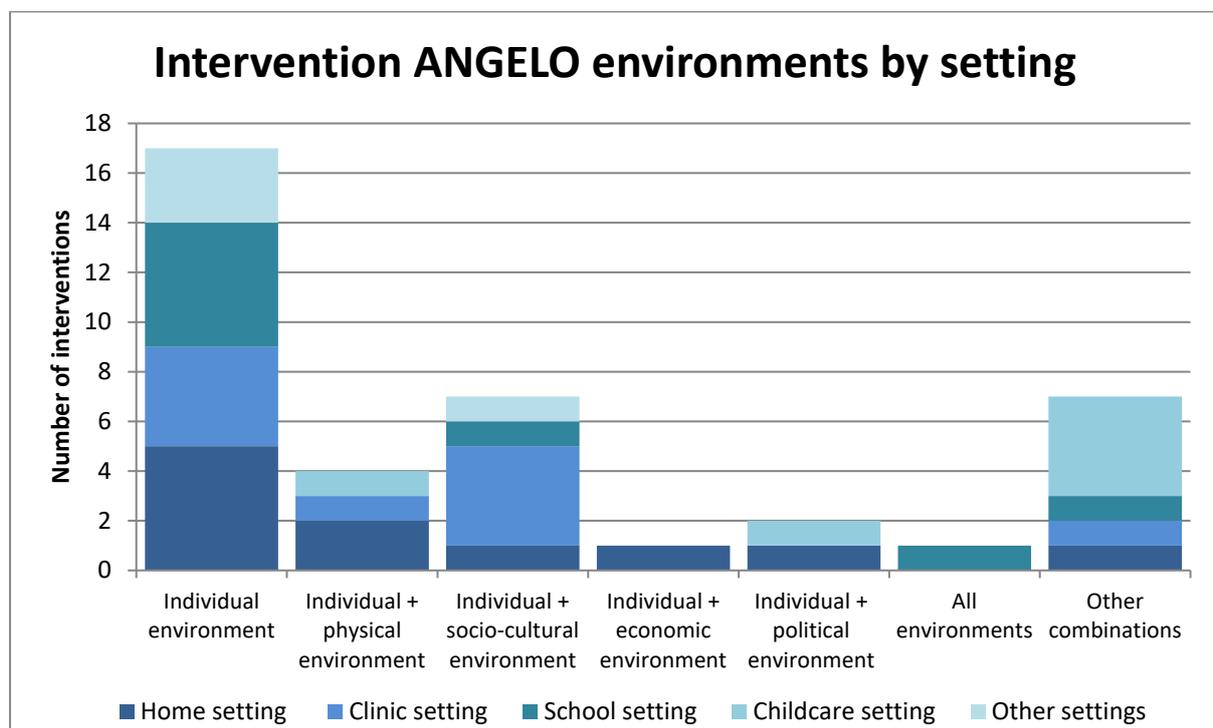


Figure 3: Environments of the ANGELO framework addressed in the five settings

Table 5: Data extraction table of the rapid review

#	Study	Setting	Sample size (baseline/last measurement)	Sample child age	Length of intervention/follow-up	Outcomes (BMI/diet/PA)	Intervention method	Results	Study quality (CASP)
1	Nutrition and physical activity randomized control trial in child care centers improves knowledge, policies, and children's body mass index (Alkon et al., 2014)	Childcare in child care settings in USA	9 child care centres with 260 children in the intervention group and 9 childcare centres with 292 children in control group	3-5 years	7 months	BMIz, PA, diet	The Nutrition and Physical Activity Self Assessment for Childcare (NAP SACC): The child care health consultants (CCHCs) facilitated five, one hour NAP SACC workshops for child care providers and other staff at each of the intervention centres on childhood obesity, healthy eating and PA for young children, personal health and wellness, and working with families to promote healthy behaviours. Seven of the intervention centres also received the parent workshop "Raising Healthy Kids". In addition, the CCHCs worked with the centre directors to write/update the centre's nutrition and PA policies. They provided also consultations and distributed posters and information sheets on nutrition and PA, for the child care centres and child care providers and parents. All of the materials supported NAP SACC's best practices. The control centres received the delayed NAP SACC intervention in year two of the study.	No significant changes in PA levels and children's nutrition. There were changes in child-level in children's BMIz in the intervention and control centres at both pre- and post-intervention time points, but there were no significant changes in BMIz between the intervention and control group.	Moderate

#	Study	Setting	Sample size (baseline/last measurement)	Sample child age	Length of intervention/follow-up	Outcomes (BMI/diet/PA)	Intervention method	Results	Study quality (CASP)
2	Effects of a Cognitive–Behaviorally Based Physical Activity Treatment for 4- and 5-Year-Old Children Attending US Preschools (Annesi, Smith, & Tennant, 2013a)	Children in preschool settings in Southeast USA	60 intervention and 38 control classes, each with 17 to 20 children	4-5 years	9 months	BMI, PA	Start For Life: preschool teachers received 4h training where the administration of physical activities supported by cognitive – behavioural methods was taught. They also got a binder of daily lesson plan. The treatment was administered daily, during the 30 minutes reserved for structured physical activities. It incorporated gross motor skills with the age-appropriate behavioural skill training interspersed. Each session started with a warm-up and then rotated 12 segments of vigorous, light, and moderate-to-vigorous physical activities (MVPA), ending with a cooldown. Behavioural skills included long-and short term goal setting, self-monitoring of incremental progress, and acknowledgement of physical achievements. The control group received usual care consisting of 30 minutes reserved time for PA under control of the teachers.	A significantly greater percentage of the preschool day in MVPA and vigorous PA, with sedentary time unaffected. The treatment was also associated with a significant Reduction in BMI, with effect sizes greatest in overweight and obese children.	Moderate
3	Effects of the Start For Life treatment on physical activity in primarily African American preschool children of ages 3-5 years (Annesi, Smith, & Tennant, 2013b)	Children in preschool settings in Southeast USA	11 intervention and 8 control classes, each with 17 to 20 children	3-5 years	8 weeks	PA	Start For Life (trial of study #2 above)	Changes in MVPA and vigorous PA were significant, and significantly more in the Start For Life group.	Moderate
4	Effect of a Behavioral Intervention for Underserved Preschool-Age Children on Change in Body Mass Index: A Randomized Clinical Trial	Children and parents in community centres Nashville	304 parent-child pairs intervention and 306 parent-child control	3-5 years	36 months	BMI, diet, PA	GROW Healthier: a tiered-intensity program of decreasing intensity: (a) a 12-week intensive phase with weekly 90 minutes skills-building sessions (for parents and children regarding nutritional choices, PA habits, use of the family and built environment, engaged parenting, healthy sleep, and reduced media time) via either in-person groups or telephone calls; (2) a 9-month maintenance phase with	There was no significant difference in BMI after the intervention. The intervention group children had a lower mean caloric	Strong

#	Study	Setting	Sample size (baseline/last measurement)	Sample child age	Length of intervention/ follow-up	Outcomes (BMI/diet/PA)	Intervention method	Results	Study quality (CASP)
	(Barkin et al., 2018)	e, Tennessee (USA)					monthly coaching telephone calls; and (3) a 24-month sustainability phase providing frequent cues to action (e.g. texts, personalized letters) to use parks and recreating programming for healthy family behaviours. The control group received a school readiness programme.	intake compared with the control group. There were no significant intervention effects on MVPA.	
5 & 6	Results of a multidisciplinary treatment program in 3-year-old to 5-year-old overweight or obese children: a randomized controlled clinical trial (Bocca, Corpeleijn, Stolk, & Sauer, 2012) AND Three-year follow-up of 3-year-old to 5-year-old children after participation in a multidisciplinary or a usual-care obesity treatment program (Bocca, Corpeleijn, van den Heuvel, Stolk, & Sauer, 2014) - 36 months follow-up	Children and parents in a clinic-based setting in the Netherlands	40/25 children in intervention group, 35/25 children in control group	3-5 years	16 weeks, follow up 12 months and 36 months after treatment	BMI, diet, PA	GECKO-Outpatients Clinic Study: Children were overweight or obese. The children and parents in the multidisciplinary intervention program received dietary advice, PA sessions, and for parents only psychologic counselling. Dietary advice consisted of 6 sessions of 30 minutes each, guided by a dietician. Personal goals regarding the diet were set for parents and children. Feedback was given on these goals. The PA sessions consisted of 12 group sessions of 60 minutes supervised by a physiotherapist. The exercise program focused on an active lifestyle and mimicked the type and intensity of habitual elementary school exercise. Sessions were aimed at having fun during the exercise. Parents were asked to stimulate their child's PA. In total, the multidisciplinary intervention program consisted of 25 sessions, together approximately 30 hours. The control group received usual care of the GECKO and were followed up by a paediatrician. Information on healthy eating behaviour and PA was provided.	Children in the intervention group showed a greater decrease in BMI after the treatment program and after 12 month follow-up, compared with the control group. During the follow-up period of 36 months, a significant overall treatment effect on a reduction in BMI was present for the multidisciplinary intervention group. There were no statistically significant differences between the groups with respect to energy intake and PA.	Strong & Strong
7	Improving Physical Activity	Children in	128/110 children in	3-5	6 months	PA, BMI	NAP SACC: Dieticians with PA training experience became NAP SACC certified and implemented the	Total PA in the treatment group	Strong

#	Study	Setting	Sample size (baseline/last measurement)	Sample child age	Length of intervention/ follow-up	Outcomes (BMI/diet/PA)	Intervention method	Results	Study quality (CASP)
	in Daycare Interventions (Bonis et al., 2014)	childcare settings in the USA	intervention group and 123/99 children in control group	years			program. The NAP SACC consultants delivered to the staff of each treatment facility four workshops that demonstrated the importance of PA and nutrition. The workshop topic included overweight, nutrition, PA, and growing healthy kids. The consultants maintained regular contact with the treatment facility staff and provided support in addressing any barriers that would prevent achievement of their specific facility improvement plan. They also distributed educational information to the parent/guardians that focused on PA and nutrition recommendations at home. Each treatment facility director completed the NAP SACC self-assessment tool that assessed their centre on 14 key areas in PA and nutrition. Based on the responses, the facility director with guidance from the NAP SACC consultant chose 3-4 areas for improvement and prepared a unique facility improvement plan. After the pre-intervention data measurement was completed in all facilities, a six month intervention was implemented in the treatment group facilities. The control centres were given access to the NAP SACC programme after completion of the project.	was increased by 21.9%, as compared to 4.4% in the control group, significantly increased vigorous PA by 50% in the treatment group compared to 3.8% in the control group, and significantly increased moderate PA by 32.7% in the treatment group compared to 0% in the control group. There were no significant changes in BMI of the intervention and control group.	
8	A parent-focused intervention to reduce infant obesity risk behaviors: a randomized trial (Campbell et al., 2013)	Parents in pre-existing social groups from Maternal and Child Health service in Melbourne	271/241 children in intervention- and 271/239 children in control group	3-4 months	15 months, follow-up when child was 20 months	Diet, PA, BMI	Intervention was dietitian-delivered with six 2 hour sessions quarterly during the first-time parents' group regular meeting. The pre-existing social groups were from health services provided by the Maternal and Child Health (MCH) service. Parents engage in groups that often become independent social groups. The intervention draws on the parenting support theory, which emphasizes children's psychological and behavioural goals, logical an natural consequences, mutual respect and encouragement techniques. Emphasis was placed on parents' understanding of how improved parenting skills can facilitate the development of appropriate eating and activity behaviours in children	No difference in BMI or PA. The intervention group significantly consumed fewer grams of sweet snacks compared with the control group. There was no effect on further diet.	Strong

#	Study	Setting	Sample size (baseline/last measurement)	Sample child age	Length of intervention/ follow-up	Outcomes (BMI/diet/PA)	Intervention method	Results	Study quality (CASP)
		(Australia)					(Campbell et al., 2008). Control group parents received usual care from their MCH nurse.		
9 & 10 & 11	<p>Evaluation of an intervention to promote protective infant feeding practices to prevent childhood obesity: outcomes of the NOURISH RCT at 14 months of age and 6 months post the first of two intervention modules</p> <p>(Daniels et al., 2012)</p> <p>&</p> <p>Outcomes of an early feeding practices intervention to prevent childhood obesity</p> <p>(Daniels, Mallan, Nicholson, Battistutta, & Magarey, 2013) - Follow-up at child age 2 years</p> <p>&</p> <p>An Early Feeding Practices Intervention for Obesity Prevention</p> <p>(Daniels et al., 2015) - Follow-up at child age 5</p>	<p>First-time mothers in Adelaide and Brisbane in a maternal and child health setting (Australia)</p>	<p>352/260 mothers in intervention group and 346/281 mothers in control group</p>	<p>4-6 months</p>	<p>3 months , follow-up when child was 13-15 months, two years, and five years</p>	<p>Diet, BMIz</p>	<p>NOURISH: The intervention was a comprehensive skills-based program that used a cognitive behavioural approach and focused on the feeding and parenting practices that mediate children's early feeding experiences. It comprised of two modules of 6 fortnightly group sessions (10-15 mothers per group), each of 1-1.5 hour duration. Interactive group sessions were co-led by a dietitian and psychologist. Content included anticipatory guidance on the 'when, what and how' of solid feeding. The control group received self-directed access to usual community child health services, which were similar in both states and largely targeted at high-risk families.</p>	<p>86% of the control group infants had a higher zBMI and were more likely to show rapid weight gain from baseline to follow-up.</p> <p>At age two and five, there were no significant differences in BMIz.</p>	<p>Strong & Moderate</p>

#	Study	Setting	Sample size (baseline/last measurement)	Sample child age	Length of intervention/ follow-up	Outcomes (BMI/diet/PA)	Intervention method	Results	Study quality (CASP)
					years				
12	Positive impact of a pre-school-based nutritional intervention on children's fruit and vegetable intake: results of a cluster-randomized trial (De Bock, Breitenstein, & Fischer, 2012)	Children in pre-school settings in Germany	194 children in intervention group and 183 in control group. In total 348 children provided sufficient data for analysis.	3-6 years	6 months	Diet, BMI	The intervention was delivered by external nutrition experts who participated in intensive four day training sessions covering specific nutritional guidelines for children and basic communication skills. The experts delivered the intervention during 15 standardized two hour nutrition sessions, mostly during pre-school hours, conducted once a week with five of these sessions actively involving parents by targeting them alone or together with children. Intervention activities consisted of familiarizing with different food types and preparation methods as well as cooking and eating meals together in groups of children, teachers and parents. The control group received the same intervention six months later than the intervention arm.	Children's FV intake increased significantly in the intervention group. There was no significant difference in BMI.	Strong
13	Effects of a 2-year healthy eating and physical activity intervention for 3-6-year-olds in communities of high and low socio-economic status: the POP (Prevention of Overweight among Pre-school and school children) project (De Coen et al., 2012)	Children in pre-school and primary school settings in communities of high and low SES in Belgium	1280/694 parents completed a questionnaire and 1102/1102 children were measured.	3-6 years	2 academic years	Diet, PA, BMLz	The intervention was based on the 'Nutrition and Physical Activity Health Targets' of the Flemish Community clustered into (a) increasing daily consumption of water and decreasing soft drinks consumption; (b) increasing daily milk consumption; (c) increasing daily consumption of FV; (d) decreasing consumption of sweets and savoury snacks; (e) increasing daily PA. The child was the centre of focus situated within several layers, among other: <u>the community</u> (meetings were held with researchers, community organizations and stakeholders regarding local social and health problems using concept mapping, also information brochures and posters of the project were distributed), <u>the schools</u> (all schools were requested to (a) implement five Healthy Weeks per intervention year with a minimum 1h of classroom time dedicated to the topic together with extracurricular activities (b) evaluate and improve their playground and snack and beverage policy and (c) communicate with the parents on the	There was significant effect on BMLz for the total sample. There was a significant decrease in BMLz in the low-SES intervention community compared with the low-SES control community. There were no significant intervention effects on diet and PA behaviour.	Poor

#	Study	Setting	Sample size (baseline/last measurement)	Sample child age	Length of intervention/ follow-up	Outcomes (BMI/diet/PA)	Intervention method	Results	Study quality (CASP)
							programme), <u>the parents</u> (received information on parenting practices and styles to encourage children to stick to the healthy eating and PA targets. Also received individual tailored advice on their child's dietary behaviour).		
14	Motivational Interviewing to Prevent Childhood Obesity: A Cluster RCT (Doring et al., 2016)	Children in child health care setting in Sweden	601/448 children intervention group and 768/700 children control group	8-9 months	Starts when the child is 8-9 months old, ends at age 4	BMI, PA, diet	PRIMROSE: By applying MI and principles of cognitive behaviour therapy, intervention nurses assisted parents in promoting healthy food and PA habits in their children and in changing their own health behaviours if needed. Nurses at the intervention child health care centre (CHC) attended a five day course on MI, learning theory, and the principles of cognitive behaviour therapy and on the subjects of nutrition and PA, taught by a nutritionist, psychologists, and MI experts. Families in intervention CHCs took part in nine sessions (one group, six individual, and two individual telephone sessions) in a time frame of ~39 months. The parents, in conjunction with the nurses, formulated goals for changes in unhealthy behaviours and for maintenance of healthy PA and food habits. In consecutive sessions, the nurses reinforced the parents' motivation for and commitment to health promotion and behaviour change when needed. Families in the control CHCs were only offered the regular age-related health check-ups of Swedish child health services.	There were no significant differences in children's BMI and children's PA habits. There was a significant intervention effect in consuming less french fries and discretionary calories among children.	Strong
15	Efficacy of a food parenting intervention for mothers with low income to reduce preschooler's solid fat and added sugar intakes: A randomized controlled trial (Fisher et al., 2019)	Mothers in a maternal and child health setting in USA	59/49 mothers in intervention group and 60/54 mothers in control group	3-5 year	3 months	BMIz, diet	FFF (Food, Fun, and Families): Aimed at reducing children's consumption of "empty" calories from solid fat and added sugars. Includes a weekly group intervention of 60 min, each used core behavioural change techniques to facilitate adherence including goal setting and planning, feedback and monitoring, antecedents, comparison of behaviour, natural consequences, and social reward. Sessions began with a group discussion of progress on achieving the previous weeks' goals and collective problem-	Children from the intervention group consumed 94 kcal or 23% less daily energy from solid fat and added sugar than children in the control group. There was no significant	Moderate

#	Study	Setting	Sample size (baseline/last measurement)	Sample child age	Length of intervention/ follow-up	Outcomes (BMI/diet/PA)	Intervention method	Results	Study quality (CASP)
							solving around challenges, followed by presentation of new content and interactive demonstrations, and finally discussion of the next week's goals. The control group was a delayed treatment.	difference in total daily intake or BMIz of the children.	
16	Hip-Hop to Health Jr. Obesity Prevention Effectiveness Trial: postintervention results (Fitzgibbon et al., 2011)	Children in public school settings in Chicago (USA)	325 children in intervention group and 293 children in control group. Analysed was the BMI of 309, the PA of 96 and the diet of 238 children in the intervention group, and the BMI of 260, the PA of 94 and the diet of 202 children in the control group	3-5 years	14 weeks	BMI, PA, diet	Hip-Hop to Health: Intensive intervention: 45 minutes class two times a week at school. The children participate in a 20 minutes activity related to healthy eating or exercise, with the goal to emphasize the importance of healthy eating and exercise, to encourage the exploration of new foods, and to support the relationship among nutritious foods, consistent activity, and healthy bodies. Hand puppets are used (Mr. Protein, Mr Fat, etc) and the children go on a picture food find where pictures of various foods that they learned about are hidden in the classroom. The last minutes of each class are spent in aerobic activity. The parent component of the intervention consists of a weekly newsletter, homework assignments, and twice weekly aerobics classes. General health intervention (control) consisted of 20 minutes weekly class, spent on general health activity (e.g. how to brush teeth correctly) (Fitzgibbon et al., 2002).	There were no significant differences in BMI or dietary intake between groups after the intervention. Children in the intervention schools were engaged in more MVPA than children in the control schools.	Strong
17	Guelph Family Health Study: pilot study of a home-based obesity prevention intervention (Haines et al., 2018)	Parents and their children in their home in Canada	17/16 families in intervention group with 4 home visits (HV, 14/14 families in intervention group with 2 HV, 13/12 families control group	1.5-5 years	Between 8-24 weeks	Diet, PA	Pilot of the Guelph Family Health Study (GFHS): There were two intervention groups, 4HV and 2HV. HV were conducted by four health educators; all were graduate students and dietitians who received MI training. Initial HV lasted one hour and began with health educators describing the behavioural goals of the study (e.g. engaging in family PA, establishing sleep routines, having more family meals). Families then rated their current routines and behaviours, and were asked if they wanted to set any behaviour change goals. MI techniques were used to identify specific steps required to implement the goal. Families were provided a paper family routine tracker on which they could record	Children randomised to the 4HV and 2HV groups had significantly higher fruit intake. No significant effect on other dietary behaviours or PA.	Moderate

#	Study	Setting	Sample size (baseline/last measurement)	Sample child age	Length of intervention/ follow-up	Outcomes (BMI/diet/PA)	Intervention method	Results	Study quality (CASP)
							their behaviour and identify possible facilitators or barriers to their behaviour change. Follow-up home visits lasted 30-60 minutes, where the goals were reviewed and discussed. Families could set a new goal or revise a previously established goal. Families were sent weekly e-mails that were tailored to the behaviour change goal set by the family. The control group received monthly emails with publicly available child health information.		
18	Guelph Family Health Study's Home-Based Obesity Prevention Intervention Increases Fibre and Fruit Intake in Preschool-Aged Children (Mirota et al., 2018)	Parents and their children in their family home in Canada	11/11 families in intervention and 9/9 families in control group	1.5-5 years	6 months	Diet	GFHS (from the pilot study above): The intervention consisted of two or four home visits (2HV, 4HV) with a health educator, weekly tailored emails with information about lifestyle goals and monthly mailed incentives. At the first home visit, each family tailored their individual intervention by selecting one or more lifestyle goals from the following: eating more meals together as a family, choosing water over other beverages, making time for physical activity every day, setting a bedtime routine, and limiting screen time. Dieticians who conducted the home visits worked with families at each home visit to determine realistic ways they could accomplish their selected lifestyle goals using a MI approach.	The fruit and fibre intake significantly increased in the 4HV group, whereas the 2HV group significantly increased fruit intake in the children.	Poor
19	Effects of the Healthy Start randomized intervention trial on physical activity among normal weight preschool children predisposed to overweight and obesity (Handel et al., 2017)	Parents and their children meeting with a health consultant in Denmark	271/127 children in intervention group and 272/180 children in control group	2-6 years	15 months	PA	Parents and children in the intervention group were invited to see a health consultant on a regular basis over a 15 months period with a maximum of ten visits, and most families received 4-5 consultations. The content of the consultations were based around four main themes: optimizing diet and PA, together with sleep and stress management. The intervention was a non-standardized package and focused on the entire participating family's individual needs and resources, and hence not only the child. Children in the control group met with a health consultant at baseline and at 15 months follow-up after baseline.	The intervention group spent more time on sports and outdoor activities combined per week than the control group, although no significant intervention effects were seen for each of the subcategories (e.g. sports participation and outdoor	Strong

#	Study	Setting	Sample size (baseline/last measurement)	Sample child age	Length of intervention/ follow-up	Outcomes (BMI/diet/PA)	Intervention method	Results	Study quality (CASP)
20	Effects of the Healthy Start randomized intervention on dietary intake among obesity-prone normal-weight children (Rohde et al., 2017)	Parents and their children meeting with a health consultant in Denmark	320/124 intervention and 315/161 control group children	2-6 years	15 months	Diet	Parents and children in the intervention group were assigned to a health consultant trained in nutrition and dietetics. Each child and his/her family were seen on a regular basis, with up to ten consultations during follow-up. The content of the consultations were based around four main themes: optimizing diet and PA, together with sleep and stress management. The intervention was a non-standardized package and focused on the entire participating family's individual needs and resources, and hence not only the child. The intervention families were also invited to participate in group-based bimonthly cooking classes and monthly play and activity events. Children in the control group met with a health consultant at baseline and at 15 months follow-up after baseline.	Children in the intervention group had a significant lower energy intake after the intervention compared with the control group. The intervention group had also lower intakes of carbohydrates and added sugar compared with the control group.	Strong
21	Evaluation of an eHealth intervention aiming to promote healthy food habits from infancy -the Norwegian randomized controlled trial Early Food for Future Health (Helle, Hillesund, Wills, & Øverby, 2019)	Parents in their family home and in child health clinics in Norway	360 mothers in intervention group and 358 mothers in control group. Measurements from 236-269 mothers in the intervention group and 219-264 in the control group.	3-5 months	7 months	Diet, zBMI	E-Health intervention, consisting of 7-monthly video clips of 3-5 minutes, focusing on feeding-related aspects (e.g. monthly cooking films and recipes). Parents received an email each month with a link to the age-appropriate webpage showing the month's video clip on the infant feeding topic together with the corresponding recipes and cooking-films. Parents in the control group received routine care from their local child health clinic with regular consultations at child age 6, 8, 10 and 12 months.	More than 80% of the intervention group reported viewing all/most of the video clips addressing infant feeding topics. Children in the intervention group were served FV more frequently, and had tasted a wider variety of vegetables compared to controls. No difference in BMIz.	Strong
22	An educational intervention to promote	Children in	199/194 children in	3	6 months,	BMIz, diet,	The intervention consisted of three parts: (1) Two face-to-face MI with parents, (20 minutes each)	There were no significant	Strong

#	Study	Setting	Sample size (baseline/last measurement)	Sample child age	Length of intervention/ follow-up	Outcomes (BMI/diet/PA)	Intervention method	Results	Study quality (CASP)
	healthy lifestyles in preschool children: a cluster-RCT (Iaia et al., 2017)	childcare centres in Cesena, Forlì-Cesena (Italy)	intervention group and 226/195 children in the control group	years	follow-up 2 years after baseline	PA	conducted by paediatric nurses to help families to increasingly adopt healthy lifestyles. Specific unhealthy behaviours of the parents were addressed. (2) Information tools were created for parents and teachers such as leaflets and a poster highlighting four key behaviours. (3) Teachers got a ten hour long training to promote more active play at childcare centres and inserted this subject into their annual educational timetables. Children and teachers also engaged in learning experiences (one hour per day) such as eating vegetables first at lunch and be repeatedly exposed to new FV, to achieve an increase in FV intake. The control group parents received routine healthcare advice during child health visits and children were involved in the usual learning experiences at childcare centres.	differences in BMIz. Measured was children's combined health behaviour score (CHBS) at home. A significantly higher percentage of children with a low-risk CHBS was found in the intervention group. A higher percentage of intervention in comparison with the control group showed a low-risk score for FV (four or more servings per day) and sugar-sweetened beverage (SSB) intake. A low-risk score for active playtime was more frequent in intervention children only at 1 year follow up.	g
23	Prevention of overweight in preschool children: results of kindergarten-based interventions (Jouret et al., 2009)	Children in kindergartens in France	750/556 children in EPIPO1, 1030/697 children in EPIPO2, and 410 children in the control	3-4 years	2 years	BMIz	Children in the intervention kindergartens were randomly assigned to EPIPO1 or EPIPO2 (Epidémiologie et prévention de l'obésité infantile). Both groups followed the 'basic strategy', that comprised information dissemination to parents and teachers, as well as screening for overweight at baseline and follow-up care by family practitioners for overweight, if indicated. EPIPO2 received a	After intervention, prevalence of overweight, BMIz and change in BMIz were significantly lower in intervention groups compared with	Poor

#	Study	Setting	Sample size (baseline/last measurement)	Sample child age	Length of intervention/ follow-up	Outcomes (BMI/diet/PA)	Intervention method	Results	Study quality (CASP)
			group				reinforced strategy consisting of an education program, in addition. It consisted of a kindergarten-based education program, focusing among other on promoting healthy nutrition habits and PA. The study team, comprising a dietician and an education aide, conducted ten 20 minute sessions in the classroom. These sessions incorporated learning activities and games around themes as: improved knowledge of food groups and their role in health, importance of eating balanced meals and snacks and practicing in PA. In addition, children received an audio cassette and a story book to reinforce these educational messages, whereas their parents were provided packets containing information on nutrition and PA in relation to health. Data for the control group were obtained retrospectively from school medical records.	controls in underprivileged areas. Using multilevel analysis adjusted for potential confounders, a significant effect on overweight prevalence at the end of the study was noted for EPIPOI-1 in underprivileged areas only. In non-underprivileged areas, the gain in BMIz was lower in EPIPOI-2 group compared with control and EPIPOI-1.	
24	Improving Self-Regulation for Obesity Prevention in Head Start: A Randomized Controlled Trial. (Lumeng et al., 2017)	Children in Head Start (HS) classroom settings in urban and rural Michigan (USA)	224/221 children in HS+POPS, 255/253 children in HS+POPS+IYS and 218/216 children in the control group	Preschool, average 4 years	4 academic years	BMI, diet	POPS: Behavioural goals included for example increased FV intake, reduced SSB consumption and cooking healthy meals at home. Both parent and child components were delivered by a master's-level nutrition educator in collaboration with the classroom teacher. The preschool classroom component consisted of six lessons incorporating children's stories and associated classroom activities, classroom cooking experiences and goal setting. The parent component implemented by the nutrition educator consisted of eight 75 minute lessons that incorporated a cooking activity and focused on building knowledge and self-efficacy, as well as developing and practicing skills and strategies. IYS: program that emphasizes positive behavioural management techniques and enhances	There was no effect on the prevalence of obesity. There was no effect on other outcomes except for SSB intake (HS+POPS+IYS resulted in a greater decline than HS).	Moderate

#	Study	Setting	Sample size (baseline/last measurement)	Sample child age	Length of intervention/ follow-up	Outcomes (BMI/diet/PA)	Intervention method	Results	Study quality (CASP)
							self-regulation in young, low-income children. Both parent and child components were delivered by a master's-level health specialist in collaboration with teachers. The preschool classroom component consisted of 60 lessons followed by smaller group activities that addressed self-regulation skills, problem-solving strategies, and prosocial behaviour. The parent component consisted of lessons delivered by using video vignettes in 14 group sessions or ten home visits that were reinforced with homework and follow-up phone calls.		
25	Healthy feeding habits: efficacy results from a cluster-randomized, controlled exploratory trial of a novel, habit-based intervention with parents (McGowan et al., 2013)	Parents in a home setting in London (UK)	58/51 parents in intervention and 68/55 parents in control group.	2-6 years	8 weeks	Diet	The healthy feeding intervention (habit-based) was delivered by researchers over the course of four visits to the family home. Each visit lasted one hour and involved the researcher working through an intervention booklet with the parent. This booklet introduced the concept of habit formation (actions become easier with repetition). It had detachable self-monitoring sheets to use during the habit acquisition phase. There were sections for each target feeding domain (serving FV, healthy snacks and healthy drinks). Focusing on one domain at each visit, parents first discussed with the researcher why it is important to have healthy feeding habits for children. Tips were provided on how best to aid habit formation and practical advice specific to each feeding habit. Parents then formulated a specific, healthy feeding goal in that area (e.g. to only serve water with the evening meal). At each subsequent visit, parents were encouraged to continue with the previous habit(s) while introducing a new one. In the control group, the study was described as a survey of children's eating habits. These parents received an envelope containing an information sheet and a baseline questionnaire.	For all parental feeding behaviours, automaticity increased more in the intervention group than in the control group. Significant intervention effects on children's intake of vegetables, healthy snacks, and water were observed. Changes in children's food intake correlated with changes in parental automaticity of feeding behaviours, and program acceptability was high.	Strong

#	Study	Setting	Sample size (baseline/last measurement)	Sample child age	Length of intervention/follow-up	Outcomes (BMI/diet/PA)	Intervention method	Results	Study quality (CASP)
26 & 27	<p>Early Intervention to Encourage Physical Activity in Infants and Toddlers: A Randomized Controlled Trial</p> <p>(Moir et al., 2016)</p> <p>&</p> <p>Sleep, nutrition, and physical activity interventions to prevent obesity in infancy: Follow-up of the Prevention of Overweight in Infancy (POI) randomized controlled trial at ages 3.5 and 5 y</p> <p>(Taylor et al., 2018a)</p>	<p>Pregnant women in a maternal and child health setting in Dunedin (New Zealand)</p>	<p>214/177 women in FAB group, 210/167 in control group, 209/192 in sleep group and 214/209 in control group</p>	<p>Before birth (During pregnancy)</p>	<p>18 months, follow-up at child age 5 years</p>	<p>BMI, diet, PA</p>	<p>Food, activity and breastfeeding (FAB) group: consisted of eight parent contract, including three from a lactation consultant promoting breastfeeding and delaying the introduction of solids until 6 months. Trained researchers (nurses, dietitians, and nutrition graduates) discussed with parents nutrition behaviours believed to affect weight at 7, 13 and 18 months of age. The local "Sport Otago" trust held 3 group activity sessions with families to illustrate how to be active with infants and limit time in sedentary activities. Sleep group: consisted of a sleep problem prevention program. Combination FAB + Sleep: received FAB and sleep interventions condensed into nine contacts. The control group received the standard well-child care.</p>	<p>Children in the FAB group had significantly higher BMIZ scores than did controls at age 5, but not at age 3.5 years. Children who received the Sleep intervention (Sleep and Combination groups) had significantly lower BMIZ scores at age 3.5 and 5 years than children who did not (Control and FAB groups). There were no significant differences in PA and dietary intake levels of the children between the different intervention groups and the control group at age 3.5. PA and diet outcomes at age 5 were not measured.</p>	<p>Moderate & Strong</p>
28	<p>Effect of a child care center-based obesity prevention program on body mass index and nutrition practices among preschool-aged children</p> <p>(Natale, Lopez-Mitnik,</p>	<p>Child care centres in Miami-Dade County, Florida</p>	<p>238/? children in intervention group and 69/? children in control group</p>	<p>2-5 years</p>	<p>6 months, follow up 12 months after baseline</p>	<p>BMI, diet, PA</p>	<p>Healthy Inside – Healthy Outside (HI-HO) is built on the foundation of among other the Hip-Hop to Health from Fitzgibbon et al. (2002). It consisted out of three components. Teacher component: teachers and staff were trained on the role and rationale of the HI-HO program, taught implementation strategies, and provided lessons to use with the children. Additionally, there were weekly technical</p>	<p>As parents carried out the intervention at home, BMI significantly decreased among participating children. Similarly, intervention</p>	<p>Strong</p>

#	Study	Setting	Sample size (baseline/last measurement)	Sample child age	Length of intervention/ follow-up	Outcomes (BMI/diet/PA)	Intervention method	Results	Study quality (CASP)
	Uhlhorn, Asfour, & Messiah, 2014)	(USA)					assistance visits with the teachers and a HI-HO specialist to ensure the implementation of a healthy diet with emphasis on cultural barriers. Parent component: included a monthly educational dinner in which nutrition and PA were discussed, monthly newsletters and at-home activities. The newsletters also included issues that are often of concern to parents of preschool children, such as how to introduce new foods. Sessions were provided by dietitians and tailored to be sensitive to the cultural needs of the family. Parents were encouraged to reduce TV viewing, increase PA, and model healthy eating behaviours for their child at home. For each of the six at-home activities that each family completed, they received a healthy snack bag. At the end of the program, parents who attended three or more dinners received a certificate of completion. Centre-Based Modifications Component: a nutritionist worked with each child care centre to modify menus to make them more healthy, while ensured was that the modifications were of equal cost as prior food purchases. Each centre agreed on a drink policy that included providing water as the primary beverage and a snack policy consisting of healthy snacks. The PA policy consisted of urging centres to increase PA to more than one hour per day and to decrease TV viewing to less than 60 minutes two times a week. Control group centres received a visit from an injury prevention education mobile. The mobile provided parents and teachers with hands-on safety education and information.	children consumed less junk food, ate more FV, drank less juice and more 1% than full-fat milk, compared to the control group after the intervention. There were no significant differences in PA levels between the control and intervention groups.	
29	Role modeling as an early childhood obesity prevention strategy: effect of parents and teachers on preschool children's healthy lifestyle habits	Families in child care centre settings	?/754 children in intervention and ?/457 children in control group	2-5 years	6 months	Diet, PA	Healthy Caregivers Healthy Children (HC2): intervention child care centres were implemented a drink policy, snack policy and screen time policy. Furthermore, six trainings occurred on a monthly basis during the school year for parents and teachers. They were taught about among other choosing healthy foods and making healthy food	Parents in the intervention group ate more FV and significantly influenced their children's consumption of FV.	Moderate

#	Study	Setting	Sample size (baseline/last measurement)	Sample child age	Length of intervention/ follow-up	Outcomes (BMI/diet/PA)	Intervention method	Results	Study quality (CASP)
	(Natale, Messiah, et al., 2014)	in USA					choices for child development, preparing nutritious snacks and new recipes and planning meals. By means of role modelling, parents and teachers were encouraged to implement change at the family/home and child care centre level. Furthermore, lesson plans were designed to incorporate and reinforce the policy standards; half focused on beverage/snack policies and half focused on PA/screen time policies. The teachers received weekly technical assistance instruction on how to promote wellness within a group's child care setting. The control group received three times during the school year an attention control safety curriculum delivered by character "Safety Sam", which provided parents and teachers with home, car and child seat safety information.	Also, intervention parents significantly influenced a decrease in children's junk food consumption, whereas control parents significantly influenced an increase in their children's junk food consumption and sedentary behaviour. Teachers did not significantly influence the children's nutrition or PA patterns.	
30	Mobile-based intervention intended to stop obesity in preschool-aged children: the MINISTOP randomized controlled trial (Nystrom et al., 2017)	Parents in a home setting in Östergötland (Sweden)	156/143 parents in intervention group and 159/159 parents in control group	4 years	6 months	Diet, PA	The Mobile-Based Intervention Intended to Stop Obesity in Preschoolers (MINISTOP) intervention was delivered via a smartphone application to the parents. It was centred around guidelines for healthy eating and PA in preschool-aged children. Parents were able to access the information at any time and received regular push notifications. The intervention included 12 themes: healthy foods in general, breakfast, healthy small meals, PA and sedentary behaviour, candy and sweets, FV, drinks, eating between meals, fast food, sleep, foods outside the home, and foods at special occasions. Parents were encouraged to register information within the application on their child's dietary intake and time spent being sedentary. At the end of every week the parents received graphic feedback and automated comments based on the submitted information. Within the application parents could contact a dietitian and/or a psychologist to ask	The odds of increasing the composite score for dietary and physical activity behaviors were 99% higher for the intervention group than the control group.	Strong

#	Study	Setting	Sample size (baseline/last measurement)	Sample child age	Length of intervention/ follow-up	Outcomes (BMI/diet/PA)	Intervention method	Results	Study quality (CASP)
							questions pertaining to their child. The control group received a pamphlet on healthy eating and PA in preschool-aged children based on guidelines, which is similar to what parents receive from the Swedish child health care system.		
31	Parent-Focused Change to Prevent Obesity in Preschoolers: Results from the KAN-DO Study (Ostbye et al., 2012)	Mothers in a home setting in North Carolina (USA)	200 dyads in intervention and 200 dyads in control group. Analysed were 119 mothers and 102 children in the intervention group, and 129 mothers and 107 children in the control group.	2-5 years	8 months, follow-up 22 months after baseline	BMIz, diet, PA	Kids and Adults Now — Defeat Obesity! (KAN-DO): Intervention group received eight monthly mailed interactive kits, followed each month by a 20-30 minute telephone coaching session using MI techniques. Kits included child activities and incentives reinforcing the month's topic (e.g. rewards chart). The intervention targeted the dyad's healthy weight via instruction in parenting styles and skills, techniques for stress management, and education about healthy behaviours. Parenting skill instruction emphasized an authoritative parenting style, routines for sleep and mealtimes, a supportive home environment, role modelling of healthy eating and PA, and improvement of feeding style. Education about healthy behaviour changes targeted: decreased intake of SSB and fast food, increased FV, meals prepared at home and MVPA. Coaching calls reviewed information in the module and addressed motivation, self-efficacy, and barriers to change. The intervention also included one semi-structured group session, where the study coaches and nutritionist reinforced content from the family kits and set aside time for role play and group discussion. A healthy meal and free child care were provided. The control group received monthly newsletters emphasizing pre-reading skills.	Child's dinners and snacks eaten in front of the TV and mothers instrumental feeding decreased more in the intervention than the control arm. Positive trends were seen in child dietary intake, but not in sedentary behaviours, amount of PA or BMIz.	Strong

#	Study	Setting	Sample size (baseline/last measurement)	Sample child age	Length of intervention/follow-up	Outcomes (BMI/diet/PA)	Intervention method	Results	Study quality (CASP)
32	Effect of a responsive parenting educational intervention on childhood weight outcomes at 3 years of age: The INSIGHT randomized clinical trial (Paul et al., 2018)	Families in a home setting in Pennsylvania (USA)	145/140 mother-child dyads in the intervention group, 146/136 dyads in the control group.	3-4 weeks	30 months, follow-up at age 3	BMIz	Research nurses conducted four home visits during infancy and annual research centre visits. The responsive parenting curriculum focused on feeding, sleep, interactive play, and emotion regulation. At study visits, age-appropriate sleep instructions promoted longer sleep duration, including putting infants to bed drowsy but awake, avoiding feeding infants to sleep, and anticipating and responding to night awakening. The emotion regulation component encouraged parents to use alternatives to feeding to calm fussy but not hungry infants. Parents were later instructed on establishing routines and expectations, and setting limits, rules, and consequences. The feeding component taught parents to recognize hunger and satiety cues, provide age appropriate portion sizes, and to feed in response to hunger only and not as a reward, punishment, or soothing strategy for a distressed but not hungry child. Guidance during the introduction of solid foods included use of repeated exposure to promote acceptance of healthy foods, the importance of modelling healthy eating behaviours, and the concept of shared feeding responsibility, which recognizes the parent's role is to provide healthy choices while the child's role is to determine how much and whether to eat. The interactive play component focused on developmentally appropriate PA beginning with daily prone position playtime and later with outdoor play. The intervention was delivered via mailed instructions at 2 weeks, at home visits at child age 3 to 4, 16, 28, and 40 weeks, research center visits at 1 and 2 years, and through telephone contacts at 18 and 30 months. The final study visit at age 3 years did not include any intervention. The control group received a home safety intervention.	The intervention group had a lower mean BMIz than the control group at age three. Mean BMI percentiles did not differ significantly.	Strong
33	Randomized Controlled Trial to Prevent Infant	Obese pregnant	91/61 women in intervention	Before birth	12	BMIz	Promotoras (community health workers without health professional education but who have been	Compared to controls, parent	Moderate

#	Study	Setting	Sample size (baseline/last measurement)	Sample child age	Length of intervention/ follow-up	Outcomes (BMI/diet/PA)	Intervention method	Results	Study quality (CASP)
	Overweight in a High-Risk Population (Reifsnider et al., 2018)	Women in a home setting in a Southwestern metropolitan area in USA	group and 83/58 women in control group	(during pregnancy)	months		trained) made prenatal and postpartum home visits once before delivery and at ages 1 and 2 weeks, and at 2, 4, 6, 9, and 12 months. During visits, the promotoras discussed infants' growth, breastfeeding, solid feeding and nutrition, child development, sleep, physical activity, and safety.	education did not reduce infant overweight.	ate
34	Two-year follow-up of a primary care-based intervention to prevent and manage childhood obesity: the High Five for Kids study (Rifas-Shiman et al., 2017)	Parents in a maternal and child health setting in Massachusetts (USA)	271/249 intervention and 204/192 control group children	2-6 year	12 months, follow-up at 2 year	BMIz, diet	High Five for Kids: Paediatric nurse practitioners were trained to be the key intervening clinicians and to use MI during four 25 minute, in-person chronic disease management visits and three 15 minute telephone calls in the first year of the intervention. Components include de-emphasizing labelling, giving the parent responsibility for identifying which behaviours are problematic, encouraging parents to clarify and resolve ambivalence about behaviour change, and setting goals to initiate the change process. Several resources were developed to assist the physicians and nurse practitioners in supporting participants and their family in behavior change. For the patient waiting rooms, posters highlighting targeted behaviors to encourage dialogue during well child care visits were created. For the chronic disease management visits with the nurse practitioners, educational modules targeting TV, fast food, and sugar sweetened beverages that were matched to a family's stage of readiness to change were developed. Also developed were printed and electronic tools for self-management support, lists of local resources for physical activity, and an interactive website with educational materials, recipes, and other features (Taveras et al., 2011). The control group received	After the intervention and at follow-up at two years, compared with the control group, intervention participants had similar changes in BMIz scores and intake of fast food and SSB.	Moderate

#	Study	Setting	Sample size (baseline/last measurement)	Sample child age	Length of intervention/ follow-up	Outcomes (BMI/diet/PA)	Intervention method	Results	Study quality (CASP)
							usual care offered by their paediatric practice (Taveras et al., 2011).		
35	Effects of a Physical Activity Intervention in Preschool Children (Roth et al., 2015)	Children in preschool settings in Wunzburg and Kitzingen (Germany)	280/246 children in intervention and 287/250 children in control group in rural areas, 88/75 children in intervention and 52/39 children in control group in urban areas	4-5 years	11 months	BMI, PA	The intervention was offered over one academic preschool year and targeted 4-5 year old children, their parents and their preschool teachers. The children received a daily 30 minute PA lesson offered by the preschool teachers. The teachers were asked to encourage the children in using and developing their motor skills while attending games and exercise tasks. The teachers were encouraged to adjust the lessons according to the children's abilities, interests, and ideas. Teachers were trained in two workshops and were regularly supervised. The children received PA homework cards once or twice a week and seasonal letters composed of games and exercises to be performed by the child. Parents were invited to three interactive lectures that provided information and exchange on healthy development and promotion of motor skills in childhood. Furthermore, principles of nutrition and the importance of PA in early years were discussed. The control group received usual care consisting of one PA lesson per week lasting 30-45 minutes.	Compared to controls, children in the intervention group showed positive effects in motor skills performance at post-intervention and follow-up. The intervention group showed also a higher increase in proportion of daily time spent in MVPA compared with the control group, although this was not significant. There was no significant effect of the intervention on BMI.	Strong
36	Early Obesity Prevention: A Randomized Trial of a Practice-Based Intervention in 0-24-Month Infants (Schroeder et al., 2015)	Parents in maternal and child health settings in Maryland (USA)	134/112 children in intervention group and 144/110 children in control group	1-2 months	24 months	BMI, diet	The intervention was based on the modules of Growing Leaps and Bounds (GLB), a set of educational materials. These materials aim at promoting an exchange between patient and paediatrician about nutrition, feeding, and PA, providing useful information to parents in order to enhance self-efficacy for the daily care of their infants, and helping parents make healthy food choices for the infants and for themselves and make PA a part of daily life. The 12 sets of educational brochures were designed to be presented and discussed with caregivers at pediatric visits at 1, 2,	At baseline, weight and height were significantly higher in the intervention versus the control group, but this difference disappeared at 12 and 24 months. At 24 months of age, there was no effect of the intervention	Poor

#	Study	Setting	Sample size (baseline/last measurement)	Sample child age	Length of intervention/ follow-up	Outcomes (BMI/diet/PA)	Intervention method	Results	Study quality (CASP)
							4, 6, 9, 12, 15, 18, and 24 months of age and at annual visits thereafter up to age 5 years. While the brochures emphasize a few key points, they also provide detailed advice on infant feeding practices, physical activity, and developmental milestones related to eating patterns. There was no information on the control group.	on BMI. Parents receiving the intervention positively changed several dietary practices.	
37	A parent-based intervention to promote healthy eating and active behaviours in pre-school children: evaluation of the MEND 2-4 randomized controlled trial (Skouteris et al., 2016)	Families in community health and childcare settings in Australia	104/93 parent-child dyads in intervention and 97/80 in control group	2-4 years	10 weeks, follow up after 6 and 12 months	Diet, PA, BMIz	Mind Exercise Nutrition Do It! (MEND): Intervention delivered to parents and their children. Consists of ten weekly 90 minute workshops relating to general nutrition, PA and behaviours, held at community health and child health centres, where parents and children attend together. Each session involves 30min of guided active play, 15 minute eating a healthy snack based on a technique to promote increased FV intake, and 45 minute where children participate in supervised crèche-style while the parents attend active education and skill-development session. The control group received the intervention delayed	There were significant positive group effects for vegetable and snack food intake. At 12 months follow-up intervention children exhibited less neophobia. The intervention had no effect on sedentary behaviour, PA and BMIz.	Strong
38	A health promotion intervention can affect diet quality in early childhood (Spence et al., 2013)	Families in first-time parent groups run by Maternal and Child Health Nurses	262 families in intervention and 266 families in control group. Analysed were 196 families in the intervention and 202 parents in the control group.	4 months	15 months	Diet	InFANT programme: Parents were invited to attend 6 group sessions facilitated by a dietitian. Sessions took an anticipatory guidance approach and included peer discussion of facilitators and barriers to improving dietary intakes and food-related behaviours. Some of the key messages included provision of fruits and vegetables at each meal and snack time, and limiting provision of noncore foods. Families were provided with purpose-designed written resources and a DVD reinforcing these messages. The control group received the usual care available to them in their local area in addition	Children in the intervention arm scored significantly higher than those in the control group for the Protective Dietary Index (OPDI), which positively correlates with energy intake, dietary fibre, some vitamins, but not	Moderate

#	Study	Setting	Sample size (baseline/last measurement)	Sample child age	Length of intervention/follow-up	Outcomes (BMI/diet/PA)	Intervention method	Results	Study quality (CASP)
		in Melbourne (Australia)					to newsletters on topics unrelated to food, PA, or weight.	with saturated fat. Three dietary patterns were identified, but the scores did not substantially differ between the intervention and control groups.	
39	Clinic and Home-Based Behavioral Intervention for Obesity in Preschoolers: A Randomized Trial (Stark et al., 2018)	Children and their families in paediatric settings in the Greater Cincinnati/Northern Kentucky area (USA)	47/43 children in LAUNCH group, 50/46 in MI group, 54/50 in control group	2-5 years	6 months	BMIz	Learning about activity and understanding for child health (LAUNCH): The intervention consisted of 18 clinic and home family-based behavioural weight management sessions. Parent clinic-based group sessions were 90 minutes each and led by a licensed clinical psychologist. Sessions consisted of education and problem-solving around parent and child diet, dietary and PA changes, and child behaviour management strategies such as differential attention (ignoring complaints about food, praising trying vegetables) and contingency management (rewarding healthy behaviours). Sessions 1-7 focused on dietary changes, sessions 8-10 focused on changing sedentary behaviour and PA, and sessions 11-18 focused on bringing all the skills together and problem-solving barriers to recommend lifestyle changes. A simultaneously held child group provided education about healthy eating, opportunities for moderate to vigorous PA, and exposure to a variety of FV through a meal. LAUNCH incorporated home visits (60 minutes) to facilitate generalization of the clinic taught skills to the home. MI: a parent only intervention consisting of 18 sessions. At the initial session, parents met with a paediatrician trained in MI during which they completed questionnaires to assess their values and motivation for change, were given information about their child's weight and BMI percentile, and a packet of publicly available materials/brochures	LAUNCH participants demonstrated a significantly greater decrease in BMIz compared with the MI and control group.	Moderate

#	Study	Setting	Sample size (baseline/last measurement)	Sample child age	Length of intervention/ follow-up	Outcomes (BMI/diet/PA)	Intervention method	Results	Study quality (CASP)
							from another programme (Let's Go 5-2-1-0). MI sessions were delivered by a licensed clinical psychologist in either the families' home or over the telephone. These sessions consisted of a discussion focused on goal setting. The control group was informed of their child's weight status during the recruitment process, but there was not any treatment.		
40	Personalized Web-Based Advice in Combination With Well-Child Visits to Prevent Overweight in Young Children: Cluster Randomized Controlled Trial (van Grieken et al., 2017)	Parents in a home setting in the Netherlands	1008/752-778 parents in intervention group and 1094/739-765 in control group	2-4 weeks	36 months	Diet, BMI	E-health4Uth Healthy Toddler: this intervention provides parents with customized advice regarding key health behaviours designed to prevent childhood overweight. The following four key behaviours were targeted by the intervention: (1) the promotion of eating breakfast daily, (2) the stimulation of daily exercise and outdoor playing, (3) discouraging the consumption of sweetened beverages, and (4) discouraging TV viewing and computer use. Parents received an invitation to visit the intervention website and complete the eHealth module online one month before the regular well-child visits scheduled for when the child was approximately 18 and 24 months of age. As a first step, parents completed the assessment questionnaire and the answers were used to generate tailored advice available online. After reading the tailored advice, parents could make an implementation-intervention plan in which they could specify actions. During the subsequent well-child visits, the advice was discussed with the youth health care (YHC) professional who prescribed intervention conditions based on MI techniques to help parents change their child's health-related behaviours. The control group parents received usual care, which included regular YHC well-child visits.	At 36 months of age, there were no differences in BMI of the children in the intervention and control group. Significantly more children in the intervention group ate breakfast daily and drank less SSB as compared with the control group.	Moderate
41	Prevention of overweight in children younger than 2	Parents in a	126/100 children in	9-24 month	12	BMI, diet, PA	The intervention aimed at increasing daily consumption of water, milk, FV, increasing daily PA	The intervention had a significant	Poor

#	Study	Setting	Sample size (baseline/last measurement)	Sample child age	Length of intervention/ follow-up	Outcomes (BMI/diet/PA)	Intervention method	Results	Study quality (CASP)
	years old: a pilot cluster-randomized controlled trial (Verbestel et al., 2014)	home setting in Flanders (Belgium)	intervention group and 65/56 children in control group.	s	months		and decreasing daily consumption of sweets and savoury snacks and daily screen-time behaviour. The intervention consisted on two components: guidelines and tips presented on a poster and tailored feedback form for parents about their children's activity- and dietary related behaviours provided through the day care centres of their children. This feedback was based on the activity and dietary-related measures as reported by the parents in a baseline questionnaire.	positive effect on BMIz score. BMIz score decreased in both groups but decreased more in the intervention group compared with the control group. The intervention was not effective in parent-reported positive dietary changes and PA.	
42	Sustainability of Effects of an Early Childhood Obesity Prevention Trial Over Time: A Further 3-Year Follow-up of the Healthy Beginnings Trial (Wen et al., 2015)	First time mothers in their homes in England	337/255 mothers in the intervention group and 330/242 mothers in the control group at phase 1. 236/191 mothers in the intervention group and 229/178 mothers in the control group participated in phase 2.	Before birth (during pregnancy)	24 months, follow-up 5 year after intervention	BMI, diet, PA	This study is a follow-up of the Healthy Beginners Trial (HBT) phase 1. This was a RCT to show the effectiveness of an early childhood obesity intervention delivered in the first two years of life. The intervention comprised eight home visits from community nurses delivering a staged home-based intervention with one visit in the antenatal period and seven visits after birth. The key intervention messages included: breast is best, no solids for me until six months, I eat a variety of FV every day, only water in my cup, and I am part of an active family. The control group families received the usual childhood nursing service from community health service nurses (Wen et al., 2012). Phase 2 investigated the long-term effects of the HBT intervention.	After the intervention, the mean BMI was significantly lower in the intervention group than in the control group. The differences between the intervention and control groups disappeared over time. No effect of the early intervention on dietary behaviours or PA was detected at age five years.	Strong
43	Tooty Fruity Veggie: an obesity prevention intervention evaluation in Australian preschools	Children in preschools in Australia	537/468 children in 18 intervention and 13 control	3-6 years	10 months, follow-up 3 years after the	BMIz, diet, PA	Tooty Fruity Veggie (TFV): The intervention included of the development of a nutrition policy; staff training and parent workshops on healthy eating and fundamental movement skills (FMS); regular FMS sessions as part of the preschool curriculum;	In comparison to the controls, children in the intervention preschools	Strong

#	Study	Setting	Sample size (baseline/last measurement)	Sample child age	Length of intervention/follow-up	Outcomes (BMI/diet/PA)	Intervention method	Results	Study quality (CASP)
	(Zask, Adams, Brooks, & Hughes, 2012)	a	preschools		intervention		children's cooking classes; and improving access to drinking water. The control group schools were put on a waiting list for an intervention and were offered the full program in subsequent years.	significantly improved FMS, had more FV serves, and were less likely to have unhealthy food items in their lunch boxes following the intervention. There was also a significant difference in a reduction of BMIz.	

4.3 Intervention effects

Overall, of 33 of the 39 interventions in 43 studies demonstrated one or more significant positive developments in BMI, physical activity and/or diet of the children in the intervention groups compared to the controls (Annesi et al., 2013a, 2013b; Barkin et al., 2018; Bocca et al., 2012; Bonis et al., 2014; Campbell et al., 2013; De Bock et al., 2012; De Coen et al., 2012; Doring et al., 2016; Fisher et al., 2019; Fitzgibbon et al., 2011; Haines et al., 2018; Handel et al., 2017; Helle, Hillesund, Wills, & Overby, 2019; Iaia et al., 2017; Lumeng et al., 2017; McGowan et al., 2013; Mirota et al., 2018; Natale, Lopez-Mitnik, et al., 2014; Natale, Messiah, et al., 2014; Nystrom et al., 2017; Ostbye et al., 2012; Paul et al., 2018; Rohde et al., 2017; Roth et al., 2015; Schroeder et al., 2015; Skouteris et al., 2016; Spence et al., 2013; Stark et al., 2018; van Grieken et al., 2017; Verbestel et al., 2014; Zask et al., 2012).

Figure 4 shows the effectiveness of the interventions for the environments in the ANGELO framework, and Figure 5 shows effectiveness of interventions by delivery settings. The 39 interventions reviewed mostly focused on individual environments in a home setting, which also seems to have the most “effective” results. But results should be interpreted conservatively, given the small number of studies conducted in the various environments and settings. Moreover, categorisation on effectiveness by outcome does not take in account relevant outcomes that are not considered in some studies. For example, some studies only considered diet as an outcome and not BMI.

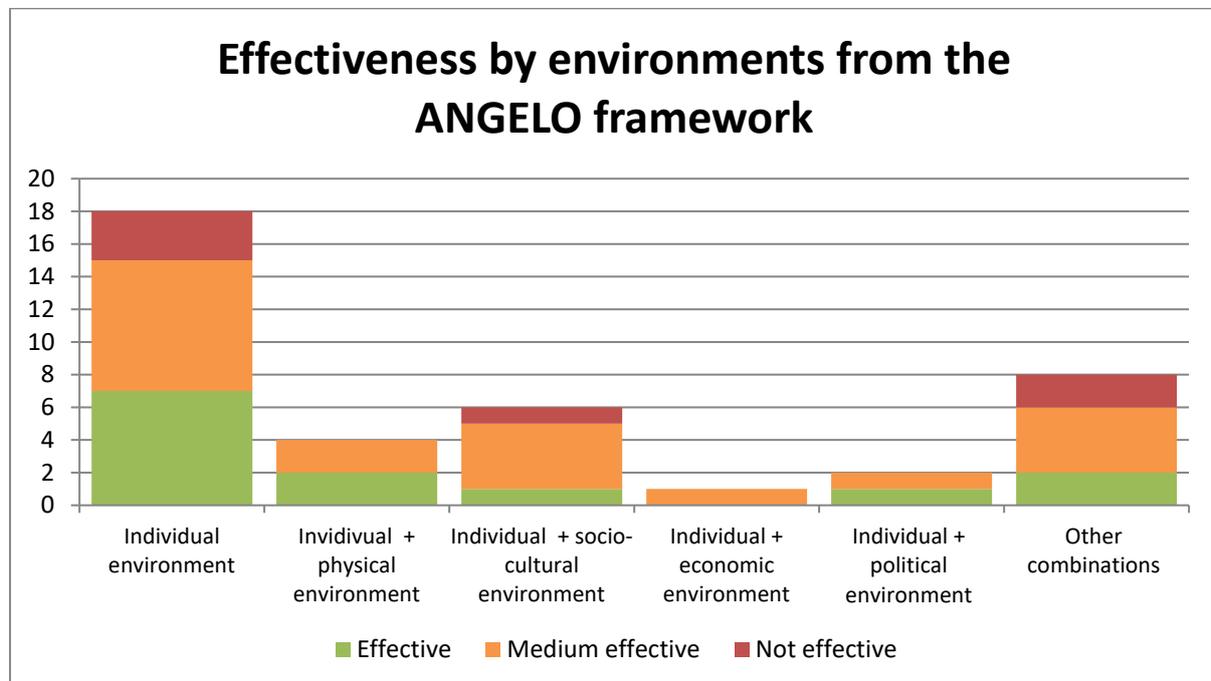


Figure 4: Effectiveness of the interventions from the rapid review by environments from the ANGELO framework

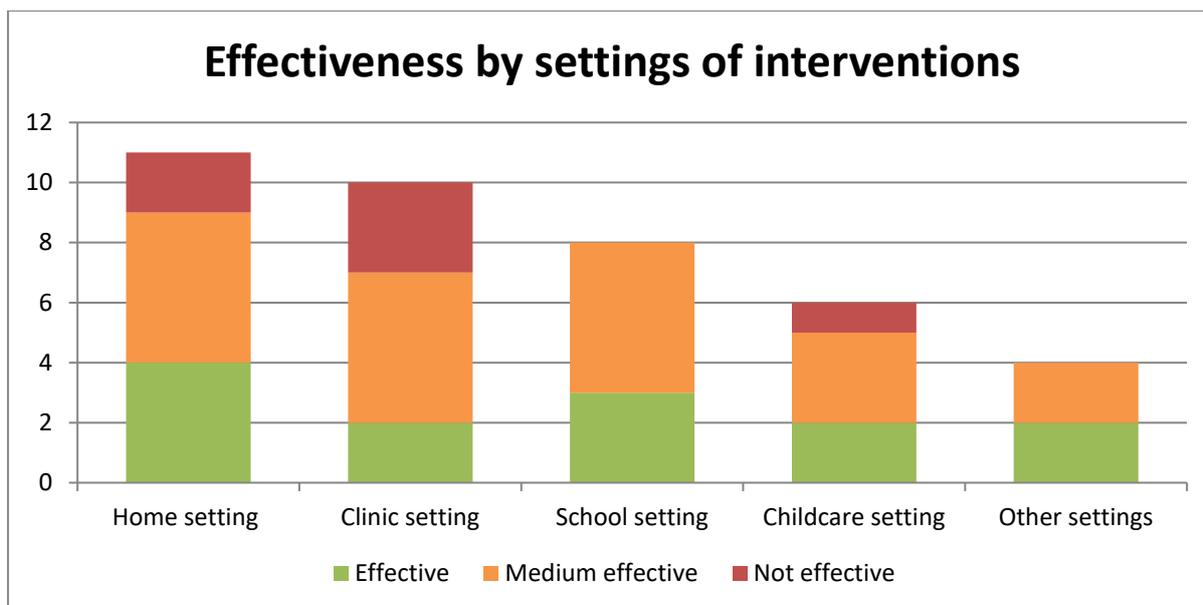


Figure 5: Effectiveness of the interventions from the rapid review by settings

4.3.1 Home setting

Of the eleven interventions that were conducted in a home setting, nine showed a positive effect on the diet, physical activity level or BMI of the children (Haines et al., 2018; Helle, Hillesund, Wills, & Øverby, 2019; McGowan et al., 2013; Mirota et al., 2018; Nystrom et al., 2017; Ostbye et al., 2012; Paul et al., 2018b; van Grieken et al., 2017; Verbestel et al., 2014). Most interventions in a home setting targeted both diet and physical activity (Haines et al., 2018; Mirota et al., 2018; Nystrom et al., 2017; Ostbye et al., 2012; Paul et al., 2018; Reifsnider et al., 2018; van Grieken et al., 2017; Verbestel et al., 2014; Wen et al., 2015). The studies of Helle, Hillesund, Wills, & Øverby (2019) and McGowan et al. (2013) targeted healthy nutrition only. There were no studies in a home setting that targeted physical activity only (see Figure 6). In the home setting, both parents and children took part in two interventions (Haines et al., 2018; Mirota et al., 2018). Most interventions however were for parents only (Helle, Hillesund, Wills, & Øverby, 2019; McGowan et al., 2013; Nystrom et al., 2017; Ostbye et al., 2012; Paul et al., 2018; Reifsnider et al., 2013; van Grieken et al., 2017; Verbestel et al., 2014; Wen et al., 2015). The intervention from van Grieken et al. (2017) primarily took place in a home setting, but also partly in a clinic setting. Interventions lasted between eight weeks and 30 months.

Two interventions (a pilot and the subsequent intervention lasting 8 weeks to six months and six months) consisted of home visits presenting information regarding healthy nutrition and physical activity, including formulating and discussing lifestyle family goals (Haines et al., 2018; Mirota et al., 2018). In both studies, positive dietary changes of the intervention group were observed, but there were no changes in physical activity. The intervention of McGowan et al. (2013) lasting eight weeks also consisted of forming and discussing family goals for a healthier diet, although these were focused on habit formation for a healthy child lifestyle. Significant intervention effects on children's dietary intake were observed and attributed to changes in parent's habits of feeding behaviours.

Four interventions in a home setting were internet-based (Helle, Hillesund, Wills, & Overby, 2019; Nystrom et al., 2017; Ostbye et al., 2012; van Grieken et al., 2017) and one intervention was paper-based (Verbestel et al., 2014). Two interventions lasted 7-8 months and consisted of emails, focusing on feeding-related aspects for parents of children below six months old (Helle, Hillesund, Wills, & Øverby, 2019) and above two years old (Ostbye et al., 2012). The latter intervention also included telephone coaching sessions. In both studies, there were positive dietary changes of the children in the intervention group compared to the control group, but there was no effect on BMI and physical activity. The other internet-based interventions consisted of a smartphone application with information on healthy nutrition and physical activity (Nystrom et al., 2017) and a website with eHealth modules (van Grieken et al., 2017), and included tailored feedback to the child's dietary and physical activity behaviour (Nystrom et al., 2017; van Grieken et al., 2017). For the latter intervention, this feedback was discussed in a childcare setting. These interventions lasted six and 36 months. Nystrom et al. (2017) found that children in the intervention group had 99% higher odds of increasing the composite score for dietary and physical activity variables compared to the control group, although the authors acknowledge that a bias in the intake reported by parents may have occurred. Van Grieken et al. (2017) also found a positive effect of the intervention on child's dietary intake compared to the control group, but not on BMI. Parents in the intervention from Verbestel et al. (2014) received a letter with information about healthy nutrition or physical activity every two months for a year, and once received a tailored feedback form about their children's physical activity and dietary related behaviours. The intervention resulted in a significant decrease of BMI score, although the control group also showed a (less) decrease. There were no changes in diet and physical activity levels.

Three interventions in home settings focused on infant feeding practices (Paul et al., 2018; Reifsnider et al., 2018; Wen et al., 2015). Just as in the clinic setting, these interventions entailed parent education on breastfeeding, play/exercise time with infants, and /or early feeding practices with a timely introduction of solid foods. Interventions lasted one year (Reifsnider et al., 2018), two years (Wen et al., 2015), and three years (Paul et al., 2018). After the interventions, found was a significant lower mean BMIz of the intervention group compared to the control group, but no difference in BMI percentiles (Paul et al., 2018), a significant lower BMI in the intervention compared to the control group that disappeared over time (Wen et al., 2015), and no change in BMI (Reifsnider et al., 2018).

4.3.2 Clinic setting

Ten interventions took place in a clinic setting. Of these, six showed a positive effect on BMI, diet or physical activity (Bocca et al., 2012; Campbell et al., 2013; Doring et al., 2016; Fisher et al., 2019; Spence et al., 2013; Stark et al., 2018). The interventions from Bocca et al. (2012) and Stark et al. (2018) had components aimed at parents and at children. The rest of the interventions in a clinic setting were aimed at parents only, and were sometimes (partly) conducted through training health care providers first (Doring et al., 2016; Rifas-Shiman et al., 2017; Schroeder et al., 2015). Six interventions focused on a combination of healthy nutrition and physical activity (Bocca et al., 2012; Campbell et al., 2013; Doring et al., 2016; Moir et al., 2016; Schroeder et al., 2015; Stark et al., 2018),

and four on diet only (Daniels et al., 2012; Fisher et al., 2019; Rifas-Shiman et al., 2017; Spence et al., 2013) (see Figure 6). There were no interventions in a clinic setting that focused on physical activity only. Interventions lasted between three months and almost four years.

Two interventions consisted of parent education with use of the parenting support theory which emphasizes children's goal setting and planning, natural consequences and encouragement techniques for healthy eating (Fisher et al., 2019) and both healthy eating and physical activity (Campbell et al., 2013). Both intervention groups showed a positive effect on diet, but not on BMI and physical activity.

Other interventions specifically aimed at healthy early feeding practices. One intervention focused on parent guidance on solid feeding solely (Daniels et al., 2012), while another intervention included guidance on breastfeeding, solid feeding, and appropriate exercise activities with infants (Moir et al., 2016). The intervention of Daniels et al. (2012) had no effect on the long-term (Daniels et al., 2013, 2015), and the intervention from Moir et al. (2016) showed an adverse effect: children in one of the intervention groups had a significantly higher BMI compared to the control- and other intervention group at follow-up (Taylor et al., 2018b).

Another study (Schroeder et al., 2015) trained paediatricians to deliver interventions to parents during paediatric visits, and consisted of providing parents useful information in order to enhance self-efficacy for the daily care of their infants, and helping them making healthy food choices for their infants and make physical activity a part of their daily life. There was no significant effect of the intervention on BMI, although the BMI of the intervention group was significantly higher compared to the control group at baseline, and this difference disappeared at follow-up.

The intervention from Spence et al. (2013) consisted of six group sessions for parents facilitated by a dietician, which included peer discussion of facilitators and barriers to improving dietary intakes and food-related behaviours. Children in the intervention group scored significantly higher than those in the control group for the Protective Dietary Index, which positively correlates with some dietary habits. However, there was no significant difference between the intervention and control group on the three dietary patterns identified.

Bocca et al. (2012) conducted a multidisciplinary intervention for children with overweight and obesity. The children and parents received dietary advice, PA sessions and, for parents only, psychologic counselling. Children in the intervention group showed a significantly greater decrease in BMI after the intervention, at 12 month follow up, and at 36 month follow up. There were no significant differences between the intervention- and control group with respect to energy intake and physical activity (Bocca et al., 2012, 2014).

Using motivational interviewing (MI) to deliver messages and setting goals was used in three studies (Doring et al., 2016; Rifas-Shiman et al., 2017; Stark et al., 2018). (Paediatric) nurses in the clinic setting received MI training in studies from Doring et al. (2016) and Rifas-Shiman et al. (2017) and

delivered the intervention to parents. The study from Stark et al. (2018) had two intervention groups, from which one focused on using MI on parents to assess motivation to change and to present information on their child's BMI and healthy nutrition and physical activity. The other intervention was about clinic and home family-based behavioural weight management. This consisted of education and problem-solving around parent and child diet, dietary and PA changes, and child behaviour management strategies. Results were that only this second intervention group showed a significantly greater decrease in BMI compared with the MI and control group (Stark et al., 2018). Doring et al. (2016) only showed small positive significant intervention effects in dietary intake, but not on BMI and physical activity, and Rifas-Shiman et al. (2017) found no intervention effect on BMI and dietary intake in the short- and long term.

4.3.3 School setting

Of the eight interventions that were conducted in a school setting, seven reported improvements in physical activity, BMI and/or diet (Annesi et al., 2013a, 2013b; De Bock et al., 2012; De Coen et al., 2012; Fitzgibbon et al., 2011; Lumeng et al., 2017; Zask et al., 2012). In three interventions teachers were trained to conduct the intervention themselves (Annesi et al., 2013a, 2013b; Roth et al., 2015). Most interventions in school settings involved the parents of the children as well (De Bock et al., 2012; De Coen et al., 2012; Fitzgibbon et al., 2011; Roth et al., 2015; Zask et al., 2012). Three interventions were aimed to influence physical activity (Annesi et al. 2013a, 2013b; Roth et al. 2015), two targeted diet (De Bock et al. 2012; Lumeng et al. 2017), and three interventions aimed at both physical activity and diet (De Coen et al. 2012; Fitzgibbon et al. 2011; Zask et al. 2012) (see Figure 6). Interventions lasted between eight weeks and four academic years.

The interventions from Annesi et al. (2013a; 2013b), and Roth et al. (2015) consisted of 30 minutes of physical activity among preschool children after the teacher was trained to carry out the exercises. The interventions varied from eight weeks to 11 months, and were all administered daily during school hours. The intervention groups from Annesi et al. 2013a and 2013b included the development of behavioural skills with goal setting, self-monitoring of incremental progress, and acknowledgement of physical achievements. Both studies showed that the intervention group significantly engaged in more moderate-to-vigorous physical activity (MVPA) and vigorous physical activity (VPA) after implementation compared to the control groups, and Annesi et al. (2013a) showed also a significant reduction in the BMI. The intervention of Roth et al. (2015) however, found no significant change in physical activity or BMI but did show positive effects in motor skills performance at post-intervention.

Other interventions (De Bock et al., 2012; Lumeng et al., 2017) targeted healthy nutrition with lessons and classroom cooking experiences, and lasted six months and four school years. Lumeng et al. (2017) also included an intervention group that addressed self-regulation skills and pro-social behaviour among children and their parents. In both studies, BMI of the children did not change, but the intervention group consumed significantly more fruit and vegetables (De Bock et al., 2012) and less sugar sweetened beverages (Lumeng et al., 2017).

A combination of physical activity and healthy nutrition in a school setting was conducted in studies from De Coen et al. (2012), Fitzgibbon et al. (2011) and Zask et al. (2012). The interventions lasted from 14 weeks to two school years and included in-class activities on eating healthy and being physically active (De Coen et al., 2012; Fitzgibbon et al., 2011; Zask et al., 2012), and the development of a nutrition and physical activity policy on participating schools (De Coen et al., 2012; Zask et al., 2012). De Coen et al. (2012) showed that children in the intervention group from a community with a low socio-economic status (SES) had a significant decrease in BMI compared to children in the control group from a community with a low SES. The intervention had no effect on diet and physical activity levels of the children. In the contrary, Zask et al. (2012) showed that children in the intervention group had significant improvements in their diet and a significant decrease in BMI. Physical activity was not measured, but reported was that the fundamental movement skills significantly improved in the intervention group. Fitzgibbon et al. (2011) on the other hand, found that children in the intervention group significantly engaged in more MVPA than children in the control group, but that the intervention did not affect BMI or diet of the children.

4.3.4 Childcare setting

Six interventions were conducted in a childcare setting, from which five showed a positive effect on BMI, diet and/or physical activity (Bonis et al., 2014; Iaia et al., 2017; Jouret et al., 2009; Natale, Lopez-Mitnik, et al., 2014; Natale, Messiah, et al., 2014). Two interventions focused on training childcare staff, but included parents as well as a second intervention component (Alkon et al., 2014; Bonis et al., 2014) and four interventions equally focused on parents and childcare staff (Iaia et al., 2017; Jouret et al., 2009; Natale, Lopez-Mitnik, et al., 2014; Natale, Messiah, et al., 2014). In one study, parents and childcare staff were trained and included an education programme for children (Jouret et al., 2009). Most interventions in a childcare setting targeted a combination of diet and physical activity (Alkon et al., 2014; Iaia et al., 2017; Jouret et al., 2009; Natale, Lopez-Mitnik, et al., 2014; Natale, Messiah, et al., 2014) (see Figure 6). Bonis et al. (2014) targeted physical activity only and there were no interventions that only influenced diet. Interventions lasted between six months and two years.

Workshops for childcare staff about childhood obesity, healthy nutrition and physical activity at childcare centres was the main component in two studies, which used the same method: the Nutrition and Physical Activity Self Assessment for Childcare (NAP SACC) (Alkon et al., 2014; Bonis et al., 2014). Interventions lasted six and seven months. Parents were involved by receiving posters and information sheets on nutrition and physical activity recommendations and the childcare centre's nutrition and physical activity policies were written or updated. Bonis et al. (2014) only measured physical activity and BMI, while Alkon et al. (2014) also incorporated dietary measures. The latter study showed no significant intervention effects. Bonis et al. (2014) however, showed that the total amount of physical activity, vigorous, and moderate physical activity levels increased significantly in the intervention group as compared to the control group. There was no significant effect on BMI.

Four interventions trained childcare staff to incorporate more physical activity and healthy nutrition in their lessons and trained parents to eat healthier at home and exercise more (Iaia et al., 2017; Jouret et al., 2009; Natale, Lopez-Mitnik, et al., 2014; Natale, Messiah, et al., 2014), from which the latter two incorporated a food and drink policy in the childcare centres as well. Interventions lasted six months (Iaia et al. 2017; Natale, Lopez-Mitnik et al., 2014; Natale, Messiah et al., 2014) and three years (Jouret et al., 2009). The intervention from Natale, Messiah, et al. (2014) placed extra importance on the effect of role modelling of parents and childcare staff, and Jouret et al. (2009) included a second intervention group in which children in the childcare centre received an education programme promoting healthy nutrition habits and physical activity. Found was that when parents carried out the interventions at home specifically, there were significant positive effects on BMI and diet (Natale, Lopez-Mitnik, et al., 2014) and diet only (Natale, Messiah, et al., 2014), but showed no effect on physical activity. Iaia et al. (2014) showed that children in the intervention group were significantly more likely to eat healthier than the control group, and to engage in physical activity at the follow up one year after the intervention. No differences in BMI were found (Iaia et al., 2014). Jouret et al. (2009) found that the intervention group consisting of training of healthcare staff and parents had a significant effect on BMI of children in underprivileged areas, but not on children in non-underprivileged areas.

4.3.5 Other settings

Four interventions were conducted in different setting than described above. The interventions consisted of group meetings between children with their parents and health consultants over a period of ten weeks (Skouteris et al., 2016), 15 months (Handel et al., 2017; Rohde et al., 2017) and 36 months (Barkin et al., 2018). Interventions targeted physical activity (Handel et al., 2017), healthy nutrition (Rohde et al., 2017), and both (Barkin et al., 2018; Skouteris et al., 2016) (see Figure 6). All four interventions showed positive results in diet, physical activity and/or BMI of the children.

Two interventions were conducted by the same study staff and were different only in that they focused on physical activity (Handel et al., 2017), or healthy nutrition (Rohde et al., 2017). The interventions consisted of meetings between the entire family and health consultants and targeted sleep- and stress management next to healthy nutrition and physical activity. Found was that intervention group significantly spent more time on physical activity combined per week compared to the control group, but that no significant effect was seen for specific physical activity categories (Handel et al., 2017), and found was that there were several positive dietary changes of the intervention group compared to the control group (Rohde et al., 2017). Skouteris et al. (2016) consisted of workshops delivered to parents and their children, where active play and healthy eating were encouraged during the session. Results were significant positive group effects in diet for the intervention group compared to the control group, but no effects were found in physical activity and BMI. Lastly, the intervention by Barkin et al. (2018) consisted of group sessions and telephone calls with parents consisting of skill building sessions of healthy nutrition and physical activity, including a maintenance and sustainability phase. Results were significant intervention effects on diet of the children, but not on physical activity and BMI.

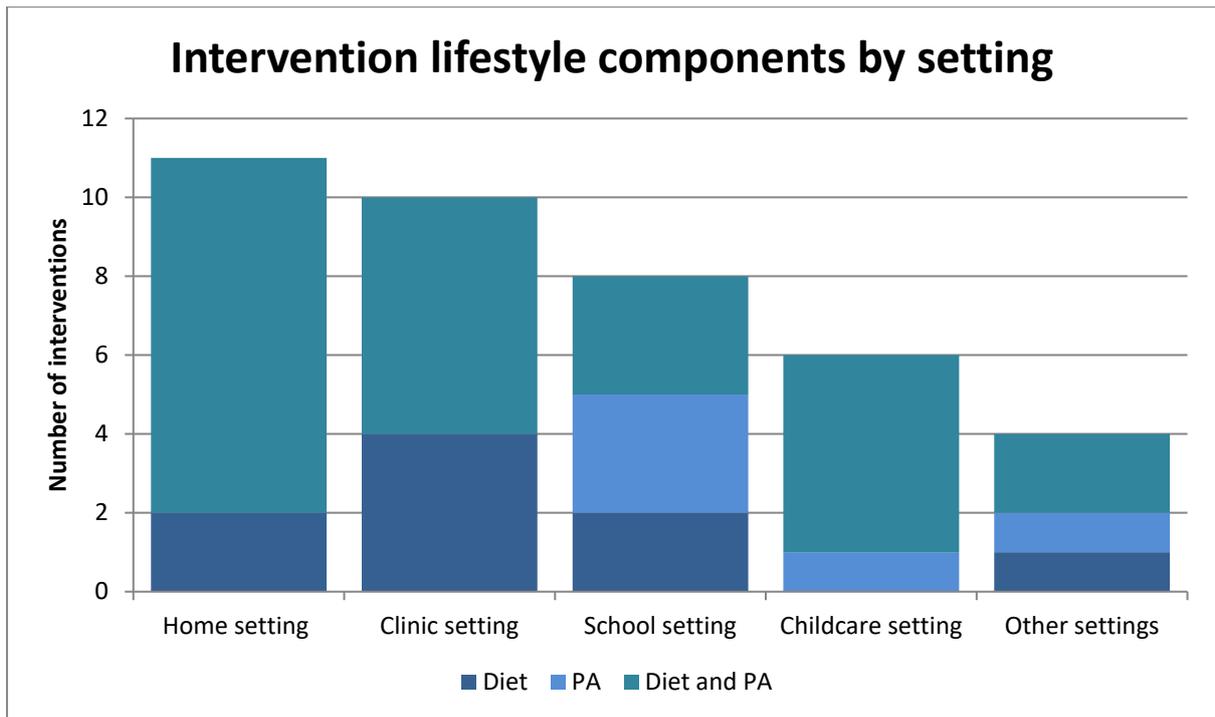


Figure 6: Lifestyle intervention targets in the five settings

5. Methods investigating childhood obesity strategies NHS boards

Semi-structured interviews were conducted in the last week of November 2019, with representatives from NHS health boards in NHS board areas of Ayrshire and Arran and Lothian. The rationale behind conducting semi-structured interviews was to ensure that desired topics were being addressed, but allowed unanticipated responses by the interviewee that could be explored in more detail (DiCiccio-Bloom & Crabtree, 2006; Ryan et al., 2009). Moreover, one-to-one interviews are a valuable method to gain insight in people's perceptions and understandings of a topic (Ryan et al., 2009).

With the semi-structured interviews, the second research question was addressed: *What types of obesity prevention programmes for children until five years of age are offered in Scottish NHS boards?*

5.1 Recruitment

Leads of four NHS boards were contacted by the programme lead of Obesity Action Scotland, who had links at those specific boards. It was assumed that boards were more likely to cooperate when they were contacted by someone they knew, and who was also a member of a prominent health promotion organization. Contact was made through an email sent during the last week of October 2019, which contained the following elements: (1) a brief explanation of the research topic and type of project; (2) a question whether they were willing to give an interview about current and future obesity prevention programmes for children in their board; (3) offering of an incentive in the form a presentation of childhood overweight and obesity statistics within for the health board. Two boards (NHS Ayrshire and Arran and NHS Lothian) responded positively. NHS Ayrshire and Arran replied that they did not offer obesity programmes for children below the age of five. The health board was, however, included as they provided valuable information on childhood obesity programmes aimed at other age groups. Although the third board responded positively and suggested a member of staff to give an interview, it was too late to conduct the interview. The fourth health board did not reply after the first e-mail and the follow-up a week after. Time reserved for the interviews was one hour and they were conducted at a location chosen by the interviewees. To conclude, a total of two interviews were conducted.

5.2 Interview guide

The interview questions were based on the main findings from the rapid review. Interview guides were developed without set questions, but with topics and example questions linked to the topic. This way, valuable information was retrieved while interviewees were able to answer in their own terms (Evans, 2017). Separate guides were developed for the boards since NHS Lothian did offer programmes for children below the age of five as opposed to NHS Ayrshire and Arran. Interview guides can be found in Appendix 4. First, introductory questions were asked relating to the interviewee's job and function

and the importance of obesity within the health board. Next, addressed was an explanation of current childhood obesity prevention and weight management services of the board and how this was developed. Other topics related to role modelling of parents and teachers, specific targets of obesity programmes, settings in which programmes are executed, disciplines who are involved, evaluation (plans) of obesity programmes and future plans. Intermediate interview questions were prepared to gain more specific details and clarification of the answers. Examples were “Could you tell me some more about that?”, or “When you mentioned that ... I wondered what you mean by that?”

5.3 Ethics

The interviews involved human participants (hereafter: interviewees). Interview topics were not about interviewee’s personal opinions, feelings or experiences. The interviews did not involve any physical contact or any risk of discomfort. No people from vulnerable groups were involved. Thus, ethical approval did not have to be sought (University of Cambridge, n.d.). Before the interview, the interviewees were presented with an information sheet with general information and the purpose of the research (Appendix 5) and signed an informed consent form (Appendix 6).

5.4 Data Analysis

Interviews were transcribed intelligent verbatim. The transcripts were printed and read thoroughly as a first step of data analysis in order to gain familiarity with the data. Codes were developed with both a deductive and inductive approach. The deductive approach was based on the environments of the ANGELO framework to systematically explore components of programmes for the different stages of obesity prevention. The inductive approach consisted of codes that emerged during the analysis that were perceived as important in the area of investigation, such as the mentioned “barriers/issues” involved in offering the programmes. The “individual” environment was added as an extra component of the framework, adopted from a systematic review that identified interventions promoting physical activity among teenagers (De Meester et al., 2009). The individual environment consisted of the programmes offered by the interviewed boards. Some information given by the interviewees was supplemented with information found online. An example of supplemented information was that in one of the interviews the “HEAT target” was mentioned. A brief description of the “HEAT target” was added in the results. All codes were divided into a codebook. Furthermore, to organise the information given by the participants, a visual timeline for each board was created with the use of the free online tool draw.io. These timelines present information the participants gave about childhood obesity programmes offered in the past, present, and future. Lastly, a separate figure was developed to categorize codes into the ANGELO framework.

5.5 Investigation situation boards

Before interview analysis, an investigation of overweight and obesity prevalence among Primary 1 children in both boards over the years was conducted. Compared was the prevalence of overweight

and obesity among those living in the boards and the national average. This way, conclusions about the urgency to intervene in the boards could be determined. Information retrieved from this investigation was also used to form the incentive for the participating boards: a detailed analysis of statistics of childhood overweight and obesity in the form of a slide set. This was emailed to the boards mid-December 2019.

Height and weight measurements of Primary 1 children across all schools in Scotland is publicly available on the website of NHS Information Services agency ISD Scotland. The data was recorded in the national information system CHSP-S. NHS Lothian records measurements since school year 2001/02, while Ayrshire and Arran hold records since school year 2007/08. Numbers of the most recent school year, 2018/19, were published on December 10th 2019. This explains why this investigation took place after the interviews, instead of before.

All data from ISD Scotland was accessible and kept in a Microsoft Excel (hereafter: Excel) file. To understand the data, graphs were developed that compared the Primary 1 overweight and obesity prevalence of the participating boards and the national average. For one graph type, estimation was made on the total number of all Primary 1 children at risk of overweight and obesity in NHS Lothian and NHS Ayrshire and Arran over the years. The estimation was made with ISD data on the total population of five-year-olds (National Records of Scotland estimate) and the percentage of Primary 1 children at risk of overweight and obesity. Results of this investigation were published in the Chapter 6: Results interviews.

The data was kept and analysed in Excel because this can be used as a reliable, convenient method which can be easily be integrated with other Microsoft Office software (Rose et al., 2015). This made it easy to create graphs in Excel, and to transfer them to a slide set in Microsoft PowerPoint.

6. Results interviews

In total, two interviews were conducted. The interview of NHS Ayrshire and Arran was conducted with two members of staff and the interview of NHS Lothian was conducted with one member of staff, all very knowledgeable about childhood obesity programmes the boards offered. Table 6 presents details of the interviews.

Table 6: Interview information

NHS Board	Date of the interview	Duration of the interview
Ayrshire and Arran	16 November 2019	01:14:58
Lothian	19 November 2019	00:24:20

6.1 Trends and current situation

First, assessed was the prevalence of Primary 1 children with valid height and weight recordings across Scotland. The most recent numbers of school year 2018/19 show that Ayrshire and Arran covered 68% of the Primary 1 children and Lothian 89% of the Primary 1 children. Overweight and obesity prevalence in Primary 1 children in Ayrshire and Arran was 23.1%, which is just over the national Scottish average of 22.4%. Lothian had one of the lowest overweight and obesity prevalence with 21% (Figure 7). This Figure shows the urgency to address the problem of overweight and obesity among Primary 1 children: in Lothian, over a fifth of Primary 1 children are at risk of overweight and obesity, compared to almost a quarter of Primary 1 children in Ayrshire and Arran.

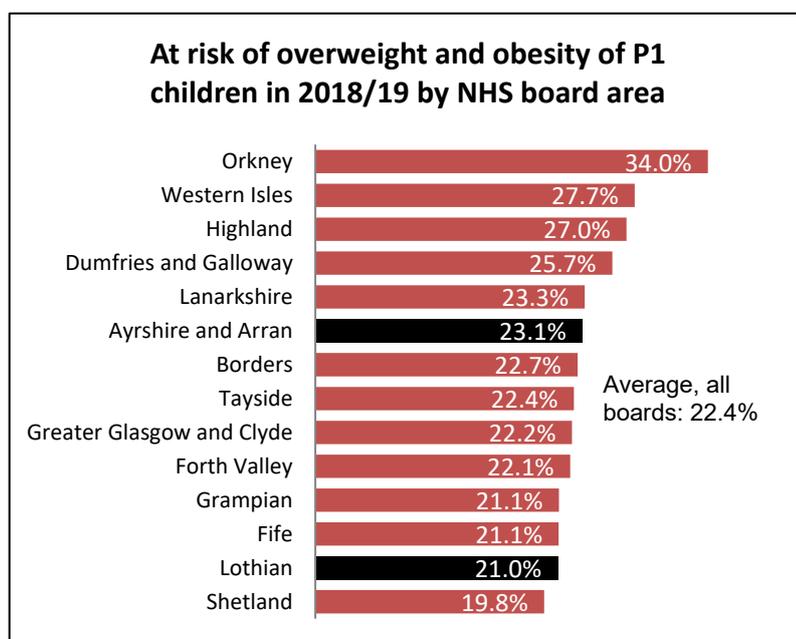


Figure 7: Prevalence of P1 children at risk of overweight or obesity in 2018/19 by NHS board area in Scotland

For both boards, the proportion of Primary 1 children with overweight and obesity fluctuated slightly over the years, but stayed relatively the same from the start of the century (Figure 8 and Figure 9).

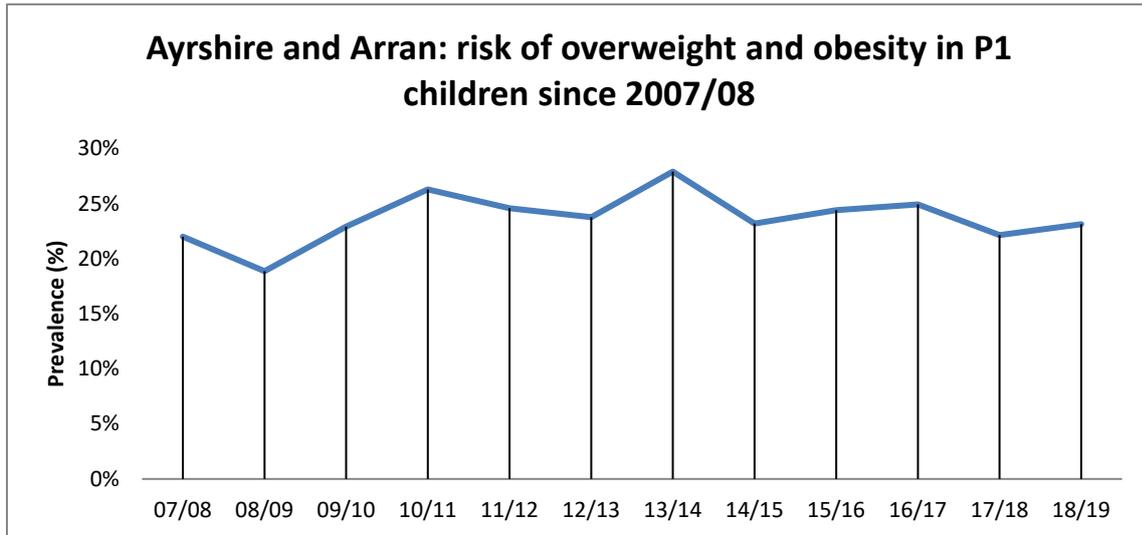


Figure 8: Prevalence of P1 children at risk of overweight and obesity in Ayrshire and Arran between 2007/08 to 2018/19

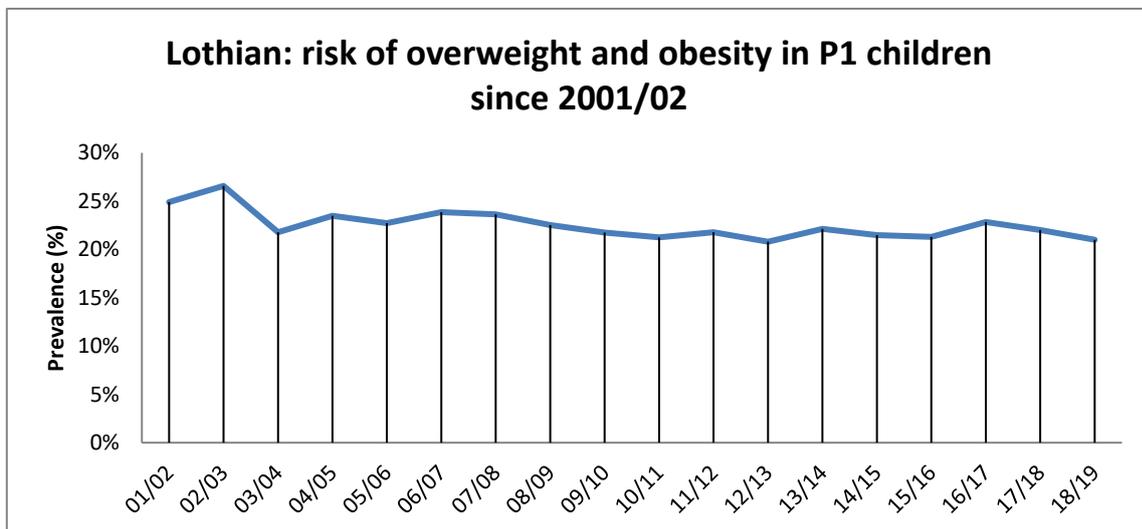


Figure 9: Prevalence of P1 children at risk of overweight and obesity in Lothian between 2001/02 to 2018/19

Estimation was made of the total number of all Primary 1 children at risk of overweight and obesity over the years. In Ayrshire and Arran, close to 900 Primary 1 children were estimated to be at risk for overweight and obesity, and Lothian had a total of almost 2100 Primary 1 children at risk of overweight and obesity (Figure 10 and Figure 11). The Figures show that those numbers do not differ substantially since records began. There has been some fluctuation, but reasons for this cannot be determined with certainty. A possibility is that there were fluctuations in the number of Primary 1 children living in Scotland.

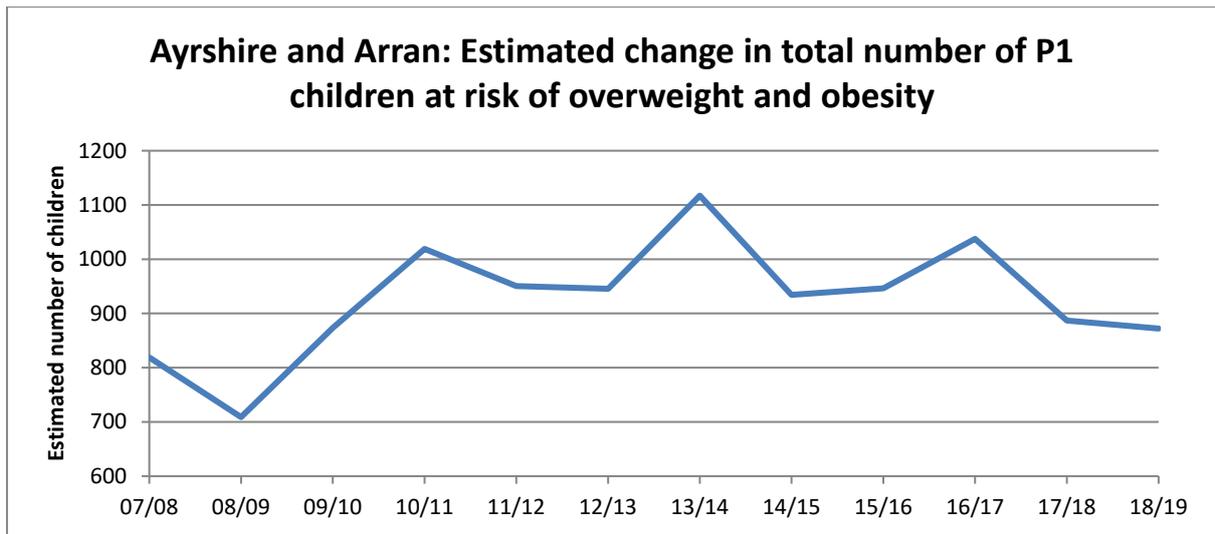


Figure 10: Estimated number of P1 children at risk of overweight and obesity in Ayrshire and Arran between 2007/08 and 2018/19

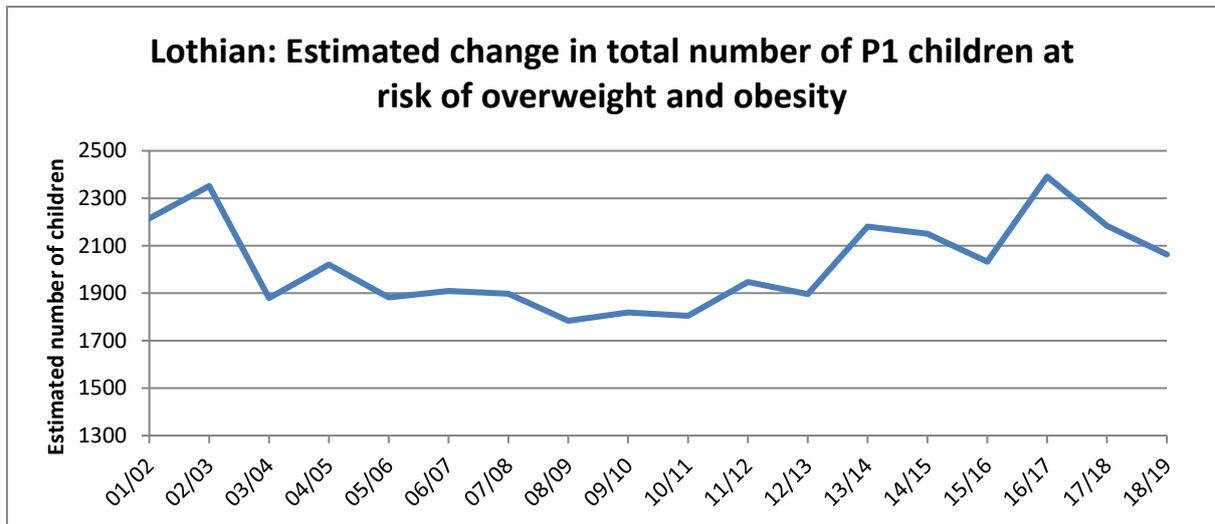


Figure 11: Estimated number of P1 children at risk of overweight and obesity in Lothian between 2001/02 and 2018/19

6.2 Analysis NHS Boards

This section explains all themes and codes from the codebook (Table 7). Themes in the codebook were constructed with the five environments of the ANGELO framework, information regarding the childhood obesity prevention programmes the boards offer, and other issues and topics raised by the interviewees that are of interest to the research question.

Clarification: the codebook contains information interviewees voluntarily communicated. This means that the codebook does not show full information. In other words, information that board X gave could also apply to board Y, even if this was not communicated.

Table 7: Codebook with themes, codes, explanation of the codes, and connected boards (NHS Ayrshire and Arran = A, NHS Lothian = L)

Themes	Codes	Code explanation	A/L
ANGELO framework: Individual environment	Summary JumpStart	Group-based, health-coach led, in schools/leisure centres, evening, for children with BMI above the 91 st percentile and their families, ten sessions, 7-8 families per group, 5-15 year olds, treatment obesity. Referrals through self-referrals, school nurses, teachers, dieticians, general practitioners, mental health services, social workers and dentists (present)	A
	Summary JumpStart Choices	Group-based, health-coach led, in school classes, during school hours, for all children, eight sessions, primary 4-7, treatment and prevention obesity (past)	A
	Summary JumpStart Choices Juniors	Group-based, health-coach led, in school classes, during school hours, for all children, eight sessions, primary 1-3, treatment and prevention obesity (past)	A
	Summary JumpStart one-to-one	One-to-one, at home or in leisure centres (e.g. gym), health-coach led, for children above the 91 st percentile and their families, eight sessions, 15-17 year olds or 5-15 year olds, treatment obesity (present)	A
	Summary JumpStart 27,5 months	One-to-one, dietetics assistant practitioners and health coaches led, for whole families, eight sessions, 2-5 year olds, focus more on how families can be active together, treatment obesity (future)	A
	Summary Get Going	Group-based, specialist paediatric dietician led, in community and leisure centres, for children above the 91 st percentile and their families, nine sessions, 6-18 year olds, treatment obesity. Self-referrals, Referrals through general practitioners, health visitors, or other health professional (present)	L
	Summary Keep Going	Group-based, specialist paediatric dietician led, only in some areas in community and leisure centres, drop-in sessions for whole families from children who have completed Get Going, 6-18 year olds, treatment and prevention obesity (present)	L
	Summary dietetic-let family intervention (clinic programme)	One-to-one, specialist paediatric dietician led, in a clinic setting, for children with BMI in the 99.6 th percentile plus 3.33 SD's, eight or more sessions, 2-18 year olds, treatment (present)	L
ANGELO framework: Physical environment	Marketing campaign	Programme was promoted with a marketing campaign, consisting of leaflets and posters in the area	A
	Parents in home environment	Realised was that the environment around the child at home has to be changed, and that parents have more power to do that	A
	Shopping	Health coaches go grocery shopping with some parents to create more understanding what to buy in the supermarkets	A
	Programme location	Families are invited to JumpStart programmes as close to their home as possible	A
ANGELO framework: Sociocultural environment	Different age groups	Separate programmes were developed for age groups 5-10 and 11-15, since they have different needs	A
	Separate programmes for children with additional needs	Children with additional needs can join adaptive programmes if needed, otherwise they can join regular JumpStart	A
	Role modelling	Parents are encouraged to have a healthy lifestyle themselves and how this can influence their	A, L

Themes	Codes	Code explanation	A/L
		children's lifestyle	
	Appreciation	Children look for positive reactions from their parents on how well they are doing in JumpStart	A
	Avoid stigma	At a certain time bad press was going on about children being in "fat camps"; with JumpStart Choices children were not stigmatized	A
	Weighing full family	The full family who are present at JumpStart are weighed at the beginning and end of the programme, and children can take the weight of health coaches	A
ANGELO framework: Economic environment	Free leisure card	Children in the JumpStart programme receive a free leisure card for activities as swimming, badminton, ice skating and going to a gym. Parents can join for free too. If children attend the final assessment, the free leisure card is extended for three months	A
	Funding for programmes	The board receives funding from the government to develop child weight management programmes	A
	Letter free-post envelop	A letter is send to families who are being referred, and they are able to send a free-post letter back to say if they like to engage in the programme	A
ANGELO framework: Political environment	No phone rule	Parents are not allowed to look at their phones during JumpStart	A
	Standards	The Standards are taken into account when designing and evaluating childhood obesity prevention programmes. See code 'Standards'.	A, L
Barriers/issues	Engagement after referral	Families that are being referred often do not join the programme	A
	Hard to plan	Funding is on a year to year basis, so planning where the budget goes is harder	A
	Evaluation not possible	Evaluation of JumpStart Choices was not possible on the long-term, because funding was short	A
	Children would not come to follow-up	Children who completed the programmes would not come to the follow-up at six months	A
	Resenting parents	Children in the JumpStart programme are sometimes weighed by their parents. For this, children resent their parents and feel restricted	A
	Teachers did not engage	Because of funding issues, JumpStart Choices and JumpStart Choices Juniors had to stop. Teachers were encouraged to deliver the programme after that period but they would not engage as much	A
	Transport	It is a barrier for families to join JumpStart programmes if they have to use public transportation	A
	Older children did not like being in groups	Often children aged 15-17 do not like being in groups, as they are working out and sweating	A
	People do not answer the phone	When families are being called to discuss a first assessment, they often do not pick up the phone. A barrier is that phoning from a NHS building comes up as a 0800 number, which is the same as teleservices use	A
Basis of the programmes	Based on Scott	The programmes were formed on the basis of a study called Scott: Scottish Childhood Obesity Treatment Trial	L
	Based on MEND	JumpStart was formed on the basis of a programme called MEND: Mind, Exercise, Nutrition and Do it.	A
	Based on JumpStart	JumpStart Choices, JumpStart Choices Juniors and JumpStart one-to-one were developed on the basis of the regular JumpStart	A

Themes	Codes	Code explanation	A/L
Effort of staff	Contact attempts	After families are being referred, they are being contacted about three times in two/three months, although sometimes families are being contacted for up to a year	A
	Travel	Health coaches can travel a lot to meet families, sometimes up to hundred miles in a day	A
	Taxi	When families encounter logistical difficulties to join intervention locations, sometimes a taxi is arranged	A
Experiences	Appreciation from parents of children with additional needs	Parents of children with additional needs appreciate it that their children often can join the mainstream JumpStart programme with other children without additional needs	A
	Shopping with health coaches is beneficial	Parents who went grocery shopping with parents found it beneficial	A
	Preference teachers	Teachers felt that children would enjoy the programme more if health coaches delivered it instead of teachers	A
	Appreciation children	Children enjoy participating in the group-based programmes	A, L
Family-based	Invite siblings, both parents (also when divorced), grandparents, friends, etc.	The whole family is encouraged to participate, also when parents are divorced. Often is seen that at the one parent children have to eat healthy and at the other parent it is 'treat time'. Sometimes friends can come along as well if the child is shy and has no siblings	A
	Parents and their children are invited	Both parents and their children are invited	A, L
Future	Continual service development and expansion	Future plans entail general continual service development and expansion	L
	Physical activity plan in clinic setting	Future plans entail getting more specific physical activity involvement for children in a clinic setting	L
	27,5 months programme	Expected implementation of the 27,5 months programme is in April 2020	A
	Study	Planned is to perform a study on the reasons why people do not engage in the programme after they are being referred	A
Having fun	Having fun	Having fun is an important aspect of the group-based programmes	A, L
Language use	No mentioning of the weight to the children	Children's weight is never mentioned in JumpStart programmes	A
	Parent education on language use	Parents are educated on how to communicate appropriately with their children and do not talk about weight	A
Materials	School setting: parent pack	Parents received JumpStart Choices pack prior to the programme. This contained information of the programme	A
	School setting: booklet	Children received a JumpStart Choices booklet which contained all the topics of the programme, including tasks that they could do at home with their family	A
	School setting: lesson plan and toolkit	Teachers received a lesson plan with a tool kit to investigate the topics further and to use it in their lessons if they wished. Other classes where the programme was not conducted, could use the lesson	A

Themes	Codes	Code explanation	A/L
		plan and toolkit as well	
	School setting: toolkit development	The programme 5210 was developed, that looked at: five fruits and vegetables, two hours maximum screen time, one hour of physical activity, zero added sugars. A teacher toolkit was developed for that. This will be distributed to schools that joined JumpStart Choices and Jumpstart Choices Juniors after feedback is given by educational colleagues. This toolkit will be put on the teachers portal	A
Other activities	Events	Events such as going to gymnastic centres and going to a taekwondo club were organised for all JumpStart participants. Moreover, quarterly, at the end of each natural block, all running programmes were brought together for a larger activity such as sledging on a dry ski slope, orienteering, visit to National Sports Centre or night walks.	A
	Invite guests	For children only programmes, guests are invited to engage in activities with the children. These can be for example local leaders and sports leaders	A
Programme components	Education on diet and physical activity	Components included education on diet and physical activity	A, L
	Encourage eating different foods	Components of the JumpStart programme includes food tasting	A
	Interactive discussion	Jumpstart has a new topic every week that is actively discussed within the group	A
	Play activities	Components of the group-based programmes included play activities for children while they learn about a healthy diet and physical activity	A, L
	Health and inequality self-assessment tool	Since 2018/2019, health and inequality self-assessment tools were incorporated in the programmes. This consists of conversations between a health coach and family to detect other determinants that affects the family's lifestyle (such as housing situation, finances, smoking, alcohol, and drugs)	A
Programme deliverers	Dieticians	All programmes are led by paediatric dieticians. Clinical associate of applied psychology (CAPs) help the dieticians if families need additional input	L
	Leisure partners	Leisure partners within leisure facilities run Get Going and Keep Going	L
	Health coaches	All programmes are led by health coaches	A
	Teachers	The last years of JumpStart Choices and JumpStart Juniors, the teachers were encouraged to co-deliver the programme so they could apply it when the health coaches were not around anymore	A
	Mentors	Children who have finished JumpStart and are older, are coming back to the programme to help the younger children	A
Relate	Children relate to health coaches	Children feel comfortable with health coaches because they are wearing informal clothes and are being enthusiastic	A
Results	Progress school	Behaviours of children at school improved	A, L
	BMI SD reduction	Children above a healthy weight reduced their BMI SD's slightly in the JumpStart Choices programme	A
	Physical activity	Children are more physically active and less sedentary in the programmes	A, L

Themes	Codes	Code explanation	A/L
	Condition	Children in JumpStart have better stamina after the programme	A
	Same weight	83% of the children stayed the same weight before and after the JumpStart programme	A
	Fruit intake	Fruit intake of the children in the JumpStart programme was increased, but not vegetable intake	A
	Quality of life	Children's own rated quality of life increased during the JumpStart programme. Children rated their own quality of life lower than their parents rated their children's quality of life.	A
	Knowledge	Knowledge of the discussed topics of children in JumpStart Choices and JumpStart Juniors increased	A
	Age groups	Children aged 8-12 were getting most benefits from the programmes	A
Role modelling	Involving parents	When parents actively join JumpStart, children are more likely to participate and do it outside of the programme as well	A
	Give right example	Parents are encouraged to have a healthy lifestyle themselves and how this can influence their children's lifestyle	A, L
Standards/criteria	HEAT Target	Years before the Standards guided the boards, the HEAT Target, a core set of objectives and measures, guided NHS boards to develop and implement programmes. During this period Ayrshire and Arran was conducting research to employ an operational programme for children with overweight or obesity	A
	Focus on most deprived areas	Following the Standards, at least 60% of the children in the programmes are from SIMD areas 1 and 2	A
	Extra parent-only session	Following the Standards, extra parent-only session is included in the programmes	A, L
	Go further than minimal criteria	Families are seen within 28 days after referral, whereas the criteria is that families are seen within 18 weeks	A
	Involve parents in development programme	Following the Standards, programme development will take parent evaluation of the programme into account	A
	Programmes met criteria	Generally, programmes met the criteria from the Standards	A, L

6.3 ANGELO Framework: Individual environment

In the individual environment, the body of the programmes the boards offer are explained. The programmes are visualised with a separate timelines for the boards in Appendix 7 and 8. The following sub-paragraphs explain all programmes the boards offer.

6.3.1 Ayrshire and Arran: JumpStart

JumpStart was a group-based programme for children aged 5-15 with a BMI above the 91st percentile and their families. Children were either self-referred by their parents or caretakers, teachers, school nurses, or health professionals such as dietitians, paediatricians, general practitioners or even dentists. The programme consisted of 10 group sessions once a week, for two hours, led by health coaches. Programme content included families being advised on a healthy lifestyle, group nutrition-based interactive sessions, food-tasting sessions, physical activity sessions and group discussions. Every week, a different topic was discussed in relation to the children's lifestyle. All sessions were

interactive and games-based and children were encouraged to learn by actively seeing and doing. So-called “brainfriendly” learning was used. Parents were encouraged to actively participate in the sessions. This programme was still running at time of the interview.

6.3.2 Ayrshire and Arran: JumpStart Choices

JumpStart Choices was implemented 2,5 year after JumpStart started, because NHS Ayrshire and Arran were interested in preventing obesity as well. Another reason to start the Choices programme was because often referred children did not show up in JumpStart (see “Barriers”). JumpStart Choices was a weekly 8-session group-based programme of 45 minutes for Primary 4-7 school classes. The content of JumpStart Choices was similar to that from JumpStart, but less intensive. Health coaches executed the programme. Parents were less involved than in JumpStart, but prior to the start of the programme they were invited to voluntary meet the health coaches. The programme got popular: all schools in the area of Ayrshire requested to join the programme. Moreover, after requests from schools JumpStart Choices was also implemented in Primary 1 to 3. This programme was called JumpStart Choices Juniors. Content was similar to that from JumpStart Choices, but more tailored to that age group. JumpStart Choices and JumpStart Choices Juniors could not be sustained anymore when funding from the government changed. Thus, this programme was not running anymore at time of the interview.

6.3.3 Ayrshire and Arran: Jump-Start one-to-one

JumpStart one-to-one consists of eight meetings between a health coach and a child aged 5-17 with his or her family, who has a BMI above the 91st percentile. One-to-one sessions were applied when children did not feel comfortable being in a group setting as in JumpStart regular. For example, children aged 14-17 that did not want to sweat in front of peers when doing physical exercise (see “Barriers”). Children and their families that are interested in JumpStart but cannot join due to logistical reasons (see “Barriers”), can also join the one-to-one programme. The one-to-one meetings were held at the family’s home or in leisure centres close to their homes. This programme was running at time of the interview.

6.3.4 Ayrshire and Arran: JumpStart 27.5 months

The programme of JumpStart 27.5 months will be implemented starting approximately in April 2020. This will consist of eight one-to-one sessions with both dietetics assistant practitioners and health coaches and children aged 2-5 with their families. In this programme, the focus will lie more on lifestyle of the families and the how the entire family can be more active together.

6.3.5 Lothian: Get Going

Get Going was a group-based programme for children aged 5 to 17 years with a BMI above the 91st percentile with their families. The programme consisted of nine sessions and were specialist paediatric dietician led. Topics included healthy eating, physical activity and making positive lifestyle choices (NHS Lothian, n.d.). Children were either referred through self-referral or by general practitioners, health visitors or other health professionals. This programme was running at time of the interview.

6.3.6 Lothian: Keep Going

Keep Going was a programme designed for children who completed the Get Going programme. Children aged 6-18 years old and their families could join the drop-in sessions led by a specialist paediatric dietician. These sessions were held in community- and leisure centres. This programme was conducted in a few areas in Lothian and was still running at time of the interview.

6.3.7 Lothian: dietetic-led family intervention (clinic programme)

Lothian health board offered a Tier 3 specialist dietetic-led one-to-one family intervention for children aged 2-18 with a BMI in the 99.6th percentile plus 3.33 standard deviations. The programme was led by a specialist paediatric dietician and consisted of eight sessions, or more if the family required additional contact.

6.4 ANGELO framework: Physical environment

During the interview with the representative of NHS Ayrshire and Arran, four codes were created in the physical environment. There were no codes from NHS Lothian in the physical environment. A marketing campaign was carried out to promote the JumpStart programme. This consisted among other of posters and leaflets spread around different facilities. This change to the physical environment could influence people's decision to join JumpStart, and thus to change their diet and physical activity level. Next, health coaches went grocery shopping with parents to create more understanding what they could buy to eat healthy. Changing people's perceptions by being aware of the physical environment (supermarket) can predict shopping behaviour changes. Third, the proximity of programme location to the family's home predicts whether people join the programme or not. Thus, families are invited to join programmes as close to their family home as possible. The last code consists of a realisation how the physical environment influences diet and physical activity, rather than an actual change to the physical environment. After implementing JumpStart, developers of childhood obesity prevention programmes in Ayrshire and Arran realised the importance of the home environment on lifestyle behaviour. Specifically, the realisation that parents have the most power to change the home environment. This realisation was the basis of changes in programmes to include parents even more.

6.5 ANGELO framework: Sociocultural environment

In all childhood obesity prevention programmes from NHS Ayrshire and Arran and NHS Lothian, role modelling of parents was found as an important predictor of their child's eating- and physical activity behaviour. Within the programmes, parents were encouraged to have a healthy lifestyle themselves and thought how their lifestyle can influence their child's lifestyle. Furthermore, children wanted appreciation from their parents when they performed an activity within JumpStart. This is a way in which parents can influence their child's physical activity behaviour.

NHS Ayrshire and Arran offered JumpStart programmes for children in different age groups. Also separate programmes for children with additional needs were offered, although in many cases

children with additional needs joined the regular programme. Avoiding stigmatization was an important factor of the sociocultural environment of NHS Ayrshire and Arran. At a certain point in time, there was media attention of children being in “fat camps”. That being said, with JumpStart Choices children of all weights participated, avoiding stigmatization. Another way to avoid stigma, was to weigh the whole family instead of only the child at both the beginning and end of the programmes. Children could also weigh the health coaches.

6.6 ANGELO framework: Economic environment

Three codes of NHS Ayrshire and Arran could be divided in the economic environment that can influence children’s diet and physical activity. Firstly, content of childhood obesity prevention programmes depends on the type and amount of funding they receive from the government. In the interview with the representative from NHS Ayrshire and Arran mentioned was that funding they received from the Scottish Government was one of the largest predictors on what kind of programmes they would offer. In 2008, the Scottish Government gave each NHS board funding to develop programmes to tackle childhood obesity. Along with the funding came criteria that supported the Health Improvement, Efficiency, Access and Treatment (HEAT) target. This was a core set of objectives and measures for NHS boards (Maternal and Early Years, 2013). NHS Ayrshire and Arran received three years funding to develop and implement an operational programme to help families and their children at risk of overweight and obesity. This went on for six years. After this, the HEAT target was not used within the Scottish Government anymore. From that time on, NHS Ayrshire and Arran received funding on a year-to-year basis. In the interview with the representative of NHS Lothian, funding was not mentioned although it was assumed is that the information above applies all NHS boards.

Secondly, families received a letter when they were being referred containing information of the programme and a request to join the programme. Parents could reply with the post-free envelope if they wished. Lastly, children in the JumpStart programme received a free leisure card they could use for different leisure centres. Examples of possible activities were swimming, badminton, ice-skating and going to a gym. If children and their families attended the final assessment the free leisure card was extended for three months. Parents could also use the leisure card, but only when they went together with their child(ren).

6.7 ANGELO framework: Political environment

The Standards, which contain criteria for childhood obesity prevention programmes, were used to evaluate and develop programmes in both boards (See “Standards/criteria”). Another code in the political environment is the strict no-phone-rule in the JumpStart programme in NHS Ayrshire and Arran. This was introduced because health coaches noticed that parents often were distracted by their mobile phones.

6.8 Visual representation of all environments

The codes divided by the different micro-environmental settings can be seen in Figure 12. Every layer stands for a different setting in which programmes of the boards were delivered: the community/leisure setting, clinic setting, school setting and home setting. The five parts represent the five environments. An example of how the Figure can be read is as follows: in the interview in NHS Ayrshire and Arran, explained was that the location of JumpStart (often offered in community/leisure centres) is an important predictor whether children and their families are willing and able to join the programme. Thus, the code “programme location” can be divided into the physical environment, in the community/leisure setting layer.

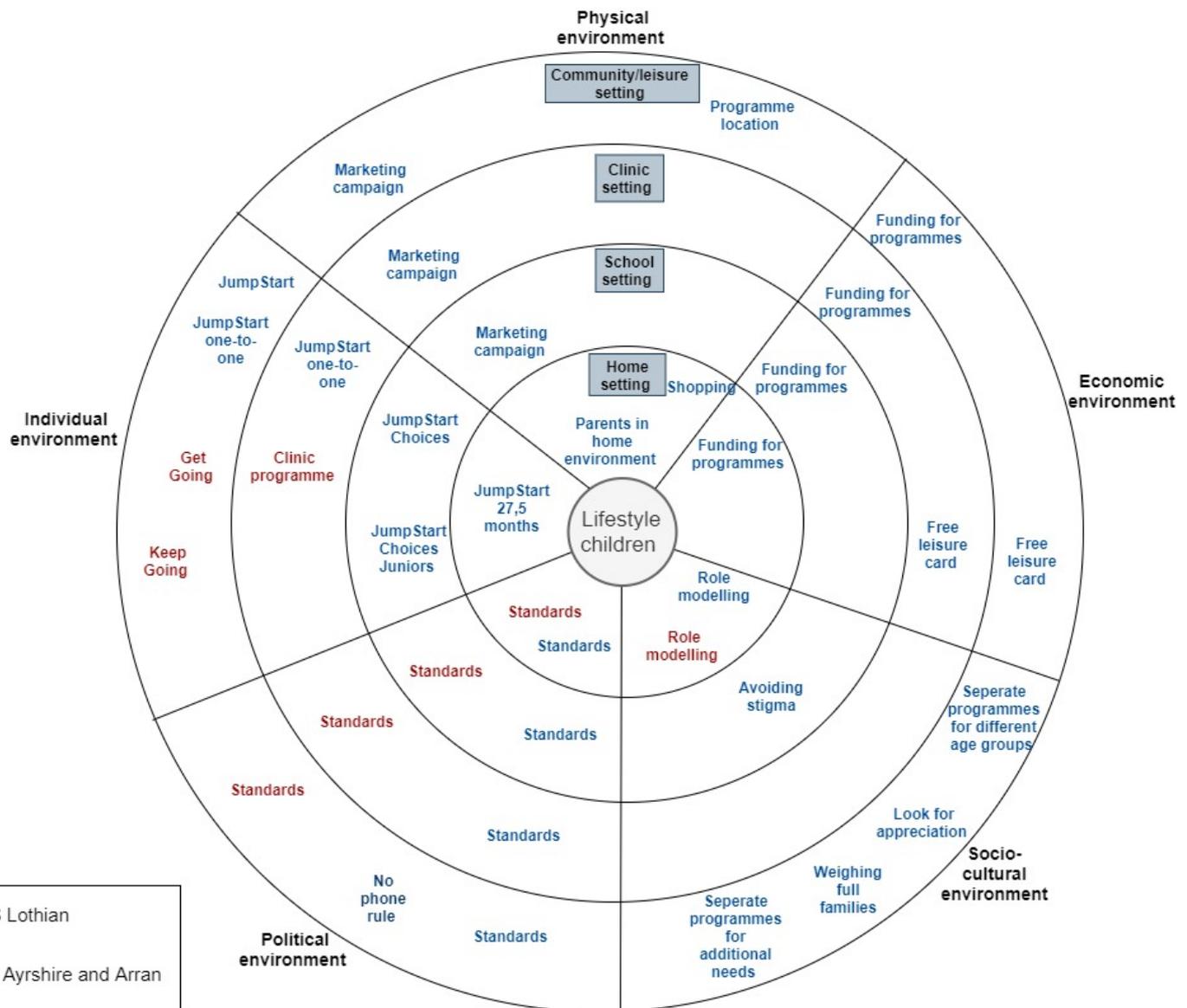


Figure 12: Interview components in the ANGELO framework by setting of delivery

6.9 Other codes

Barriers/issues

NHS Ayrshire and Arran raised several issues and barriers regarding childhood obesity prevention programmes. The largest barrier for them was engagement to JumpStart after families have been referred. An example was that in one of the local areas of the board, an estimated 27 families were referred, from which ten families joined the programme. For families, it was a barrier to join the programme when they had to travel far or when they had to use public transportation. Not only children and their parents lacked engagement, also teachers did not engage as much in the programmes as desired by the board. Especially when JumpStart Choices could not be sustained, teachers were encouraged to deliver the programme themselves. Teachers however did not engage as much as the health coaches did. The last issue regarding engagement is that families who are being referred often do not answer the phone. This is most likely due to seeing a 0800 number is calling them, which is the same telemarketing companies use.

Another issue is that funding of the Scottish Government used to be on a three-year basis, but it changed to a year-to-year basis (See "ANGELO framework: economic environment"). This makes it harder to plan how funding for childhood obesity programmes will be used exactly. Furthermore, it was not possible to continue JumpStart Choices due to funding problems. Therefore it was not possible to evaluate the programme in the long-term. Also, in JumpStart, children who completed the programme often were not present at the follow-up at six months, which means that an evaluation of the effectiveness of the programme could not be done in all children.

Lastly, parents of some families who joined the programmes weighed their children at home placing more emphasis on the importance of losing weight. Children started to resent their parents for this. Teaching parents how to communicate appropriately to their children concern about their weight was necessary (see "Language use"). Lastly, children aged 15-17 years often felt self-conscious and did not feel comfortable being in groups. Anecdotally, this was because they were performing physical exercises and were sweating.

Basis of the programmes

NHS Ayrshire and Arran initially planned to use the Mind, Exercise, Nutrition, Do it (MIND) programme as a childhood obesity prevention programme. Another council had that programme running and NHS Ayrshire and Arran concluded on the basis of the evidence that the programme was effective. However, due to the funding they received, it was not possible to take on the MEND programme. They decided to develop their own programme based on the MEND programme and other best practices. This is how JumpStart started. Other variations of JumpStart programmes were based on the regular JumpStart. NHS Lothian based their programmes on a study: the Scottish Childhood Obesity Treatment Trial (Scott). This was an RCT looking at the best practice for childhood interventions and outcomes.

Effort of staff

In NHS Ayrshire and Arran, efforts of staff members of childhood obesity prevention programmes were made to include referred children into the programmes. Families from referred children were usually contacted three times in two or three months, to ask them to engage in the programme. In some cases, families were being contacted for up to a year. Additionally, families were invited to intervention locations as close to their home as possible. When they would still encounter logistical difficulties, staff members of childhood obesity prevention programmes called in a taxi for the family to use. Furthermore, health coaches travelled sometimes up to a hundred miles in a day to meet families.

Experiences

In both boards, children generally enjoyed participating in the group-based programmes because they were bonding and playing with other children. The following other experiences were only mentioned in the interview with the NHS Ayrshire and Arran. Parents of children with additional needs appreciated it when their children were placed in mixed groups, which contained of children with and without additional needs. Moreover, parents found it beneficial when health coaches gave tips and advice during grocery shopping. Lastly, teachers were encouraged to co-deliver JumpStart choices with the health coaches and to continue the programme after eight weeks. Teachers experienced however that children enjoyed the programme more when this was delivered by health coaches.

Family-based

The programmes adopted a whole-family approach. Siblings and families were invited to join group-based programmes. NHS Ayrshire and Arran occasionally also invited friends of participating children to JumpStart, especially when those children were shy and did not have any siblings.

Future

Future plans for NHS Lothian regarding childhood obesity prevention services entail continuing service development and expansion. A specific plan was to involve children in physical activities during sessions in the clinic setting. NHS Ayrshire and Arran is planning to implement the 27,5 months programme from April 2020 (see an explanation at the individual environment in of the ANGELO framework). Another plan of this board is to perform a study on the barriers and reasons why some referred families do not engage and attend the programmes. Goal of this study is to increase family engagement.

Having fun

Engagement of children in active play activities regarding healthy nutrition and physical activity was the aim of the group-based programmes of both boards. Additionally, for children and their families, fun was an important aspect of the programmes.

Language use

Health coaches in childhood obesity prevention programmes in NHS Ayrshire and Arran strictly do not mention (losing) weight to the children. Only at first and last assessment children's weight is being measured. Instead, the focus to the children lies more on playing and having fun while learning about healthy nutrition and physical activity. Proper communication to encourage children to have a healthier lifestyle is also taught to their parents. Especially since children start to resent their parents for weighing at home (see "Barriers/Issues").

Materials

In JumpStart Choices, offered in NHS Ayrshire and Arran, several types of materials were developed. Prior to implementation of the programme, parents received a JumpStart Choices parent pack with information about the programme. Children received a booklet with specific information on the topics discussed in the programme, including tasks they could perform at home with their family. Teachers in classes that completed JumpStart Choices, received a lesson plan and a toolkit. Teachers could use this in their lessons if they wished to continue investigating the discussed topics further. Other classes could also use the lesson plan and toolkit. Recently the programme *5210* was developed, with the key messages: five portions fruit and vegetables a day, maximum of two hours screen time, one hour physical activity, and zero added sugars. A toolkit was developed for schools that joined JumpStart Choices, and will be placed on the teacher's portal after approval from the board's educational colleagues. Lastly, posters and flyers were distributed and shared (See Appendix 9 for an example of a promotional poster for JumpStart).

Other activities

Children in JumpStart programmes offered by NHS Ayrshire and Arran could join a range of organised events. Children from different groups were able to meet each other this way. Additionally, guests such as local sport leaders were occasionally invited into JumpStart to engage in activities with the children.

Programme components

The boards have several programme components in common. The basis of all programmes was education on living a healthy lifestyle with eating healthy and engaging in physical activity. In both group-based programmes of the boards, this was conveyed mostly with play activities in which the children could engage together with their families. Group-based programmes of NHS Ayrshire and Arran also included interactive discussions with parents and health coaches on a different topic every week. Moreover, these programmes included food-tasting as an intervention component. Lastly, health and inequality self-assessment tools were incorporated in all programmes of NHS Ayrshire and Arran. These are conversations between a health coach and family to detect other determinants that might affect how the families live a healthy lifestyle. This could be topics such as housing situation,

finances and smoking behaviour. Parents tended to open up to health coaches because they saw them on a regular basis.

Programme deliverers

Generally, paediatric dieticians delivered childhood obesity prevention programmes in NHS Lothian, and health coaches delivered childhood obesity prevention programmes in NHS Ayrshire and Arran. Occasionally, when children and parents needed extra input, the clinical associate of applied psychology (CAP) co-delivered interventions in a clinic setting in NHS Lothian. In Get Going and Keep Going leisure partners from the leisure facilities where the interventions were held, run the programme. In NHS Ayrshire and Arran, so-called mentors are sometimes invited to JumpStart. These mentors are children who have previously finished JumpStart, and who came back to help the younger children. Lastly, teachers of JumpStart Choices were encouraged to co-deliver the programme. The rationale behind this was that teachers could continue programme components after the eight sessions with health coaches.

Relate

Children in childhood obesity prevention programmes in NHS Ayrshire and Arran felt comfortable spending time with health coaches. Children could relate with them because they were wearing informal clothes and delivered the programme enthusiastically.

Results

Children who participated in programmes of both boards behaved better in school and were more physically active. NHS Ayrshire and Arran evaluated the programmes and found that children with overweight and obesity reduced their BMI standard deviations slightly in the JumpStart Choices programme. In JumpStart, weight of 83% of the children did not change. At the same time, children's wellbeing and fruit intake increased. Moreover, children's own rated quality of life increased during the JumpStart programme. Still, children rated their own quality of life lower than the parents rated their children's quality of life. In JumpStart and JumpStart Choices, knowledge of the discussed topics increased as well. Children aged 8 to 12 years seemed to have the most benefits from the programmes offered in NHS Ayrshire and Arran.

Role modelling

In programmes of both boards parents were encouraged to live a healthy lifestyle themselves. They were taught how their behaviour could influence their children's behaviour. NHS Ayrshire and Arran saw the effectiveness of role modelling in the JumpStart programme offered. Children of parents who actively joined the programme were more likely to participate actively themselves.

Standards/criteria

As mentioned in the Paragraph "Funding", the HEAT target consisted of a core set of objectives and measures that guided boards to develop and implement programmes, among other issues, for

childhood obesity prevention programmes. During the HEAT target period, NHS Ayrshire and Arran was conducting research to employ an operational programme for children with overweight and obesity. The HEAT target is not in use anymore. Currently, the Standards guide boards to develop and evaluate effective childhood obesity prevention programmes.

Programmes of both boards generally complied with the criteria set out by the Standards, although a few changes to their existing programmes were made accordingly to the Standards. Both boards included an extra parent-only session and NHS Ayrshire and Arran will involve families more in the development and adjustment of programmes with use of a parent evaluation of current programmes. NHS Ayrshire and Arran highlighted that the Standards require that at least 60% of participating children should be from the most deprived areas, and that they exceeded this percentage. Also highlighted was that a criteria from the Standards is that referred families should be seen within 18 weeks. Within the board aimed is to meet with the families within 28 days, although often families were seen even earlier.

7. Discussion

The overall aim of this study was to broaden the understanding of effective childhood obesity prevention programmes and to understand how childhood obesity is tackled by the Scottish NHS health boards. The overall aim was reached with two key aims. The first, most important aim was to provide a comprehensive understanding of which obesity prevention programmes for children below the age of five have a positive effect on BMI, diet and/or physical. This was done via a rapid review consisting of 43 citations. The second key aim was to present a brief overview of different types of obesity prevention programmes offered by Scottish NHS boards for children below the age of five. Two interviews with representatives from two Scottish NHS boards were conducted.

7.1 Main findings: rapid review

The rapid review answered the first research question: *“What is the effect of childhood obesity prevention programmes on children’s BMI, diet and physical activity level, among children from conception to five years of age, in comparison to children (or their parents) not exposed to childhood obesity prevention programmes?”*

There were nine main findings that emerged from the rapid review:

- i) Only eight (29%) of the interventions in the rapid review showed a positive effect on children’s BMI
- ii) Involving both children and their parents, instead of targeting parents or children separately, is likely most successful
- iii) Surprisingly, the identified studies provided no evidence on effectiveness of starting the intervention during pregnancy or at infant or toddler age compared to starting the intervention at a later age
- iv) Interventions in school settings and childcare settings generally led to short-term increases in physical activity and decreases in BMI, but less changes in diet
- v) Role modelling and habit formation in families may be highly effective at influencing child’s dietary intake, especially in a home setting
- vi) There is some evidence that interventions conducted in multiple environments are more effective than interventions conducted in a single environment
- vii) Interventions in a clinic setting may be most effective for tertiary prevention and when multiple disciplines and both children and their parents are involved. Although there is no evidence that a clinic setting is the most promising setting to reduce children’s BMI
- viii) There is evidence that training teachers to conduct the interventions is more effective than researchers conducting the interventions in a childcare and school setting
- ix) Multiple studies hypothesised that using motivational interviewing would be an effective intervention strategy; this was not seen in this rapid review

The first five findings are perceived as most important and are explained in the following three paragraphs.

7.1.1 Main finding 1

A total of 39 interventions in 43 papers were retrieved. The first main finding was that only eight (29%) out of the 28 interventions that measured BMI, actually showed positive effects in BMI (Annesi et al., 2013b; Bocca et al., 2012; De Coen et al., 2012; Jouret et al., 2009; Natale, Lopez-Mitnik, et al., 2014; Paul et al., 2018; Stark et al., 2018; Verbestel et al., 2014). Overall, these positive effects were only measured in the short term. Of the three studies that showed a positive intervention effect on BMI and included a follow-up, the effect in two studies could not be sustained (Daniels et al., 2015; Wen et al., 2015). However, many citations did show a small or significant effect on children's diet. Even without a positive change in BMI, this might be seen as an intervention's success. A delayed decrease in BMI could be shown if the healthier diet is maintained over a longer period (De Bock et al., 2012). The small number of studies that included follow-up measurements highlights the need for long-term research. Eleven studies only considered diet and/or physical activity as an outcome (Annesi et al., 2013a; Haines et al., 2018; Handel et al., 2017; McGowan et al., 2013; Mirotta et al., 2018; Natale, Messiah, et al., 2014; Nystrom et al., 2017; Reifsnider et al., 2018; Rohde et al., 2017; Roth et al., 2015; Spence et al., 2013). The rest of the studies were not successful in positively changing BMI. Some interventions showed a positive effect on BMI, diet and/or physical activity directly after implementation. But in some cases positive effects disappeared after a follow-up several years later, such as in the study from Wen et al. (2015). Thus, long-term effect of interventions can only be considered when a follow-up study is performed. Nevertheless, one intervention is not going to prevent obesity for a lifetime. A healthy lifestyle should be embedded in one's daily routine. To tackle obesity completely, many strategies need to be combined in different settings and sectors (Katz et al., 2008).

7.1.2 Main finding 2 & 3

Another finding is that both child and parent involvement is more successful than an intervention aimed at children or parents only. Most interventions were only aimed at parents without their children being involved. This is not surprising, since some interventions started at a child's very young age. However, interventions that aimed to prevent obesity in infants and toddlers (0-36 months) were generally not successful in reducing BMI. Of the nine interventions that focused on these age groups, three found a positive effect of the intervention on BMI (Daniels et al., 2012; Paul et al., 2018; Verbestel et al., 2014), although the intervention effect disappeared in the follow-up of one study (Daniels et al., 2012; 2015). Small positive changes in diet were more common (Campbell et al., 2013; Doring et al., 2014; Helle, Hillesund, Wills, & Overby, 2019; Schroeder et al., 2015; Spence et al., 2013; van Grieken et al., 2014). Of these nine studies, all but one included BMI as an outcome and interventions lasted from seven months to more than three years. Three interventions even started before birth and continued for 12 months (Reifsnider et al., 2018), 18 months (Moir et al., 2016) and 24 months (Wen et al., 2015). These interventions turned out to be unsuccessful, one of which even showed an adverse effect in BMI on the long-term; at follow-up children in one of the intervention groups had a significantly higher BMI, compared to those in other groups (Moir et al., 2016). The findings suggest that starting interventions at a very young age or even before children are

born are not successful, but this stands in contrast with the growing interest in the development of childhood obesity prevention programmes to focus on the first 1000 days: the period from conception to two years of age (Blake-Lamb et al., 2016). Several researchers discussed that there are relatively few trials that investigate obesity prevention in children below the age of two (Taylor et al., 2018b; Woo Baidal et al., 2016). From these, only few interventions show the effectiveness of childhood obesity prevention programmes in the first 1000 days (Blake-Lamb et al., 2016; Healthy Eating Research, 2016). Often, study designs are not optimal and child growth measures are not demonstrated (Healthy Eating Research, 2016). Other studies did recognise that interventions during pregnancy and continuing after birth could be effective in reducing childhood obesity (Healthy Eating Research, 2016), and increasingly it is recognised that the first 1000 days are a critical period for the development of childhood obesity (Blake-Lamb et al., 2016; Taveras, 2016). Thus, starting obesity prevention interventions at an early age could be successful when executed properly.

7.1.3 Main finding 4 & 5

The following main finding is that the most effective interventions were either conducted in a school- or childcare setting. These terms are somewhat interwoven, since both settings entail lessons and play activities for children during the day. Looking back, these settings could have been merged together although results would barely differ. Interventions in school- and childcare settings were mainly effective in engaging children in more physical activity, and improvements in BMI. Interestingly, two interventions were initially conducted in a childcare setting, but showed only significant positive changes in child's diet after role modelling of the parents in a home setting (Natale, Lopez-Mitnit et al., 2014; Natale, Messiah et al., 2014). Other studies in a home setting also showed that role modelling and family habit formation are important predictors for a healthier diet in children (Ostbye et al., 2012; McGowan et al., 2013).

7.1.4 Main finding 6

As hypothesised, all intervention designs focused on the individual environment of the ANGELO framework by trying to change parents' and children's diet and physical activity level. There is evidence from the rapid review that addressing multiple environments can be more effective than addressing only one, but this should be interpreted with caution. Generally, most intervention to prevent childhood obesity focus on an individual level (Blake-Lamb et al., 2016). Research however states that childhood obesity prevention programmes should be delivered in not only multiple micro-environmental settings, but also in macro-environmental sectors. This way, the system that explains healthy and unhealthy lifestyles can be affected (Blake-Lamb et al., 2016; Healthy Eating Research, 2016). After all, the micro-environment is influenced by the macro-environment (Swinburn et al., 1999).

7.2 Main findings interviews

The interviews answered the second research question: *“What types of obesity prevention programmes for children until five years of age are offered in Scottish NHS boards?”*

Two interviews were conducted with two representatives from NHS Ayrshire and Arran and one representative from NHS Lothian. Both boards offered several programmes for tertiary prevention for childhood obesity, and NHS Ayrshire and Arran offered in the past a primary school-based group programme called JumpStart Choices for every stage of prevention (primary, secondary and tertiary). The programmes JumpStart and Get Going seemed fairly similar as they both were group-based, executed in leisure centres for children aged 5 to 15 for JumpStart and 6 to 18 for Get Going, who have a BMI above the 91st percentile. They were also similar in focusing on a whole-family approach and that having fun is an important aspect of the programmes. NHS Lothian also offered a one-to-one programme in a clinic setting, for children aged 2 to 18 with a BMI above the 99.6th percentile plus 3.33 SD's. NHS Ayrshire and Arran did not have a clinic programme as of yet, although there are plans to implement one-to-one sessions for parents with their two to five year old children that focus on how families can be active together.

Programme components were present in all environments of the ANGELO framework, although found was that NHS Ayrshire and Arran held more codes that could be divided into the framework. This is most likely because the interview in NHS Ayrshire and Arran lasted more than three times as long as the interview in NHS Lothian and more information was given in this time. The difference in interview length and disclosed information could be due to personality differences of the interviewees and to the fact that there were two interviewees from NHS Ayrshire and Arran present and one from NHS Lothian.

Both boards evaluate their own programmes through data collection of children's BMI and feedback of children and their parents. Both boards reported behaviour of children in school improved and that physical activity increased after they joined the group-based programmes. NHS Ayrshire and Arran found that children ate more fruit, had a better stamina and had more knowledge of healthy nutrition and physical activity. More specifically, children in JumpStart Choices who were above a healthy weight reduced their BMI SD's slightly, and 83% of the children in JumpStart stayed the same weight.

Discussed during the interview with NHS Ayrshire and Arran was that the type and amount of funding of the Scottish Government played a large role in which childhood obesity prevention and treatment programmes were offered. Even though this was not mentioned by NHS Lothian's representative, assumed is that this board also relies on funding of the government. Certainly, Swinburn et al. (2005) noted that many decisions about the development and implementation of programmes are driven by economic and political considerations.

The interviews provided useful examples of types of childhood obesity prevention programmes NHS boards in Scotland offered. Although the target group in the research question were children below the age of five, boards spoke about all programmes they offered for children of all ages. This way, more valuable information was given. Even with this small amount of interviews and information retrieved, it can be concluded that Scotland is active in tackling the problem of childhood obesity.

Future will show whether the programmes of the interviewed boards and other boards are effective. Answer to this research question can be used as complementary data next to findings from the rapid review.

7.3 Strengths and limitations

There are certain limitations in this study. The search of the rapid review was limited to RCTs as the only study design. Retrospectively, found was that the use of RCT designs in obesity prevention endures its limitations (Chatterji et al., 2014). Using RCT evidence in public health research can be too artificial since it requires manipulating at least one set of variables (Swinburn et al., 2005). This can be unrealistic because childhood obesity is a complex problem, which cannot be solved by a single intervention. Moreover, even when an intervention of an RCT had very promising results, it might not be possible to adopt this kind of intervention in real life because of, for example, monetary issues. This threatens the external validity of the research. Especially, when a board has to rely on funding from the government, an intervention should be developed within those borders. On the other hand, it is certainly possible to implement an on-going programme. The programmes offered by the two interviewed boards showed this. Additionally, the rapid review was limited to interventions conducted in high-income countries only, which makes the results generalizable to the Scotland, which is positive for the external validity of this research.

Another limitation was that one person conducted the rapid review. This has been one of the requirements of the project, which was a part of the Masters degree programme. Decisions made during study selection are the most important decisions of the review process. Therefore, using a second reviewer throughout the screening process would be beneficial in identifying all relevant studies (Stoll et al., 2019; Waffenschmidt et al., 2019), although a total number of 43 citations was a good amount with the limited time and resources available for this report. Furthermore, the critical appraisal checklist CASP showed that most studies were of good quality. Questions, however, arise if study categorization was done appropriately; some studies were categorized as having a good or moderate quality, while they held methodological flaws such as a lack of blinding and loss to follow-up. This is the reason that aside from the CASP assessment itself, results did not take study quality in consideration when assessing intervention effectiveness. To improve critical appraisal, it also would have been useful to include a second reviewer.

Use of the ANGELO framework to categorize intervention components of the rapid review and programmes of the interviewed boards was a strength of this study. With the ANGELO framework, forming a childhood obesity prevention plan can be efficient, because it recognises the importance of different community needs and combines knowledge on several levels (Simmons et al., 2009). However, the effectiveness of interventions cannot be assessed with the ANGELO framework; this means that the results could not be drawn on the basis of the ANGELO framework. Looking back, a framework that would (also) assess effectiveness of the interventions emerged from the rapid review would be very useful to draw conclusions. To the best of knowledge, such a framework cannot be

found. Only a specific framework that helps to develop public health interventions, and that includes a design that allows to test the effectiveness easily, was found. This is the “Six steps in quality intervention development (6SQuID) framework”. This framework was developed by Wight et al. (2016) in Scotland, and guides the process of developing and evaluating public health interventions. Wight et al. (2016) argue that the effectiveness of interventions can be improved greatly with a suitable design and a suitable evaluation. The framework consists of six steps that should be followed when designing an intervention: “1) defining and understanding the problem and its causes; 2) identifying modifiable determinants; 3) deciding on the mechanisms of change; 4) clarifying how these will be delivered; 5) testing and adapting the intervention; and 6) collecting initial evidence of effectiveness” (Wight et al., 2016). Pringle et al. (2018) applied the 6SQuID framework to design a pilot study that supports healthy behaviour among adolescents. The authors concluded that this framework ensures that all necessary elements during the process of developing and evaluating the effectiveness of an intervention are considered. However, the intervention was not delivered in practice and could not be tested in effectiveness (Pringle et al., 2018). Not many others have adopted this framework. Nevertheless, in the current rapid review, the ANGELO framework could not be exchanged for the 6SQuID framework. Only when the six steps above could be exactly checked in each citation of the rapid review, assessed could be whether the intervention designs predict success. Thus, the ANGELO framework was deemed appropriate for this report to assess the environments in which intervention components were delivered. With this, the rapid review was able to show the micro-environments in which the most promising interventions were conducted.

Two interviews with representatives from Scottish health boards were conducted. This is not enough to get a comprehensive picture of all childhood obesity prevention interventions that are offered by NHS boards in Scotland. On the other hand, the research question was answered since multiple examples of programme types offered by two health boards were described. When the interviews are seen as merely complementary data next to the rapid review, the small amount of interviews can be viewed as neither a limitation nor strength.

7.4 Recommendations for practical application

Government. In the current study, only the micro-environment of the ANGELO framework was addressed. Changes in the macro-environment have been made by the Scottish Government. An example is the implementation of the sugar tax on soft drinks in the UK in 2018 (British Dental Journal, 2018). Secondly, the Scottish Government developed a plan to make school food healthier by offering more fruit and vegetables, less processed red meat and sugar on the menu. The regulations will come into effect by autumn 2020 (Scottish Government, 2019a). A suggestion to take this matter even further, is to set out a compulsory lesson plan with education and active play activities for children to learn about healthy nutrition and physical activity.

Health boards. Recommended for all health boards is to use an adequate framework to develop, adjust and evaluate interventions to promote a healthy weight in children. Consideration of the

6SQuiD framework, as explained in last paragraph of the “Strengths and limitations”, is suggested. Especially, the last step of the framework is useful to test the intervention in the long-term. Because not many others have adopted the 6SQuiD framework, it would be useful to first design and implement an intervention with this framework to test its actual effect (see “Recommendations for further research”).

Next, it would be useful to map and summarize childhood obesity prevention programmes of all boards in Scotland. The author of this review suggests that information on childhood obesity programmes of all boards is placed on a portal where staff can access it. With an overview of programmes, boards can generate ideas or even discuss plans with other board members during for example organised meetings once a year.

7.5 Recommendations for further research

The rapid review showed some evidence that a childhood obesity prevention intervention that addresses multiple environments in the ANGELO framework is more effective than when only one environment is addressed. Already known is that interventions should best be delivered in both the micro-environment as the macro-environment (Blake-Lamb et al., 2016; Healthy Eating Research, 2016). As far as is known, there is no study performed yet that examines environmental combinations for childhood obesity prevention programmes. The next logical step is to conduct a research which examines the optimal blending of environments to positively change children’s and their parent’s lifestyle.

Another suggestion for further research is to conduct a systematic review on childhood obesity prevention interventions specifically in the first 1000 days. Currently, researchers do not agree fully whether it is wise to start as early in life as possible or not.

Lastly, it is suggested to develop and execute a childhood obesity prevention intervention with the 6SQuiD framework. Researchers have only adapted the framework to develop a pilot study without executing it (Pringle et al., 2018).

7.6 Conclusion

This study provides insight into possible effective components of lifestyle interventions for children below the age of five to prevent obesity. The effect of childhood obesity prevention programmes on BMI, diet and physical activity can be very promising when executed properly and when long-term follow-ups are considered. Effective interventions can be conducted in different settings, although it appears that continuing the intervention in a home setting with active parent involvement predicts greater intervention success; a healthy lifestyle of parents can positively influence their children’s diet and physical activity level, which ultimately can predict a healthy BMI. There is no consistency in the perfect time to start an intervention, although it is evident that prevention is the best strategy, and

making living a healthy lifestyle the norm. The ANGELO framework suggests that an intervention that addresses different micro-environments is likely to be more effective than one environment only. Still, changing behaviour of people is difficult, and one change in the micro-environment is probably not enough to break unhealthy habits. Ideally, macro-environments should also be addressed to influence an unhealthy lifestyle. The challenge is to be innovative in creating interventions in different environments that are cost-effective and that can be sustained and evaluated over a longer period of time. The Scottish Government and NHS boards already employed several actions, with the goal to meet the target to halve childhood obesity in Scotland by 2030. Two boards were interviewed to find out which obesity prevention programmes for children they employed. Both boards currently offered one-to-one sessions and group sessions for children and their families, in which they were taught to eat healthy and perform physical activity while having fun. Years ahead will show the effect of those actions.

References

- Alkon, A., Crowley, A. A., Neelon, S. E. B., Hill, S., Pan, Y., Nguyen, V., Rose, R., Savage, E., Forestieri, N., Shipman, L., & Kotch, J. B. (2014). Nutrition and physical activity randomized control trial in child care centers improves knowledge, policies, and children's body mass index. *BMC Public Health*, *14*, 215. <https://doi.org/10.1186/1471-2458-14-215>
- Annesi, J. J., Smith, A. E., & Tennant, G. A. (2013a). Effects of the Start For Life treatment on physical activity in primarily African American preschool children of ages 3-5 years. *Psychology, Health & Medicine*, *18*(3), 300–309. <https://doi.org/10.1080/13548506.2012.712704>
- Annesi, J. J., Smith, A. E., & Tennant, G. A. (2013b). Effects of a cognitive-behaviorally based physical activity treatment for 4- and 5-year-old children attending US preschools. *International Journal of Behavioral Medicine*, *20*(4), 562–566. <https://doi.org/10.1007/s12529-013-9361-7>
- Arroyo-Johnson, C., & Mincey, K. D. (2016). Obesity Epidemiology Worldwide. In *Gastroenterology Clinics of North America*. <https://doi.org/10.1016/j.gtc.2016.07.012>
- Barkin, S. L., Heerman, W. J., Sommer, E. C., Martin, N. C., Buchowski, M. S., Schlundt, D., Po'e, E. K., Burgess, L. E., Escarfuller, J., Pratt, C., Truesdale, K. P., & Stevens, J. (2018). Effect of a behavioral intervention for underserved preschool-age children on change in body mass index: A randomized clinical trial. *JAMA - Journal of the American Medical Association*, *320*(5), 450–460. <https://doi.org/10.1001/jama.2018.9128>
- Blake-Lamb, T. L., Locks, L. M., Perkins, M. E., Woo Baidal, J. A., Cheng, E. R., & Taveras, E. M. (2016). Interventions for Childhood Obesity in the First 1,000 Days A Systematic Review. *American Journal of Preventive Medicine*, *50*(6), 780–789. <https://doi.org/10.1016/j.amepre.2015.11.010>
- Bocca, G., Corpeleijn, E., Stolk, R. P., & Sauer, P. J. J. (2012). Results of a multidisciplinary treatment program in 3-year-old to 5-year-old overweight or obese children: a randomized controlled clinical trial. *Archives of Pediatrics & Adolescent Medicine*, *166*(12), 1109–1115. <https://doi.org/10.1001/archpediatrics.2012.1638>
- Bocca, G., Corpeleijn, E., van den Heuvel, E. R., Stolk, R. P., & Sauer, P. J. J. (2014). Three-year follow-up of 3-year-old to 5-year-old children after participation in a multidisciplinary or a usual-care obesity treatment program. *Clinical Nutrition (Edinburgh, Scotland)*, *33*(6), 1095–1100. <https://doi.org/10.1016/j.clnu.2013.12.002>
- Bonis, M., Loftin, M., Ward, D., Tseng, T. S., Clesi, A., & Sothorn, M. (2014). Improving physical activity in daycare interventions. *Childhood Obesity (Print)*, *10*(4), 334–341. <https://doi.org/10.1089/chi.2014.0040>
- Bradshaw, P., & Hinchliffe, S. (2018). *Growing up in scotland: overweight and obesity at age 10*. 23–65.
- British Dental Journal. (2018). SOFT DRINKS LEVY: Sugar tax now in place. In *British Dental Journal* (Vol. 224, Issue 8, pp. 565–566). Nature Publishing Group. <https://doi.org/10.1038/sj.bdj.2018.323>
- Brown, T., Moore, T., Hooper, L., Gao, Y., Zayegh, A., Ijaz, S., Elwenspoek, M., Foxen, S., Magee, L., O'Malley, C., Waters, E., & Summerbell, C. (2019). Interventions for preventing obesity in

- children. *Sao Paulo Medical Journal*, 7. <https://doi.org/10.1002/14651858.CD001871>
- Campbell, K. J., Lioret, S., McNaughton, S. A., Crawford, D. A., Salmon, J., Ball, K., McCallum, Z., Gerner, B. E., Spence, A. C., Cameron, A. J., Hnatiuk, J. A., Ukoumunne, O. C., Gold, L., Abbott, G., & Hesketh, K. D. (2013). A parent-focused intervention to reduce infant obesity risk behaviors: a randomized trial. *Pediatrics*, 131(4), 652–660. <https://doi.org/10.1542/peds.2012-2576>
- Castle, A. (2015). *SPICe Briefing: Obesity in Scotland* (Issue 15/01). http://www.parliament.scot/ResearchBriefingsAndFactsheets/S4/SB_15-01_Obesity_in_Scotland.pdf
- Chatterji, M., Green, L. W., & Kumanyika, S. (2014). L.E.A.D.: a framework for evidence gathering and use for the prevention of obesity and other complex public health problems. *Health Education & Behavior: The Official Publication of the Society for Public Health Education*, 41(1), 85–99. <https://doi.org/10.1177/1090198113490726>
- Cheong, C., Dean, L., Dougall, I., Hinchliffe, S., Mirani, K., Vosnaki, K., & Wilson, V. (2019). *The Scottish Health Survey. 2018 Edition. Volume 1. Main Report*.
- Cnattingius, S., Villamor, E., Lagerros, Y. T., Wikström, A. K., & Granath, F. (2012). High birth weight and obesity—a vicious circle across generations. *International Journal of Obesity*, 36(10), 1320–1324. <https://doi.org/10.1038/ijo.2011.248>
- Critical Appraisal Skills Programme. (2018). *CASP Checklist: 11 questions to help you make sense of a Randomised Controlled Trial*. <https://casp-uk.net/wp-content/uploads/2018/01/CASP-Randomised-Controlled-Trial-Checklist-2018.pdf>
- Daniels, L. A., Mallan, K. M., Battistutta, D., Nicholson, J. M., Perry, R., & Magarey, A. (2012). Evaluation of an intervention to promote protective infant feeding practices to prevent childhood obesity: outcomes of the NOURISH RCT at 14 months of age and 6 months post the first of two intervention modules. *International Journal of Obesity (2005)*, 36(10), 1292–1298. <https://doi.org/10.1038/ijo.2012.96>
- Daniels, Lynne Allison, Mallan, K. M., Nicholson, J. M., Battistutta, D., & Magarey, A. (2013). Outcomes of an early feeding practices intervention to prevent childhood obesity. *Pediatrics*, 132(1), e109-18. <https://doi.org/10.1542/peds.2012-2882>
- Daniels, Lynne Allison, Mallan, K. M., Nicholson, J. M., Thorpe, K., Nambiar, S., Mauch, C. E., & Magarey, A. (2015). An Early Feeding Practices Intervention for Obesity Prevention. *Pediatrics*, 136(1), e40-9. <https://doi.org/10.1542/peds.2014-4108>
- De Bock, F., Breitenstein, L., & Fischer, J. E. (2012). Positive impact of a pre-school-based nutritional intervention on children's fruit and vegetable intake: results of a cluster-randomized trial. *Public Health Nutrition*, 15(3), 466–475. <https://doi.org/10.1017/S136898001100200X>
- De Coen, V., De Bourdeaudhuij, I., Vereecken, C., Verbestel, V., Haerens, L., Huybrechts, I., Van Lippevelde, W., & Maes, L. (2012). Effects of a 2-year healthy eating and physical activity intervention for 3-6-year-olds in communities of high and low socio-economic status: the POP (Prevention of Overweight among Pre-school and school children) project. *Public Health Nutrition*, 15(9), 1737–1745. <https://doi.org/10.1017/S1368980012000687>

- De Meester, F., Van Lenthe, F. J., Spittaels, H., Lien, N., & De Bourdeaudhuij, I. (2009). Interventions for promoting physical activity among European teenagers: a systematic review. *International Journal of Behavioral Nutrition and Physical Activity*, 6(6). <https://doi.org/10.1186/1479-5868-6-82>
- DiCicco-Bloom, B., & Crabtree, B. F. (2006). Making sense of qualitative research: The qualitative research interview. *Medical Education*, 40(4), 314–321. <https://doi.org/10.1111/j.1365-2929.2006.02418.x>
- Dobbins, M. (2017). *Rapid Review Guidebook*.
<https://www.nccmt.ca/uploads/media/media/0001/01/a816af720e4d587e13da6bb307df8c907a5dff9a.pdf%0Ahttp://www.nccmt.ca/uploads/media/media/0001/01/a816af720e4d587e13da6bb307df8c907a5dff9a.pdf>
- Doring, N., Ghaderi, A., Bohman, B., Heitmann, B. L., Larsson, C., Berglind, D., Hansson, L., Sundblom, E., Magnusson, M., Blennow, M., Tynelius, P., Forsberg, L., & Rasmussen, F. (2016). Motivational Interviewing to Prevent Childhood Obesity: A Cluster RCT. *Pediatrics*, 137(5). <https://doi.org/10.1542/peds.2015-3104>
- Doring, N., Hansson, L. M., Andersson, E. S., Bohman, B., Westin, M., Magnusson, M., Larsson, C., Sundblom, E., Willmer, M., Blennow, M., Heitmann, B. L., Forsberg, L., Wallin, S., Tynelius, P., Ghaderi, A., & Rasmussen, F. (2014). Primary prevention of childhood obesity through counselling sessions at Swedish child health centres: design, methods and baseline sample characteristics of the PRIMROSE cluster-randomised trial. *BMC Public Health*, 14, 335. <https://doi.org/10.1186/1471-2458-14-335>
- Egger, G., Pearson, S., Pal, S., & Swinburn, B. (2007). Dissecting obesogenic behaviours: The development and application of a test battery for targeting prescription for weight loss. In *Obesity Reviews* (Vol. 8, Issue 6, pp. 481–486). <https://doi.org/10.1111/j.1467-789X.2007.00395.x>
- Evans, C. (2017). Analysing Semi-Structured Interviews Using Thematic Analysis: Exploring Voluntary Civic Participation Among Adults. *Analysing Semi-Structured Interviews Using Thematic Analysis: Exploring Voluntary Civic Participation Among Adults*.
<https://doi.org/10.4135/9781526439284>
- Ferreira, I., Van Der Horst, K., Wendel-Vos, W., Kremers, S., Van Lenthe, F. J., & Brug, J. (2007). Environmental correlates of physical activity in youth - A review and update. In *Obesity Reviews* (Vol. 8, Issue 2, pp. 129–154). <https://doi.org/10.1111/j.1467-789X.2006.00264.x>
- Fisher, J. O., Serrano, E. L., Foster, G. D., Hart, C. N., Davey, A., Bruton, Y. P., Kilby, L., Harnack, L., Ruth, K. J., Kachurak, A., Lawman, H. G., Martin, A., & Polonsky, H. M. (2019a). Title: efficacy of a food parenting intervention for mothers with low income to reduce preschooler's solid fat and added sugar intakes: a randomized controlled trial. *The International Journal of Behavioral Nutrition and Physical Activity*, 16(1), 6. <https://doi.org/10.1186/s12966-018-0764-3>
- Fitzgibbon, M. L., Stolley, M. R., Dyer, A. R., VanHorn, L., & KauferChristoffel, K. (2002). A community-based obesity prevention program for minority children: Rationale and study design for Hip-Hop to Health Jr. *Preventive Medicine*, 34(2), 289–297. <https://doi.org/10.1006/pmed.2001.0977>

- Fitzgibbon, M. L., Stolley, M. R., Schiffer, L. A., Braunschweig, C. L., Gomez, S. L., Van Horn, L., & Dyer, A. R. (2011). Hip-Hop to Health Jr. Obesity Prevention Effectiveness Trial: postintervention results. *Obesity (Silver Spring, Md.)*, *19*(5), 994–1003. <https://doi.org/10.1038/oby.2010.314>
- Fullen, B. M., Baxter, G. D., O'Donovan, B. G. G., Doody, C., Daly, L., & Hurley, D. A. (2008). Doctors' attitudes and beliefs regarding acute low back pain management: A systematic review. *Pain*, *136*(3), 388–396. <https://doi.org/10.1016/j.pain.2008.01.003>
- Grant, M. J., & Booth, A. (2009). A typology of reviews: An analysis of 14 review types and associated methodologies. *Health Information and Libraries Journal*, *26*(2), 91–108. <https://doi.org/10.1111/j.1471-1842.2009.00848.x>
- Haines, J., Douglas, S., Mirotta, J. A., O'Kane, C., Breau, R., Walton, K., Krystia, O., Chamoun, E., Annis, A., Darlington, G. A., Buchholz, A. C., Duncan, A. M., Vallis, L. A., Spriet, L. L., Mutch, D. M., Brauer, P., Allen-Vercoe, E., Taveras, E. M., & Ma, D. W. L. (2018). Guelph Family Health Study: pilot study of a home-based obesity prevention intervention. *Canadian Journal of Public Health = Revue Canadienne de Sante Publique*, *109*(4), 549–560. <https://doi.org/10.17269/s41997-018-0072-3>
- Handel, M. N., Larsen, S. C., Rohde, J. F., Stougaard, M., Olsen, N. J., & Heitmann, B. L. (2017). Effects of the Healthy Start randomized intervention trial on physical activity among normal weight preschool children predisposed to overweight and obesity. *PloS One*, *12*(10), e0185266. <https://doi.org/10.1371/journal.pone.0185266>
- Healthy Eating Research. (2016). *The Impact of the First 1,000 Days on Childhood Obesity*. https://healthyeatingresearch.org/wp-content/uploads/2016/03/her_1000_days_final-1.pdf
- Helle, C., Hillesund, E. R., Wills, A. K., & Overby, N. C. (2019). Evaluation of an eHealth intervention aiming to promote healthy food habits from infancy -the Norwegian randomized controlled trial Early Food for Future Health. *The International Journal of Behavioral Nutrition and Physical Activity*, *16*(1), 1. <https://doi.org/10.1186/s12966-018-0763-4>
- Helle, C., Hillesund, E. R., Wills, A. K., & Øverby, N. C. (2019). Evaluation of an eHealth intervention aiming to promote healthy food habits from infancy -the Norwegian randomized controlled trial Early Food for Future Health. *International Journal of Behavioral Nutrition and Physical Activity*, *16*(1). <https://doi.org/10.1186/s12966-018-0763-4>
- Iaia, M., Pasini, M., Burnazzi, A., Vitali, P., Allara, E., & Farneti, M. (2017). An educational intervention to promote healthy lifestyles in preschool children: a cluster-RCT. *International Journal of Obesity (2005)*, *41*(4), 582–590. <https://doi.org/10.1038/ijo.2016.239>
- Information Services Division. (n.d.). *Publications Child Health*. Retrieved October 29, 2019, from <https://www.isdscotland.org/Health-Topics/Child-Health/Publications/>
- Information Services Division. (2017). *Body Mass Index of Primary 1 Children in Scotland. School Year 2016/17*. <https://www.isdscotland.org/Health-Topics/Child-Health/Publications/2017-12-12/2017-12-12-P1-BMI-Statistics-Publication-Report.pdf>
- ISD Scotland. (2019). *Body Mass Index of Primary 1 Children in Scotland: School Year 2018/19*. <https://www.statisticsauthority.gov.uk/national-statistician/types-of-official-statistics/>

- Johnson, B. J., Hendrie, G. A., & Golley, R. K. (2015). *Reducing discretionary food and beverage intake in early childhood: a systematic review within an ecological framework*.
<https://doi.org/10.1017/S1368980015002992>
- Jouret, B., Ahluwalia, N., Dupuy, M., Cristini, C., Negre-Pages, L., Grandjean, H., & Tauber, M. (2009). Prevention of overweight in preschool children: results of kindergarten-based interventions. *International Journal of Obesity (2005)*, 33(10), 1075–1083.
<https://doi.org/10.1038/ijo.2009.166>
- Katz, D. L., O'Connell, M., Njike, V. Y., Yeh, M. C., & Nawaz, H. (2008). Strategies for the prevention and control of obesity in the school setting: Systematic review and meta-analysis. In *International Journal of Obesity* (Vol. 32, Issue 12, pp. 1780–1789).
<https://doi.org/10.1038/ijo.2008.158>
- Kothandan, S. K. (2014). School based interventions versus family based interventions in the treatment of childhood obesity- a systematic review. *Archives of Public Health*, 72(1).
<https://doi.org/10.1186/2049-3258-72-3>
- Lumeng, J. C., Miller, A. L., Horodyski, M. A., Brophy-Herb, H. E., Contreras, D., Lee, H., Sturza, J., Kaciroti, N., & Peterson, K. E. (2017). Improving Self-Regulation for Obesity Prevention in Head Start: A Randomized Controlled Trial. *Pediatrics*, 139(5). <https://doi.org/10.1542/peds.2016-2047>
- Martin, L., & Greci, S. (2019). *Summary of highly processed evidence on components of effective weight management interventions for children and young people This resource may also be made available*.
- Maternal and Early Years. (2013). *Health Improvement, Efficiency, Access and Treatment (HEAT) Targets - Maternal and Early Years*. <http://www.maternal-and-early-years.org.uk/health-improvement-efficiency-access-and-treatment-heat-targets>
- McGowan, L., Cooke, L. J., Gardner, B., Beeken, R. J., Croker, H., & Wardle, J. (2013). Healthy feeding habits: efficacy results from a cluster-randomized, controlled exploratory trial of a novel, habit-based intervention with parents. *The American Journal of Clinical Nutrition*, 98(3), 769–777. <https://doi.org/10.3945/ajcn.112.052159>
- Methley, A. M., Campbell, S., Chew-Graham, C., McNally, R., & Cheraghi-Sohi, S. (2014). PICO, PICOS and SPIDER: A comparison study of specificity and sensitivity in three search tools for qualitative systematic reviews. In *BMC Health Services Research* (Vol. 14, Issue 1). BioMed Central Ltd. <https://doi.org/10.1186/s12913-014-0579-0>
- Mirota, J. A., Darlington, G. A., Buchholz, A. C., Haines, J., Ma, D. W. L., & Duncan, A. M. (2018). Guelph Family Health Study's Home-Based Obesity Prevention Intervention Increases Fibre and Fruit Intake in Preschool-Aged Children. *Canadian Journal of Dietetic Practice and Research : A Publication of Dietitians of Canada = Revue Canadienne de La Pratique et de La Recherche En Dietetique : Une Publication Des Dietetistes Du Canada*, 79(2), 86–90.
<https://doi.org/10.3148/cjdpr-2017-036>
- Moher, D; Liberati, A; Tetzlaff, J., & Altman, D. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement... Preferred Reporting Items for Systematic reviews and Meta-Analyses. *International Journal of Surgery*, 8(5), 336–341.

<https://doi.org/10.1016/j.ijisu.2010.02.007>

- Moir, C., Meredith-Jones, K., Taylor, B. J., Gray, A., Heath, A.-L. M., Dale, K., Galland, B., Lawrence, J., Sayers, R. M., & Taylor, R. W. (2016). Early Intervention to Encourage Physical Activity in Infants and Toddlers: A Randomized Controlled Trial. *Medicine and Science in Sports and Exercise*, 48(12), 2446–2453. <https://doi.org/10.1249/MSS.0000000000001055>
- Mustila, T., Raitanen, J., Keskinen, P., & Luoto, R. (2018). A pragmatic controlled trial to prevent childhood obesity within a risk group at maternity and child health-care clinics: results up to six years of age (the VACOPP study). *BMC Pediatrics*, 18(1), 89. <https://doi.org/10.1186/s12887-018-1065-3>
- Natale, R. A., Lopez-Mitnik, G., Uhlhorn, S. B., Asfour, L., & Messiah, S. E. (2014). Effect of a child care center-based obesity prevention program on body mass index and nutrition practices among preschool-aged children. *Health Promotion Practice*, 15(5), 695–705. <https://doi.org/10.1177/1524839914523429>
- Natale, R. A., Messiah, S. E., Asfour, L., Uhlhorn, S. B., Delamater, A., & Arheart, K. L. (2014). Role modeling as an early childhood obesity prevention strategy: effect of parents and teachers on preschool children's healthy lifestyle habits. *Journal of Developmental and Behavioral Pediatrics: JDBP*, 35(6), 378–387. <https://doi.org/10.1097/DBP.0000000000000074>
- NHS Health Scotland. (2019). *Standards for the delivery of tier 2 and tier 3 weight management services for children and young people in Scotland*.
- NHS Lothian. (n.d.). *Get Going*. Retrieved January 2, 2020, from <https://www.nhslothian.scot.nhs.uk/getgoing/>
- Nieuwendyk, L. M., Belon, A. P., Vallianatos, H., Raine, K. D., Schopflocher, D., Spence, J. C., Plotnikoff, R. C., & Nykiforuk, C. I. (2016). How perceptions of community environment influence health behaviours: Using the analysis grid for environments linked to obesity framework as a mechanism for exploration. *Health Promotion and Chronic Disease Prevention in Canada*, 36(9), 175–184. <https://doi.org/10.24095/hpcdp.36.9.01>
- Nystrom, C. D., Sandin, S., Henriksson, P., Henriksson, H., Trolle-Lagerros, Y., Larsson, C., Maddison, R., Ortega, F. B., Pomeroy, J., Ruiz, J. R., Silfvernagel, K., Timpka, T., & Lof, M. (2017). Mobile-based intervention intended to stop obesity in preschool-aged children: the MINISTOP randomized controlled trial. *The American Journal of Clinical Nutrition*, 105(6), 1327–1335. <https://doi.org/10.3945/ajcn.116.150995>
- Obesity Action Scotland. (n.d.). *About Us*. Retrieved September 5, 2019, from <https://www.obesityactionscotland.org/about-us>
- Obesity Action Scotland. (2019a). *Nearly a quarter of children start school while being at risk of overweight or obesity*. <https://www.obesityactionscotland.org/blog/nearly-a-quarter-of-children-start-school-while-being-at-risk-of-overweight-or-obesity/>
- Obesity Action Scotland. (2019b). *Protecting our Children: How do we meet the childhood obesity 2030 target in Scotland?* <https://www.obesityactionscotland.org/blog/protecting-our-children-how-do-we-meet-the-childhood-obesity-2030-target-in-scotland>
- Ostbye, T., Krause, K. M., Stroo, M., Lovelady, C. A., Evenson, K. R., Peterson, B. L., Bastian, L. A.,

- Swamy, G. K., West, D. G., Brouwer, R. J. N., & Zucker, N. L. (2012). Parent-focused change to prevent obesity in preschoolers: results from the KAN-DO study. *Preventive Medicine, 55*(3), 188–195. <https://doi.org/10.1016/j.ypmed.2012.06.005>
- Parkes, A., Sweeting, H., & Wight, D. (2012). *GROWING UP IN SCOTLAND : Overweight , obesity and activity*. <http://www.scotland.gov.uk/Resource/0039/00392688.pdf>
- Paul, I. M., Savage, J. S., Anzman-Frasca, S., Marini, M. E., Beiler, J. S., Hess, L. B., Loken, E., & Birch, L. L. (2018a). Effect of a Responsive Parenting Educational Intervention on Childhood Weight Outcomes at 3 Years of Age: The INSIGHT Randomized Clinical Trial. *JAMA, 320*(5), 461–468. <https://doi.org/10.1001/jama.2018.9432>
- Pringle, J., Doi, L., Jindal-Snape, D., Jepson, R., & McAteer, J. (2018). Adolescents and health-related behaviour: using a framework to develop interventions to support positive behaviours. *Pilot and Feasibility Studies, 4*(1), 69. <https://doi.org/10.1186/s40814-018-0259-7>
- Reifsnider, E., McCormick, D. P., Cullen, K. W., Szalacha, L., Moramarco, M. W., Diaz, A., & Reyna, L. (2013). A randomized controlled trial to prevent childhood obesity through early childhood feeding and parenting guidance: rationale and design of study. *BMC Public Health, 13*, 880. <https://doi.org/10.1186/1471-2458-13-880>
- Reifsnider, E., McCormick, D. P., Cullen, K. W., Todd, M., Moramarco, M. W., Gallagher, M. R., & Reyna, L. (2018). Randomized Controlled Trial to Prevent Infant Overweight in a High-Risk Population. *Academic Pediatrics, 18*(3), 324–333. <https://doi.org/10.1016/j.acap.2017.12.007>
- Rifas-Shiman, S. L., Taveras, E. M., Gortmaker, S. L., Hohman, K. H., Horan, C. M., Kleinman, K. P., Mitchell, K., Price, S., Prosser, L. A., & Gillman, M. W. (2017). Two-year follow-up of a primary care-based intervention to prevent and manage childhood obesity: the High Five for Kids study. *Pediatric Obesity, 12*(3), e24–e27. <https://doi.org/10.1111/ijpo.12141>
- Rohde, J. F., Larsen, S. C., Angquist, L., Olsen, N. J., Stougaard, M., Mortensen, E. L., & Heitmann, B. L. (2017). Effects of the Healthy Start randomized intervention on dietary intake among obesity-prone normal-weight children. *Public Health Nutrition, 20*(16), 2988–2997. <https://doi.org/10.1017/S1368980017002026>
- Rose, S., Spinks, N., & Canhoto, A. I. (2015). An introduction to using Microsoft Excel for quantitative data analysis. In *Management Research: Applying the Principles* (pp. 1–16).
- Roth, K., Kriemler, S., Lehmacher, W., Ruf, K. C., Graf, C., & Hebestreit, H. (2015). Effects of a Physical Activity Intervention in Preschool Children. *Medicine and Science in Sports and Exercise, 47*(12), 2542–2551. <https://doi.org/10.1249/MSS.0000000000000703>
- Ryan, F., Coughlan, M., & Cronin, P. (2009). Interviewing in qualitative research: The one-to-one interview. *International Journal of Therapy and Rehabilitation, 16*(6), 309–314. <https://doi.org/10.12968/ijtr.2009.16.6.42433>
- Scarborough, P., Bhatnagar, P., Wickramasinghe, K. K., Allender, S., Foster, C., & Rayner, M. (2011). The economic burden of ill health due to diet, physical inactivity, smoking, alcohol and obesity in the UK: An update to 2006-07 NHS costs. *Journal of Public Health, 33*(4), 527–535. <https://doi.org/10.1093/pubmed/fdr033>
- Schroeder, N., Rushovich, B., Bartlett, E., Sharma, S., Gittelsohn, J., & Caballero, B. (2015). Early

- Obesity Prevention: A Randomized Trial of a Practice-Based Intervention in 0-24-Month Infants. *Journal of Obesity*, 2015, 795859. <https://doi.org/10.1155/2015/795859>
- Scottish Cancer Prevention Network. (2019). *New alliance launches to tackle obesity in Scotland*. <https://www.cancerpreventionscotland.org.uk/newsletter/new-alliance-launches-to-tackle-obesity-in-scotland/>
- Scottish Government. (2019a). *Making school food healthier*. <https://www.gov.scot/news/making-school-food-healthier/>
- Scottish Government. (2019b). *Poverty & income inequality in Scotland: 2015-18. March*. <https://www.gov.scot/publications/poverty-income-inequality-scotland-2015-18/>
- Scottish Government. (2019c). The Scottish Health Survey. In *2018 edition* (Vol. 1). <https://doi.org/10.4135/978144627305013501440>
- Simmons, A., Mavoa, H. M., Bell, A. C., De Courten, M., Schaaf, D., Schultz, J., & Swinburn, B. A. (2009). Creating community action plans for obesity prevention using the ANGELO (Analysis Grid for Elements Linked to Obesity) Framework. *Health Promotion International*, 24(4), 311–324. <https://doi.org/10.1093/heapro/dap029>
- Skouteris, H., Hill, B., McCabe, M., Swinburn, B., & Busija, L. (2016). A parent-based intervention to promote healthy eating and active behaviours in pre-school children: evaluation of the MEND 2-4 randomized controlled trial. *Pediatric Obesity*, 11(1), 4–10. <https://doi.org/10.1111/ijpo.12011>
- Spence, A. C., McNaughton, S. A., Lioret, S., Hesketh, K. D., Crawford, D. A., & Campbell, K. J. (2013). A health promotion intervention can affect diet quality in early childhood. *The Journal of Nutrition*, 143(10), 1672–1678. <https://doi.org/10.3945/jn.113.177931>
- Stark, L. J., Spear Filigno, S., Bolling, C., Ratcliff, M. B., Kichler, J. C., Robson, S. M., Simon, S. L., McCullough, M. B., Clifford, L. M., Odar Stough, C., Zion, C., & Ittenbach, R. F. (2018). Clinic and Home-Based Behavioral Intervention for Obesity in Preschoolers: A Randomized Trial. *The Journal of Pediatrics*, 192, 115-121.e1. <https://doi.org/10.1016/j.jpeds.2017.09.063>
- Stoll, C. R. T., Izadi, S., Fowler, S., Green, P., Suls, J., & Colditz, G. A. (2019). The value of a second reviewer for study selection in systematic reviews. *Research Synthesis Methods*, jrsm.1369. <https://doi.org/10.1002/jrsm.1369>
- Swinburn, B., Gill, T., & Kumanyika, S. (2005). Obesity prevention: A proposed framework for translating evidence into action. *Obesity Reviews*, 6(1), 23–33. <https://doi.org/10.1111/j.1467-789X.2005.00184.x>
- Swinburn, Boyd, Egger, G., & Raza, F. (1999). Dissecting Obesogenic Environments: The Development and Application of a Framework for Identifying and Prioritizing Environmental Interventions for Obesity 1. In *Preventive Medicine* (Vol. 29). <http://www.idealibrary.comon>
- Taveras, E. M. (2016). Childhood Obesity Risk and Prevention: Shining a Lens on the First 1000 Days. *Childhood Obesity*, 12(3), 159–161. <https://doi.org/10.1089/chi.2016.0088>
- Taveras, E. M., Gortmaker, S. L., Hohman, K. H., Horan, C. M., Kleinman, K. P., Mitchell, K., Price, S., Prosser, L. A., Rifas-Shiman, S. L., & Gillman, M. W. (2011). Randomized controlled trial to improve primary care to prevent and manage childhood obesity: the High Five for Kids study. *Archives of Pediatrics & Adolescent Medicine*, 165(8), 714–722.

<https://doi.org/10.1001/archpediatrics.2011.44>

- Taylor, R. W., Gray, A. R., Heath, A. L. M., Galland, B. C., Lawrence, J., Sayers, R., Healey, D., Tannock, G. W., Meredith-Jones, K. A., Hanna, M., Hatch, B., & Taylor, B. J. (2018b). Sleep, nutrition, and physical activity interventions to prevent obesity in infancy: Follow-up of the Prevention of Overweight in Infancy (POI) randomized controlled trial at ages 3.5 and 5 y. *American Journal of Clinical Nutrition*, *108*(2), 228–236. <https://doi.org/10.1093/ajcn/nqy090>
- The Scottish Government. (2018). *A Healthier Future - Scotland's Diet & Healthy Weight Delivery Plan*. <https://www.gov.scot/binaries/content/documents/govscot/publications/strategy-plan/2018/07/healthier-future-scotlands-diet-healthy-weight-delivery-plan/documents/00537708-pdf/00537708-pdf/govscot%3Adocument/00537708.pdf>
- University of Cambridge. (n.d.). *Does my study need ethical approval?* Retrieved from <https://www.bio.cam.ac.uk/psyres/approval>
- Van Der Horst, K., Oenema, A., Ferreira, I., Wendel-Vos, W., Giskes, K., Van Lenthe, F., & Brug, J. (2007). A systematic review of environmental correlates of obesity-related dietary behaviors in youth. *Health Education Research*, *22*(2), 203–226. <https://doi.org/10.1093/her/cyl069>
- van Grieken, A., Renders, C. M., Veldhuis, L., Looman, C. W., Hirasing, R. A., & Raat, H. (2014). Promotion of a healthy lifestyle among 5-year-old overweight children: health behavior outcomes of the “Be active, eat right” study. *BMC Public Health*, *14*, 59. <https://doi.org/10.1186/1471-2458-14-59>
- van Grieken, A., Vlasblom, E., Wang, L., Beltman, M., Boere-Boonekamp, M. M., L'Hoir, M. P., & Raat, H. (2017). Personalized Web-Based Advice in Combination With Well-Child Visits to Prevent Overweight in Young Children: Cluster Randomized Controlled Trial. *Journal of Medical Internet Research*, *19*(7), e268. <https://doi.org/10.2196/jmir.7115>
- Verbestel, V., De Coen, V., Van Winckel, M., Huybrechts, I., Maes, L., & De Bourdeaudhuij, I. (2014). Prevention of overweight in children younger than 2 years old: a pilot cluster-randomized controlled trial. *Public Health Nutrition*, *17*(6), 1384–1392. <https://doi.org/10.1017/S1368980013001353>
- Vine, M. M., & Elliott, S. J. (2014). Exploring the School Nutrition Policy Environment in Canada Using the ANGELO Framework. *Health Promotion Practice*, *15*(3), 331–339. <https://doi.org/10.1177/1524839913498087>
- Waffenschmidt, S., Knelangen, M., Sieben, W., Bühn, S., & Pieper, D. (2019). Single screening versus conventional double screening for study selection in systematic reviews: a methodological systematic review. *BMC Medical Research Methodology*, *19*(1), 132. <https://doi.org/10.1186/s12874-019-0782-0>
- Wen, L. M., Baur, L. A., Simpson, J. M., Rissel, C., Wardle, K., & Flood, V. M. (2012). Effectiveness of home based early intervention on children's BMI at age 2: randomised controlled trial. *BMJ (Clinical Research Ed.)*, *344*, e3732. <https://doi.org/10.1136/bmj.e3732>
- Wen, L. M., Baur, L. A., Simpson, J. M., Xu, H., Hayes, A. J., Hardy, L. L., Williams, M., & Rissel, C. (2015). Sustainability of Effects of an Early Childhood Obesity Prevention Trial Over Time: A Further 3-Year Follow-up of the Healthy Beginnings Trial. *JAMA Pediatrics*, *169*(6), 543–551.

<https://doi.org/10.1001/jamapediatrics.2015.0258>

- Wendel-Vos, W., Droomers, M., Kremers, S., Brug, J., & Van Lenthe, F. (2007). Potential environmental determinants of physical activity in adults: A systematic review. *Obesity Reviews*, 8(5), 425–440. <https://doi.org/10.1111/j.1467-789X.2007.00370.x>
- Wight, D., Wimbush, E., Jepson, R., & Doi, L. (2016). Six steps in quality intervention development (6SQulD). *J Epidemiol Community Health*, 70. <https://doi.org/10.1136/jech-2015-205952>
- Woo Baidal, J. A., Locks, L. M., Cheng, E. R., Blake-Lamb, T. L., Perkins, M. E., & Taveras, E. M. (2016). Risk Factors for Childhood Obesity in the First 1,000 Days: A Systematic Review. *American Journal of Preventive Medicine*, 50(6), 761–779. <https://doi.org/10.1016/j.amepre.2015.11.012>
- World Health Organization. (2012). *Prioritizing areas for action in the field of population-based prevention of childhood obesity*. <http://www.who.int/about/licensing/>
- Zask, A., Adams, J. K., Brooks, L. O., & Hughes, D. F. (2012). Tooty Fruity Veggie: an obesity prevention intervention evaluation in Australian preschools. *Health Promotion Journal of Australia : Official Journal of Australian Association of Health Promotion Professionals*, 23(1), 10–15.

Appendix 1: Search strategy

Search step	Search term	Field searches
#1*	Preschool OR pre-schooler OR infant OR baby OR newborn OR infancy OR toddler OR babyhood OR youngster OR young children OR pregnancy OR first 1000 days OR prenatal	Title/abstract
#2*	Obesity OR overweight OR body weight	Title/abstract
#3*	Prevention OR follow-up OR intervention	Title/abstract
#4	#1 AND #2 AND #3	
#5	Limit to publication 10 years	
#6	Limit to English language	
#7	Limit to human species	
#8	Limit to ages: infant (birth – 23 months), preschool child (2 – 5 years)	
#9	Limit to RCTs	

* These steps were searched for MeSH terms

Appendix 2: CASP to assess study quality

CASP Questions*												
#	Study	1	2	3	4	5	6	7	8	9	10	11
1	Nutrition and physical activity randomized control trial in child care centers improves knowledge, policies, and children's body mass index (Alkon et al., 2014)	Yes	Yes	Yes	Can't tell. It is only stated that the research assistants were blinded.	No. The intervention and control centres demographic data were significantly different in various aspects. Data was controlled for state, parent education, and poverty level.	Yes	No significant changes in PA levels and children's nutrition. There were changes in child-level in children's BMIz in the intervention and control centres at both pre- and post-intervention time points, but there were no significant changes in BMIz between the intervention and control group.	CI 95%	Yes	No. Diet and PA level of the children were not assessed.	No. There were no significant positive changes in the intervention group.
2	Effects of a Cognitive–Behaviorally Based Physical Activity Treatment for 4- and 5-Year-Old Children Attending US Preschools (Annesi, Smith, & Tennant,	Yes	Yes	Yes	No	Can't tell. This was not stated.	Yes	A significantly greater percentage of the preschool day in MVPA and vigorous PA, with sedentary time unaffected. The treatment was also associated with a significant Reduction in BMI, with effect sizes greatest in overweight and obese children.	CI was not stated.	Can't tell. Participants were mostly African American women/children in low-income communities in the USA.	Yes	Yes. There were no harms and significant positive effects in the intervention group.

CASP Questions*												
#	Study	1	2	3	4	5	6	7	8	9	10	11
	2013a)											
3	Effects of the Start For Life treatment on physical activity in primarily African American preschool children of ages 3-5 years. (Annesi, Smith, & Tennant, 2013b)	Yes	Yes	Yes	No	Yes	Yes	Changes in MVPA and vigorous PA were significant, and significantly more in the Start For Life group.	CI was not stated.	Can't tell. Participants were mostly African American women/children in low-income communities in the USA.	No. BMI was measured at baseline, but change in BMI was not reported after the intervention	Yes. There were no harms and significant positive effects in the intervention group
4	Effect of a Behavioral Intervention for Underserved Preschool-Age Children on Change in Body Mass Index: A Randomized Clinical Trial.	Yes	Yes	Yes	Yes	Yes	Yes	There was no significant difference in BMI after the intervention. The intervention group children had a lower mean caloric intake compared with the control group. There were no significant intervention effects on	CI 95%	Can't tell. Participants were mostly African American women/children in low-income communi	Yes	Yes. There were no harms and significant positive effects in the intervention group

CASP Questions*												
#	Study	1	2	3	4	5	6	7	8	9	10	11
	(Barkin et al., 2018)							MVPA.		ties in the USA.		
5	Results of a multidisciplinary treatment program in 3-year-old to 5-year-old overweight or obese children: a randomized controlled clinical trial. (Bocca, Corpeleijn, Stolk, & Sauer, 2012)	Yes	Yes	Yes	Can't tell. This was not stated.	Yes	Yes	Children in the intervention group showed a greater decrease in BMI after the treatment program and after 12 month follow-up, compared with the control group.	CI 95%	Yes	No. Diet and PA level of the children were not assessed although this was a part of the intervention	Yes. There were no harms and significant positive effects in the intervention group
6	Three-year follow-up of 3-year-old to 5-year-old children after participation in a multidisciplinary or a usual-care obesity treatment program. (Bocca, Corpeleijn, van den Heuvel, Stolk, & Sauer, 2014) - 36 months follow-up	Yes	Yes	Yes	Can't tell. This was not stated.	Yes	Yes	During the follow-up period of 36 months, a significant overall treatment effect on a reduction in BMI was present for the multidisciplinary intervention group. There were no statistically significant differences between the groups with respect to energy intake and PA.	CI 95%	Yes	No. Diet and PA level of the children were not assessed although this was a part of the intervention	Yes. There were no harms and significant positive effects in the intervention group
7	Improving	Yes	Yes	Yes	No	Can't tell.	Yes	Total PA in the	CI was	Yes	Yes	Yes. There were

CASP Questions*												
#	Study	1	2	3	4	5	6	7	8	9	10	11
	Physical Activity in Daycare Interventions. (Bonis et al., 2014)					This was not explained.		treatment group was increased by 21.9%, as compared to 4.4% in the control group, significantly increased vigorous PA by 50% in the treatment group compared to 3.8% in the control group, and significantly increased moderate PA by 32.7% in the treatment group compared to 0% in the control group. There were no significant changes in BMI of the intervention and control group.	not stated.			no harms and significant positive effects in the intervention group
8	A parent-focused intervention to reduce infant obesity risk behaviors: a randomized trial. (Campbell et al., 2013)	Yes	Yes	Yes	No	Yes	Yes	No difference in BMI or PA. The intervention group significantly consumed fewer grams of sweet snacks compared with the control group. There was no effect on further diet.	CI 95%	Yes	Yes	Can't tell. There were only small significant positive changes in the intervention group
9	Evaluation of an intervention to promote protective infant feeding practices to prevent childhood obesity:	Yes	Yes	Yes	Can't tell. It was only stated that the study staff who performed the measurements were	Yes	No. The control group had self-directed access to universal communi	86% of the control group infants had a higher zBMI and were more likely to show rapid weight gain from baseline to follow-up.	CI 95%	Yes	Yes	Yes. There were no harms and significant positive effects in the intervention group

CASP Questions*												
#	Study	1	2	3	4	5	6	7	8	9	10	11
	outcomes of the NOURISH RCT at 14 months of age and 6 months post the first of two intervention modules. (Daniels et al., 2012)				blinded		ty child health services, potentially child weighing, and information via the Internet or telephone help line.					
10	Outcomes of an early feeding practices intervention to prevent childhood obesity. (Daniels, Mallan, Nicholson, Battistutta, & Magarey, 2013)	Yes	Yes	Yes	Can't tell. It was only stated that the study staff and researchers were blinded	Yes	No. See above.	At age two, there were no significant differences in BMIz.	CI was not stated.	Yes	Yes	Can't tell. Maybe, since this study was a follow-up of an initial effective study
11	An Early Feeding Practices Intervention for Obesity Prevention. (Daniels et al., 2015)	Yes	Yes	Yes	Can't tell. It was only stated that the study staff and researchers were blinded	Yes	No. See above.	At age five, there were no significant differences in BMIz.	CI was not stated.	Yes	Yes	Can't tell. Maybe, since this study was a follow-up of an initial effective study

CASP Questions*												
#	Study	1	2	3	4	5	6	7	8	9	10	11
12	Positive impact of a pre-school-based nutritional intervention on children's fruit and vegetable intake: results of a cluster-randomized trial. (De Bock, Breitenstein, & Fischer, 2012)	Yes	Yes	Yes	Can't tell. It was only stated that the study staff who performed the measurements were blinded.	Yes	Yes	Children's FV intake increased significantly in the intervention group. There was no significant difference in BMI.	CI was not stated.	Yes	Yes	Yes. There were no harms and significant positive effects in the intervention group
13	Effects of a 2-year healthy eating and physical activity intervention for 3-6-year-olds in communities of high and low socioeconomic status: the POP (Prevention of Overweight among Pre-school and school children) project. (De Coen et al., 2012)	No. There was no information of the control group.	Yes	Yes								
14	Motivational Interviewing to Prevent	Yes	Yes	Yes	No	Yes	Yes	There were no significant differences in children's BMI and	CI 95%	Yes	Yes	No. There were no significant positive changes

CASP Questions*												
#	Study	1	2	3	4	5	6	7	8	9	10	11
	Childhood Obesity: A Cluster RCT (Doring et al., 2016)							children's PA habits. There was a significant intervention effect in consuming less french fries and discretionary calories among children.				in the intervention group
15	Efficacy of a food parenting intervention for mothers with low income to reduce preschooler's solid fat and added sugar intakes: A randomized controlled trial (Fisher et al., 2019)	Yes	Yes	Yes	Can't tell. It was only stated that the study team was blind to treatment allocation prior to randomization and that other study staff were blind to group assignment following randomization. No information about the participants.	Yes	Yes	Children from the intervention group consumed 94 kcal or 23% less daily energy from solid fat and added sugar than children in the control group. There was no significant difference in total daily intake or BMI of the children.	CI 95%	Can't tell. Participants were mostly African American women/children in low-income communities in the USA	Yes	Can't tell. There were only small significant positive changes in the intervention group
16	Hip-Hop to Health Jr. Obesity Prevention Effectiveness Trial: postintervention results (Fitzgibbon et	Yes	Yes	Yes	Can't tell, this was not stated.	No. Children in the intervention group were significantly younger than children in	Yes	There were no significant differences in BMI or dietary intake between groups after the intervention. Children in the intervention schools were engaged in more MVPA than children	CI was not stated.	Yes	Yes	Yes. There were no harms and significant positive effects in the intervention group

CASP Questions*													
#	Study	1	2	3	4	5	6	7	8	9	10	11	
	al., 2011)					the control group. They also weighed less and were shorter, but these differences were no longer significant when adjusted for age.		in the control schools.					
17	Guelph Family Health Study: pilot study of a home-based obesity prevention intervention (Haines et al., 2018)	Yes	Yes	Yes	Can't tell. It was only stated that the staff who conducted the measurements were blinded.	Can't tell. This was not stated.	Yes	Children randomised to the 4HV and 2HV groups had significantly higher fruit intake. No significant effect on other dietary behaviours or PA.	CI 95%	Yes.	No. BMI was measured at baseline, but not after the intervention.	Can't tell. There were only small significant positive changes in the intervention group.	
18	Guelph Family Health Study's Home-Based Obesity Prevention Intervention Increases Fibre and Fruit Intake in Preschool-Aged Children (Mirota et al., 2018)	No.	Yes	Yes									

CASP Questions*													
#	Study	1	2	3	4	5	6	7	8	9	10	11	
19	Effects of the Healthy Start randomized intervention trial on physical activity among normal weight preschool children predisposed to overweight and obesity (Handel et al., 2017)	Yes	Yes	Yes	No	Yes	Yes	The intervention group spent more time on sports and outdoor activities combined per week than the control group, although no significant intervention effects were seen for each of the subcategories (e.g. sports participation and outdoor activities)	CI 95%	Yes	No. BMI of the children was not measured.	Yes. There were no harms and significant positive effects in the intervention group.	
20	Effects of the Healthy Start randomized intervention on dietary intake among obesity-prone normal-weight children (Rohde et al., 2017)	Yes	Yes	Yes	No	Yes	Yes	Children in the intervention group had a significant lower energy intake after the intervention compared with the control group. The intervention group had also lower intakes of carbohydrates and added sugar compared with the control group	CI was not stated.	Yes	BMI of the children was measured at baseline, but was not discussed in the results.	Yes. There were no harms and significant positive effects in the intervention group.	
21	Evaluation of an eHealth intervention aiming to promote healthy food habits from infancy -the Norwegian randomized controlled trial	Yes	Yes	Yes	Can't tell. Allocation was naturally concealed from recruitment by virtue of the e-recruitment strategy.	Yes	Yes	More than 80% of the intervention group reported viewing all/most of the video clips addressing infant feeding topics. Children in the intervention group were served FV more frequently, and had tasted a wider variety	CI was not stated.	Yes	Yes	Yes. There were no harms and significant positive effects in the intervention group.	

CASP Questions*												
#	Study	1	2	3	4	5	6	7	8	9	10	11
	Early Food for Future Health (Helle, Hillesund, Wills, & Øverby, 2019)							of vegetables compared to controls. No difference in BMIz.				
22	An educational intervention to promote healthy lifestyles in preschool children: a cluster-RCT (Iaia et al., 2017)	Yes	Yes	Yes	Can't tell. The participants were blind to which group they were allocated. It is not stated whether the study staff was blinded as well.	Yes	Yes	There were no significant differences in BMIz. Measured was children's combined health behaviour score (CHBS) at home. A significantly higher percentage of children with a low-risk CHBS was found in the intervention group. A higher percentage of intervention in comparison with the control group showed a low-risk score for FV (four or more servings per day) SSB intake. A low-risk score for active playtime was more frequent in intervention children only at 1 year follow up.	CI 95%	Yes	No. PA was not assessed although this was mentioned to be important.	Yes. There were no harms and significant positive effects in the intervention group.
23	Prevention of overweight in preschool children: results of kindergarten-based	Yes	No. Data were retrieved from the	Yes								

CASP Questions*												
#	Study	1	2	3	4	5	6	7	8	9	10	11
	interventions (Jouret et al., 2009)		school medical records.									
24	Improving Self-Regulation for Obesity Prevention in Head Start: A Randomized Controlled Trial. (Lumeng et al., 2017)	Yes	Yes	Can't tell. Families were assigned to a study arm as a function of their classroom assignment, which was based on the location geographically close to their home address.	Can't tell. Data collectors were blinded to study arm. It is not clear whether participants were blinded as well.	No. The groups were not similar for child race/ethnicity	Yes	There was no effect on the prevalence of obesity. There was no effect on other outcomes except for SSB intake (HS+POPS+IYS resulted in a greater decline than HS).	CI 95%	Yes	Yes	No. There were no significant changes in the intervention group.

CASP Questions*												
#	Study	1	2	3	4	5	6	7	8	9	10	11
25	Healthy feeding habits: efficacy results from a cluster-randomized, controlled exploratory trial of a novel, habit-based intervention with parents. (McGowan et al., 2013)	Yes	Yes	Yes	No. Researchers and participants were not blind. However, because randomization occurred at the cluster level, parents in other groups were unaware of the existence of a comparison group.	Yes	Yes	For all parental feeding behaviours, automaticity increased more in the intervention group than in the control group. Significant intervention effects on children's intake of vegetables, healthy snacks, and water were observed. Changes in children's food intake correlated with changes in parental automaticity of feeding behaviours, and program acceptability was high.	CI was not stated.	Yes. The participants were from the UK.	No. BMI of the children was not measured.	Yes. There were no harms and significant positive effects in the intervention group.
26	Early Intervention to Encourage Physical Activity in Infants and Toddlers: A Randomized Controlled Trial. (Moir et al., 2016)	Yes	Yes	Yes	No. The participants were not blinded. Study staff that perform measurements were blinded.	Can't tell. This was not stated.	Yes	Children in the FAB group had significantly higher BMIz scores than did controls at age 5, but not at age 3.5 years. Children who received the Sleep intervention (Sleep and Combination groups) had significantly lower BMIz scores at age 3.5 and 5 years than children who did not (Control and FAB groups). There were no significant	CI 95%	Yes	Yes	No. There were no significant changes in the intervention group

CASP Questions*												
#	Study	1	2	3	4	5	6	7	8	9	10	11
								differences in PA and dietary intake levels of the children between the different intervention groups and the control group at age 3.5. PA and diet outcomes at age 5 were not measured.				
27	Sleep, nutrition, and physical activity interventions to prevent obesity in infancy: Follow-up of the Prevention of Overweight in Infancy in Infancy (POI) randomized controlled trial at ages 3.5 and 5 y. (Taylor et al., 2018a)	Yes	Yes	Yes	No. Participants were not blinded, but study staff that performed the measurements were blinded.	Yes	Yes	See above.	CI 95%	Yes	Yes	No. The FAB intervention group had unexpected adverse outcomes. The sleep intervention might be promising.
28	Effect of a child care center-based obesity prevention program on body mass index and nutrition practices among preschool-	Yes	Yes	Yes	Can't tell. This was not stated.	This was not stated.	Yes	As parents carried out the intervention at home, BMI significantly decreased among participating children. Similarly, intervention children consumed less junk food, ate more FV, drank less juice and more 1% than full-fat milk,	CI 95%	Yes	Yes	Yes. There were no harms and significant positive effects in the intervention group.

CASP Questions*												
#	Study	1	2	3	4	5	6	7	8	9	10	11
	aged children. (Natale, Lopez-Mitnik, Uhlhorn, Asfour, & Messiah, 2014)							compared to the control group after the intervention. There were no significant differences in PA levels between the control and intervention groups.				
29	Role modeling as an early childhood obesity prevention strategy: effect of parents and teachers on preschool children's healthy lifestyle habits. (Natale, Messiah, et al., 2014)	Yes	Yes	Yes	Can't tell. This was not stated	Yes	Yes	Parents in the intervention group ate more FV and significantly influenced their children's consumption of FV. Also, intervention parents significantly influenced a decrease in children's junk food consumption, whereas control parents significantly influenced an increase in their children's junk food consumption and sedentary behaviour. Teachers did not significantly influence the children's nutrition or PA patterns.	CI was not stated	Can't tell. Participants were mainly Hispanic, Cuban or Mexican and the majority of caregivers were born outside of the US.	No. BMI was not considered.	Yes. There were no harms and significant positive effects in the intervention group.
30	Mobile-based intervention intended to stop obesity in preschool-aged children:	Yes	Yes	Yes	No. Participants were not blinded to their allocation,	Yes	Yes	The odds of increasing the composite score for dietary and physical activity behaviours were 99% higher for	CI 95%	Yes	No. BMI was measured at baseline, but not	Yes. There were no harms and significant positive effects in the intervention group.

CASP Questions*												
#	Study	1	2	3	4	5	6	7	8	9	10	11
	the MINISTOP randomized controlled trial. (Nystrom et al., 2017)				but outcome assessors were blinded to the treatment allocation.			the intervention group than the control group			post-intervention.	
31	Parent-Focused Change to Prevent Obesity in Preschoolers: Results from the KAN-DO Study (Ostbye et al., 2012)	Yes	Yes	Yes	Can't tell. This was not stated.	Yes	Yes	Child's dinners and snacks eaten in front of the TV and mothers instrumental feeding decreased more in the intervention than the control arm. Positive trends were seen in child dietary intake, but not in sedentary behaviours, amount of PA or BMIz.	CI was not stated.	Yes	Yes	Can't tell. Maybe, there were minor significant positive changes in the intervention group
32	Effect of a responsive parenting educational intervention on childhood weight outcomes at 3 years of age: The INSIGHT randomized clinical trial. (Paul et al., 2018)	Yes	Yes	Yes	Can't tell. It was only stated that the study staff that perform the measurements were blinded.	Yes	Yes	The intervention group had a lower mean BMIz than the control group at age three. Mean BMI percentiles did not differ significantly.	CI 95%	Yes	No. PA and diet were not measured, although these were a part of the intervention.	Yes. There were no harms and significant positive effects in the intervention group.
33	Randomized Controlled Trial to Prevent Infant	Yes	Yes	Yes	No	Yes	Yes	Compared to controls, parent education did not reduce infant	CI was not stated.	Can't tell. Participants were Mexican	Yes	Can't tell. There were no positive significant

CASP Questions*												
#	Study	1	2	3	4	5	6	7	8	9	10	11
	Overweight in a High-Risk Population. (Reifsnider et al., 2018)							overweight.		American		changes in the intervention group, but this study highlighted the importance of breastfeeding and infant growth in a high-risk population.
34	Two-year follow-up of a primary care-based intervention to prevent and manage childhood obesity: the High Five for Kids study. (Rifas-Shiman et al., 2017)	Yes	Yes	Yes	Can't tell. This was not stated.	No. Children randomized to the intervention group were more likely to be racial/ethnic minorities, have an obese parent, and live in lower income households.	No. The control group received usual care, and the intervention group involved changes to the health care system.	After the intervention and at follow-up at two years, compared with the control group, intervention participants had similar changes in BMIz scores and intake of fast food and SSB.	CI 95%	Yes	No. PA was considered as an outcome, but was not described in the results.	Can't tell. There were only small significant positive changes in the intervention group.
35	Effects of a Physical Activity Intervention in Preschool Children. (Roth et al., 2015)	Yes	Yes	Yes	Yes	Yes	Yes	Compared to controls, children in the intervention group showed positive effects in motor skills performance at post-intervention and follow-up. The intervention group showed also a higher increase in proportion of daily time spent in	CI 95%	Yes	No. BMI was not considered.	Can't tell. Maybe, there were no harms and significant positive effects in the intervention group, but only on motor skill performance and not on PA.

CASP Questions*												
#	Study	1	2	3	4	5	6	7	8	9	10	11
								MVPA compared with the control group, although this was not significant. There was no significant effect of the intervention on BMI.				
36	Early Obesity Prevention: A Randomized Trial of a Practice-Based Intervention in 0-24-Month Infants. (Schroeder et al., 2015)	No.	Yes	Yes	No information about the control group.							
37	A parent-based intervention to promote healthy eating and active behaviours in pre-school children: evaluation of the MEND 2-4 randomized controlled trial. (Skouteris et al., 2016)	Yes	Yes	Yes	No. All data were collected by blinded researchers, but participants and programme facilitators were not blinded.	Yes	Yes	There were significant positive group effects for vegetable and snack food intake. At 12 months follow-up intervention children exhibited less neophobia. The intervention had no effect on sedentary behaviour, PA and BMIz.	CI 95%	Yes	Yes	Can't tell. There were only small significant positive changes in the intervention group.
38	A health promotion	Yes	Yes	Yes	Can't tell. It was only	Yes	Yes	Children in the intervention arm	CI 95%	Yes	No. BMI of	Can't tell. There were only small

CASP Questions*												
#	Study	1	2	3	4	5	6	7	8	9	10	11
	intervention can affect diet quality in early childhood. (Spence et al., 2013)				stated that the research staff that conducted the recalls were blinded.			scored significantly higher than those in the control group for the Protective Dietary Index (OPDI), which positively correlates with energy intake, dietary fibre, some vitamins, but not with saturated fat. Three dietary patterns were identified, but the scores did not substantially differ between the intervention and control groups.			the children was measured at baseline, but was not discussed in the results.	significant positive changes in the intervention group.
39	Clinic and Home-Based Behavioral Intervention for Obesity in Preschoolers: A Randomized Trial. (Stark et al., 2018)	Yes	Yes	Yes	Can't tell. It was only stated that the study staff who performed the measurements were blinded.	Yes	No. The control group received standard care, which informed caregivers of their child's weight status during the recruitment process, but neither the children not	LAUNCH participants demonstrated a significantly greater decrease in BMIz compared with the MI and control group.	CI 95%	Yes	No. PA and diet were not considered, although this was part of the intervention.	Yes. There were no harms and significant positive effects in the intervention group.

CASP Questions*												
#	Study	1	2	3	4	5	6	7	8	9	10	11
							caregivers received any treatment. The intervention groups consisted of treatments.					
40	Personalized Web-Based Advice in Combination With Well-Child Visits to Prevent Overweight in Young Children: Cluster Randomized Controlled Trial. (van Grieken et al., 2017)	Yes	Yes	Yes	No. Participants and researchers were not blinded.	No. Children in the intervention group were significantly older and the intervention group contained a significantly higher percentage of children of Dutch ethnic background and a significantly higher percentage of mothers who were born in the Netherlands.	Yes	At 36 months of age, there were no differences in BMI of the children in the intervention and control group. Significantly more children in the intervention group ate breakfast daily and drank less SSB as compared with the control group.	CI 95%	Yes	No. PA is considered as an outcome but not addressed in the results.	Can't tell. There were only small significant positive changes in the intervention group.

CASP Questions*												
#	Study	1	2	3	4	5	6	7	8	9	10	11
41	Prevention of overweight in children younger than 2 years old: a pilot cluster-randomized controlled trial. (Verbestel et al., 2014)	No. There was no information of the control group.	Yes	Yes								
42	Sustainability of Effects of an Early Childhood Obesity Prevention Trial Over Time: A Further 3-Year Follow-up of the Healthy Beginnings Trial. (Wen et al., 2015)	Yes	Yes	Yes	No. Researchers that were not involved in HBT phase 1 collected the follow-up data and were blinded to intervention or control status. Participants were not blinded.	No. There were higher proportions of married or de facto partner and employed mothers in the control group than in the intervention group	Yes	After the intervention, the mean BMI was significantly lower in the intervention group than in the control group. The differences between the intervention and control groups disappeared over time. No effect of the early intervention on dietary behaviours or PA was detected at age five years.	CI 95%	Yes	Yes	Yes. There were no harms and significant positive effects in the intervention group.
43	Tooty Fruity Veggie: an obesity prevention intervention evaluation in Australian preschools. (Zask, Adams, Brooks, & Hughes, 2012)	Yes	Yes	Yes	Can't tell. This was not stated.	Can't tell. This was not stated.	Yes	In comparison to the controls, children in the intervention preschools significantly improved FMS, had more FV serves, and were less likely to have unhealthy food items in their lunch boxes following the intervention. There	CI 95%	Yes	Yes	Yes. There were no harms and significant positive effects in the intervention group.

Appendix 3: Intervention components categorised in the ANGELO framework by setting

Appendix 3.1: School setting

School setting (micro)					
Studies	Individual environment	Physical environment	Socio-cultural environment	Economic environment	Political environment
De Bock, Breitenstein, & Fischer (2012) C: received same intervention six months later than the intervention group	Diet: - Intervention delivered by nutrition experts, consisting of activities to get familiar with different food types and preparation methods and cooking and eating together. Parents were involved in five of the 15 sessions.				
Roth et al. (2015) C: usual care consisting of one PA lesson per week lasting 30-45 minutes	PA: - Teacher-led intervention consisting of daily PA lessons lasting at least 30 minutes for 11 months. Children received PA homework cards once or twice a week and seasonal letters composed of games and exercises. - Parents were invited to three interactive lectures with information on motor skills development and PA in childhood. - The kindergarten teachers were trained and supervised by physical education specialists and a physiotherapist in planning and teaching the physical education lessons.		PA: - The teachers were asked to encourage the children in using and developing their motor skills while attending games and exercise tasks. - The teachers were encouraged to adjust the lessons to the children's abilities, interests, and ideas.		
Zask, Adams, Brooks, & Hughes (2012)	Diet: - Health professionals gave interactive workshops on positive parenting and healthy eating.	Diet: - Fluorescent pictorial posters of 'better foods' and 'foods better left out' were displayed in prominent areas of the preschool. - Project management committees (PMCs),	Diet: - Parents were encouraged to attend positive parenting courses.	Diet: - Positive parenting courses were available in most towns for free or at a reduced cost.	Diet: - PMCs reviewed preschool food policies and revised them to explicitly identify appropriate and inappropriate foods for preschool lunchboxes.

School setting (micro)					
Studies	Individual environment	Physical environment	Socio-cultural environment	Economic environment	Political environment
		with parents, staff and health professionals in each preschool, reviewed access to water. Changes were made to ensure all children could access drinking water at all times without having to ask an adult for assistance. - Each preschool received a copy of the 'Family Food DVD', which models practical ways to improve children's eating habits, for their parents library.			
Fitzgibbon et al. (2011) C: 20 minutes weekly class, spent on a general health activity	Diet and PA: - Researcher-led intervention consisting of 45 minutes class two times a week for 14 weeks. Children participate in an activity related to healthy eating or PA. Hand puppets are used (Mr. Protein, Mr Fat) and the children go on a picture food find where pictures of various foods that they learned about are hidden in the classroom. - Parents received a weekly newsletter, homework assignments and twice weekly aerobics classes.				
Annesi, Smith, & Tennant (2013a) C: usual care consisting of 30 minutes reserved for PA under the control of teachers	- Teacher-led intervention that was administered daily during the 30 minutes reserved for PA. The intervention consisted of various PA activities and discussing and setting goals. - Preschool teachers received a four hour training of the administration of PA supported by cognitive and behavioural methods + binder of daily lesson plan.				

School setting (micro)					
Studies	Individual environment	Physical environment	Socio-cultural environment	Economic environment	Political environment
Annesi, Smith & Tennant (2013b) C: usual care consisting of 30 minutes reserved for PA under the control of teachers	PA: - Teacher-led intervention that was administered daily during the 30 minutes reserved for PA. The intervention consisted of various PA activities and discussing and setting goals. - Preschool teachers received a four hour training of the administration of PA supported by cognitive and behavioural methods + binder of daily lesson plan.				
Lumeng et al. (2017) C: HS (Head Start) classroom	Diet: Two intervention groups (HS + POPS and HS + POPS + IYS) <u>POPS (Preschool Obesity Prevention Series):</u> - Nutrition-educator led intervention in collaboration with the classroom teacher. It consisted of six lessons incorporating children's stories and associated classroom activities, classroom cooking experiences and goal setting. - Parents received eight 75-minute lessons that incorporated a cooking activity and focused on building knowledge and self-efficacy, and developing skills and strategies. <u>IYS (Incredible Years Series):</u> - Health-specialist led intervention in collaboration with the classroom teacher. It consisted of 60 classroom lessons followed by smaller group activities that addressed self-regulation skills, problem-solving strategies, and prosocial behaviour. - Parents received lessons delivered by using video vignettes in 14 group sessions or ten home visits that were reinforced with homework and follow-up phone calls.				
De Coen et al. (2012) C: ?	Diet and PA: - The schools received a manual how to conduct the intervention. This consisted of five Healthy Weeks, with a minimum of one hour of classroom		Diet and PA: - At the start, two meetings were held in each intervention	Diet and PA: - Teachers received €250 (£215) to buy materials or finance	Diet and PA: - Schools were requested to evaluate and improve their

School setting (micro)					
Studies	Individual environment	Physical environment	Socio-cultural environment	Economic environment	Political environment
	<p>time dedicated to a diet- or PA related topic together with extracurricular activities.</p> <ul style="list-style-type: none"> - Schools were requested to communicate with the parents on the programme and to distribute materials to the parents. - Parents received a poster with information and tips on parenting practices to encourage children to eat healthy and perform PA. They also received a website link with practical information such as tips and recipes. Based on a parental questionnaire, they received tailored advice on their child's diet and PA behaviour. 		<p>community with the researchers, community organizations and stakeholders regarding local social and health problems using concept mapping. Community organizations, members of the city council, aldermen and local non-profit organizations working with children of health topics were approached to support the intervention, to raise awareness and give greater publicity to the project.</p>	<p>environmental changes.</p> <ul style="list-style-type: none"> - Regional health boards supported the schools and community for the implementation of the project. They contacted the schools at least twice per year to assist in the selection of relevant intervention materials and supervising the implementation progress. They received €500 (£430) for their input in the project. 	<p>playground and snack and beverage policy</p>

Appendix 3.2: Home setting

Home setting (micro)					
Studies	Individual environment	Physical environment	Socio-cultural environment	Economic environment	Political environment
Haines et al. (2018) C: Received monthly emails with publicly available child health information	Diet and PA: Two intervention groups (2HV (2 home visits) and 4HV) - Health educator led intervention. Both intervention groups received the same intervention, but 4HV received two extra HV. The initial HV began with describing the behavioural goals of the study. Families rated their current routines and behaviours about food and PA behaviour, and were asked to set any behaviour specific goals. MI was used to identify steps required to implement the goal. - Families were sent weekly emails that were tailored to the behaviour change goal set by the family. - At follow-up HV, goals were reviewed and discussed. Families could set a new goal or revise a previously established goal.	Diet and PA - Families were provided a paper family routine tracker on which they could record their behaviour and identify possible facilitators or barriers to their behaviour change.			
Mirotta et al., (2018)	Diet and PA: Two intervention groups (2HV (2 home visits) and 4HV) - Health educator led intervention. Both intervention groups received the same intervention, but 4HV received two extra home visits. At the first home visit, each family tailored their individual intervention by selecting one or more lifestyle goals from the following: eating more meals together as a family, choosing water over other beverages, making time for PA every day, setting a bedtime routine, and limiting screen time. Health educators worked with families at each HV to determine realistic ways they could accomplish their selected lifestyle goals using a MI approach. - Families were sent weekly emails that were tailored to the behaviour change goal set by the family.				
Helle, Hillesund, Wills, & Øverby,	Diet: - Internet-delivered intervention consisting of				

Home setting (micro)					
Studies	Individual environment	Physical environment	Socio-cultural environment	Economic environment	Political environment
(2019) C: Usual care from local child health clinic with regular consultations at child age 6, 8, 10 and 12	seven monthly video clips of 3-5 minutes, focusing on feeding related aspects like appropriate food-types and textures; how taste-preferences evolve and responsive feeding practices; and monthly cooking-films and recipes.				
McGowan et al. (2013) C: Survey of children's eating habits	Diet: - Researcher-led intervention delivered over four visits in eight weeks. In each visit, the researcher worked through an intervention booklet with the parents. This booklet introduced the concept of habit formation. The booklet had detachable self-monitoring sheets with sections for each target feeding domain to use during the habit acquisition phase. Each visit focused on one domain (serving fruit and vegetables, healthy snacks and healthy drinks). Parents discussed why it was important to have healthy feeding habits for children and tips and advice were provided on feeding habits. Parents then formulated a specific, healthy feeding goal in that area. At each subsequent visit, parents were encouraged to continue with the previous habit(s) while introducing a new one.				
Nystrom et al. (2017) C: Received a pamphlet on healthy eating and PA	Diet and PA: - Intervention was delivered via a smartphone application to the parents. It was centred on guidelines for healthy eating and PA in preschool-aged children. Parents were able to access the information at any time. - Parents were encouraged to register information within the application on their child's dietary intake and time spent sedentary. - At the end of every week the parents received graphic feedback and automated comments based on the submitted information. Within the application parents could contact a dietitian and/or psychologist to ask questions pertaining	Diet and PA: - Parents received regular push notifications of the application.			

Home setting (micro)					
Studies	Individual environment	Physical environment	Socio-cultural environment	Economic environment	Political environment
	to their child.				
Ostbye et al. (2012) C: Received monthly newsletters emphasizing pre-reading skills	Diet and PA: - Intervention was delivered in the form of eight monthly mailed interactive kits, followed each month by a 20-30 minute telephone coaching session using MI techniques. Kits included child activities and incentives reinforcing the month's topic. The intervention targeted the dyad's healthy weight via instruction in parenting styles and skills, techniques for stress management, and education about healthy behaviours. Parenting skills instruction emphasized an authoritative parenting style, routines for sleep and mealtimes, a supportive home environment, role modelling of healthy eating and PA, and improvement of feeding style. Education also targeted healthy nutrition and PA behaviour. - Coaching calls reviewed information in the module and addressed motivation, self-efficacy, and barriers to change. - The intervention also included a group session, where the study coaches and nutritionist reinforced content from the family kits and set aside time for role play and group discussion.			Diet and PA: - During the group session, a healthy meal and free child care were provided.	
Paul et al. (2018) C: Home safety intervention	Diet: - Research nurses conducted four home visits during infancy and annual research centre visits. The responsive parenting curriculum focused on feeding, sleep, interactive play, and emotion regulation.				Diet: - Parents were instructed on establishing routines and expectations, and setting limits, rules, and consequences of feeding practices and dietary intake.
Reifsnider et al. (2018) C: Usual care as offered by their paediatric practice.	Diet and PA: - Promotoras made prenatal and postpartum home visit once before delivery and at ages one and two weeks, and two, four, six, nine, and 12 months. During visits, the promotoras discussed infants' growth, health, development, sleep, and play/exercise activities. Mothers were		Diet and PA: - The intervention was promotoras-led. A promotora is a community health worker that is in the Hispanic culture		

Home setting (micro)					
Studies	Individual environment	Physical environment	Socio-cultural environment	Economic environment	Political environment
	encouraged to breastfeed and/or to avoid giving excess formula or adding sugar or solids to the bottle. A lactation consultant visited mothers who reported problems with breastfeeding.		considered as a trusted person who is sought for advice and disseminated health information by interpersonal networks. The research promotoras were experienced in providing health education to the local population,		
van Grieken et al. (2017) C: Usual care which included regular well-child visits	<p>Diet and PA:</p> <ul style="list-style-type: none"> - Parents received an invitation to visit the intervention website and complete the eHealth module online one month before the regular well-child visits. - As a first step, parents completed the assessment questionnaire about child health-related lifestyle behaviour. The answers were used to generate online tailored advice. After reading this, parents could make an implementation-intention plan in which they could specify actions to improve their child's nutritional and/or physical activity habits. The advice was later discussed with the YHC professional. - Parents received advice and care during the scheduled visits, 8-11 visits in the first year and five visits in the second and third year. - Specific anticipating parenting education is given including stimulus control, modelling, and operant conditioning. <p>- Youth Health Care (YHC) professionals received training about child rearing and aspects of the learning theory to be applied in the intervention.</p> <p>- YHC professionals received a half-day training session on MI techniques.</p>	<p>Diet and PA:</p> <ul style="list-style-type: none"> - YHC professionals received a small calendar-like booklet with pictures of infants and toddlers who show the desired healthy behaviours and with items that discuss healthy feeding and exercise behaviours. 	<p>Diet and PA:</p> <ul style="list-style-type: none"> - The purpose of the booklet was to support counselling, especially for those who are low- or illiterate. - All items are emphatically and positively formulated. 		

Home setting (micro)					
Studies	Individual environment	Physical environment	Socio-cultural environment	Economic environment	Political environment
Verbestel et al. (2014) C: ?	Diet and PA - Parents received tailored feedback on their child's diet and PA on paper. - Parents received a poster with five stickers, each sticker presenting a targeted behaviour and providing parents with practical information and/or strategies. The stickers were distributed to the parents every two months and were gradually stuck on the poster by the parents. The stickers were always accompanied by a letter with information about the target behaviour.				
Wen et al. (2015) C: Usual childhood nursing service from community health service nurses	Diet and PA: - Community nurses conducted eight home visits with one visit in the antenatal period and seven visits after birth until the child was 2 years old. The key intervention messages included: breast is best, no solids for me until six months, I eat a variety of fruit and vegetables every day, only water in my cup, and I am part of an active family.				

Appendix 3.3: Childcare setting

Childcare setting (micro)					
Studies	Individual environment	Physical environment	Socio-cultural environment	Economic environment	Political environment
Alkon et al. (2014) C: Received delayed intervention in year two of the study	Diet and PA: - The child care health consultants (CCHCs) facilitated five, one hour workshops for childcare providers and other staff at each of the intervention centres on childhood obesity, healthy eating and PA for young children, personal health and wellness, and working with families to promote healthy behaviours. - CCHCs provided at least monthly on-site consultations and additional phone or email consultations for the childcare centres. Examples of common issues addressed were the type of milk served and ideas for PA. - Seven of the intervention centres also received the parent workshop "Raising healthy Kids".	PA: - The intervention centre directors were asked to purchase equipment or supplies to support physical activity. Diet: - Posters were displayed in childcare centres describing the intervention's best practices.			Diet and PA: - The CCHCs worked with the centre directors to write or update the centre's nutrition and PA policies.
Bonis et al. (2014) C: Received delayed treatment	PA: - The intervention consultants delivered to the staff of each treatment facility four workshops that demonstrated the importance of physical activity and nutrition. The workshop topics included overweight, nutrition, physical activity, and growing healthy kids. - The consultants maintained regular contact with the treatment facility staff and provided support in addressing any barriers that would prevent achievement of their specific facility improvement plan. They also distributed educational information to the parent/guardians that focused on physical activity and nutrition recommendations at home.				PA and diet: - Each treatment facility director completed the self-assessment tool that assessed their centre on 14 key areas in physical activity and nutrition. Based on the responses, the facility director with guidance from the intervention consultant chose three to four areas for improvement and prepared a unique facility improvement plan.
laia et al. (2017) C: Were offered routine healthcare advice during child health	Diet and PA: - Two MI with parents conducted by paediatricians to help families to increasingly adopt healthy lifestyles. Specific unhealthy behaviours of the parents were addressed. - Information tools were created for parents and	Diet and PA: - A poster highlighting four key behaviours was created, and displayed in waiting rooms of paediatric	Diet and PA: - Peer imitation and teachers' good models provide children with a social learning setting that facilitates the		

Childcare setting (micro)					
Studies	Individual environment	Physical environment	Socio-cultural environment	Economic environment	Political environment
visits	<p>teachers, such as a leaflet for parents and a manual for parents and teachers.</p> <ul style="list-style-type: none"> - Children and teachers engaged in learning experiences (one hour a day) to eat healthier. - Teachers got a ten hour training to promote more active play at childcare centres and inserted this subject into their annual educational timetables. 	clinics and in childcare centre halls.	development of healthy eating and activity patterns. This effect could also be magnified at home if both teachers and primary care paediatricians support parents in having healthy lifestyles.		
<p>Jouret et al. (2009) C: Data was obtained retrospectively from school medical records</p>	<p>Diet and PA: Two intervention groups Both groups followed the 'basic strategy', that comprised information dissemination to parents and teachers, as well as screening for overweight at baseline and follow-up care by family practitioners for overweight, if indicated. EPIPO12 received a reinforced strategy consisting of an education program, in addition. It consisted of a kindergarten-based education program, focusing among other on promoting healthy nutrition habits and PA. The study team, comprising a dietician and an education aide, conducted ten 20 minute sessions in the classroom. These sessions incorporated learning activities and games around themes as: improved knowledge of food groups and their role in health, importance of eating balanced meals and snacks and practicing in PA.</p> <ul style="list-style-type: none"> - Children received an audio cassette and a story book to reinforce these educational messages, whereas their parents were provided packets containing information on nutrition and PA in relation to health. 	<p>Diet and PA: - Posters emphasizing the prevention of obesity and the association of physical activity and health eating habits in child development and prevention of overweight in young children were placed at strategic points in all kindergartens, such as the entry hall where parents picked up their children, to reinforce the intervention messages.</p>			
<p>Natale, Lopez-Mitnik, Uhlhorn, Asfour, & Messiah, (2014) C: Parents and teachers</p>	<p>Diet and PA: - Dietitian-delivered intervention in which parents joined a monthly educational dinner in which nutrition and PA were discussed. They also received monthly newsletters and at-home activities. The newsletters also included issues</p>		<p>Diet and PA: - The program was designed to be culturally sensitive, given the ethnic diversity of the families,</p>	<p>Diet: For each of the six at-home activities that each family completed, they received a healthy</p>	<p>Diet and PA: - A nutritionist worked with each child care centre to modify menus to make them healthier, while</p>

Childcare setting (micro)					
Studies	Individual environment	Physical environment	Socio-cultural environment	Economic environment	Political environment
received information from an injury prevention education mobile on safety.	<p>that are often of concern to parents of preschool children, such as how to introduce new foods. At the end of the program, parents who attended three or more dinners received a certificate of completion.</p> <p>- Teachers and staff were trained on the role and rationale of the intervention program, taught implementation strategies, and provided lessons to use with the children. Additionally, there were weekly technical assistance visits with the teachers and an intervention specialist to ensure the implementation of a healthy diet with emphasis on cultural barriers.</p>		<p>teachers, and administrators and staff at participating schools.</p> <p>- Food, and thus nutrition, is an integral component of culture. The specific intervention strategies were designed to account for this, such as modifying recipes to reflect cultural preferences.</p> <p>- Sessions were provided by registered dietitians who were of the same cultural background of the parent.</p> <p>- The technical assistance portion of the program targeted cultural, cognitive, and environmental barriers to accommodate a low-fat, high-fiber diet that included more fresh fruits and vegetables.</p> <p>- Parents were encouraged to reduce TV viewing, increase PA, and model healthy eating behaviours for their child at home.</p>	snack bag.	<p>ensured was that the modifications were of equal cost as prior food purchases. Each centre agreed on a drink policy that included providing water as the primary beverage and a snack policy consisting of healthy snacks. The PA policy consisted of urging centres to increase PA to more than one hour per day and to decrease TV viewing to less than 60 minutes two times a week.</p>
Natale, Messiah, et al. (2014) C: Received an	<p>Diet and PA: - Six trainings occurred on a monthly basis during an academic year for parents and teachers. They were taught about choosing healthy foods and making healthy food</p>	<p>Diet and PA: - Lesson plans were designed to incorporate and reinforce the policy standards; half focused</p>	<p>Diet and PA: - The role modelling curriculum was available in both English and Spanish,</p>		<p>Diet: - Intervention child care centres were implemented a drink policy and snack policy</p>

Childcare setting (micro)					
Studies	Individual environment	Physical environment	Socio-cultural environment	Economic environment	Political environment
<p>safety curriculum delivered by character “Safety Sam”, which provided parents and teachers with home, car and child seat safety information</p>	<p>choices for child development, preparing nutritious snacks and new recipes and planning meals.</p> <p>- The teachers received weekly technical assistance instruction on how to promote wellness within a group's child care setting. During these weekly visits, curriculum specialists targeted the cognitive, cultural, and environmental barriers to a low fat, high fibre diet that include more fruits and vegetables.</p>	<p>on beverage/snack policies and half focused on PA policies.</p> <p>To increase ease of use, the lesson plans outline includes cognitive, fine motor, and self-help instructional components required for teachers as they apply to the policy objective.</p>	<p>with culturally sensitive language and activities.</p> <p>- By means of role modelling, parents and teachers were encouraged to implement change at the family/home and child care centre level.</p> <p>- Additionally, nutritional professionals served as role models for the teachers and parents and assisted them as nutritional gatekeepers and positive models for the children.</p>		

Appendix 3.4: Clinic setting

Clinic setting (micro)					
Studies	Individual environment	Physical environment	Socio-cultural environment	Economic environment	Political environment
Bocca, Corpeleijn, Stolk, & Sauer (2012) C: Received usual care and were followed up by a paediatrician. Information on healthy eating behaviour and PA was provided.	Diet and PA: - Children and parents received dietary advice, PA sessions and, for parents only, psychologic counselling. Dietary advice consisted of six sessions of 30 minutes each, guided by a dietician. Personal goals regarding the diet were set for parents and children. On consecutive sessions, feedback was given on these goals. - The PA sessions consisted of 12 group sessions of 60 minutes each and were supervised by a physiotherapist. - Behavioural therapy for parents comprised six group sessions of 120 minutes each that were guided by a psychologist. In these sessions, parents learned to be a healthy role model and work with feasible goals and healthy rewards.		PA: - The exercise programme focused on an active lifestyle and mimicked the type and intensity of habitual elementary school exercise (e.g. ball playing and dancing to music). - Sessions were aimed at having fun during exercise, thereby improving the child's wellbeing. - Parents were asked to stimulate their child's daily PA of at least 60 minutes. Diet and PA: - Parents learned how to use sticker charts to motivate the children and keep track of their progress. - Parents were taught to change family attitudes toward healthy eating and PA.		
Campbell et al. (2013) C: Received usual care from their Maternal and Child Health (MCH) nurse	Diet and PA: - The intervention was dietitian-delivered with six 2 hour sessions quarterly during first-time parents' group regular meeting. It sought to build knowledge, skills, and social support regarding infant feeding, PA, and sedentary behaviours. Control group parents received usual care from their MCH nurse.		Diet and PA - Tested was the hypothesis that an obesity prevention intervention delivered to first-time parents in pre-existing social group (from health services provided by		

Clinic setting (micro)					
Studies	Individual environment	Physical environment	Socio-cultural environment	Economic environment	Political environment
			the Maternal and Child Health (MCH) service, parents engage in groups that often become independent social groups) would improve aspects of child diet, increase child time spent physically active, and reduce child television viewing time.		
Daniels et al. (2012) C: Standard access to universal community child health services	Diet: - The intervention consisted of group sessions with mothers that focused on the feeding and parenting practices that mediate children's early feeding experiences, delivered by a dietitian and psychologist over a period of three months. - Content included anticipatory guidance on the 'when, what and how' of solid feeding. Two overarching themes underpinned both modules. Theme 1: repeated neutral exposure to unfamiliar foods and limiting exposure to unhealthy foods to promote the development of healthy food preferences. Theme 2: responsive feeding that recognises and responds appropriately to infant cues of hunger and satiety to maintain infants' innate capacity to self-regulate intake and avoid overfeeding. - Parents received key messages: (i) the way we feed young children affects the foods they will like and their health: 'learning to like, liking to eat' ²¹ , (ii) listen to and trust your child: 'parent provide, child decide' ²² , (iii) habits are formed early and track to adulthood, (iv) set good examples for your child and (v) your relationship with your child is important				
Doring et al. (2016) C: Regular age-	Diet and PA: - Nurse-led intervention. Families in took part in nine sessions (one group, six individual and two		Diet and PA: - Nurses assisted parents to change their		

Clinic setting (micro)					
Studies	Individual environment	Physical environment	Socio-cultural environment	Economic environment	Political environment
related health check-ups of child health services	<p>telephone) in a time frame of ~39 months. The parents, in conjunction with the nurses, formulated goals for changes in unhealthy behaviours and for maintenance of healthy PA and food habits. In consecutive sessions, the nurses reinforced the parents' motivation for and commitment to health promotion and behaviour change when needed.</p> <p>- Nurses attended a 5-day course on MI, learning theory, and the principles of cognitive behaviour therapy and on the subjects of nutrition and PA.</p>		own health behaviours and to promote healthy dietary and PA behaviours in their children.		
Fisher et al., 2019 C: Delayed treatment	<p>Diet</p> <p>- Weekly group intervention for in total three months, led by a graduate-level interventionist. Core behavioural change techniques were used to facilitate adherence including goal setting and planning, feedback and monitoring, antecedents, comparison of behaviour, natural consequences, and social reward.</p> <p>- Sessions began with a group discussion of progress on achieving the previous weeks' goals and collective problem-solving around challenges, followed by presentation of new content and interactive demonstrations, and finally discussion of next week's goals.</p>				
Moir et al. (2016) C: Usual care from the Well Child service	<p>Diet and PA:</p> <p>Three intervention groups</p> <p><u>Food, activity, and breastfeeding (FAB)</u></p> <p>- Participants attended a group education session at around 37 week gestation and when the infants were 3, 9, and 18 months of age. The sessions focused on breastfeeding, the importance of active play from birth, ideas for encouraging activity at different ages. And encouraging families to be active together.</p> <p>- Parents had the opportunity to try each suggested activity with their child.</p> <p>- Parents were also provided with an extensive take-home written resource to complement the</p>				

Clinic setting (micro)					
Studies	Individual environment	Physical environment	Socio-cultural environment	Economic environment	Political environment
	<p>sessions.</p> <p><u>Sleep:</u> - Focused on antenatal and early postnatal education about preventing sleep problems with optional behavioural strategy interventions from six months of age for those parents who considered their infant to have a sleep problem.</p> <p><u>Combination:</u> - Received FAB and sleep intervention.</p>				
Rifas-Shiman et al. (2017) C: Received standard well-child care offered by their paediatric practice	<p>Diet: - Paediatric nurse led intervention. Components include de-emphasis on labelling, giving the parent responsibility for identifying which behaviours are problematic, encouraging parents to clarify and resolve ambivalence about behaviour change, and setting goals to initiate the change process. - For the chronic disease management visits with the nurse practitioners, educational modules targeting TV, fast food, and sugar sweetened beverages were developed, that were matched to a family's stage of readiness to change. Also printed and electronic tools for self-management support, lists of local resources for physical activity, and an interactive website with educational materials, recipes, and other features were created. - Paediatric nurse practitioners were trained to be the key intervening clinicians and to use MI during four chronic disease management visits and three telephone calls in the first year of the intervention. - Primary care paediatricians were trained to use brief focused negotiation skills at all routine well child care visits to endorse family behaviour change. Brief focused negotiation is based on the concepts of MI but tailored for brief sessions such as the clinical encounter.</p>	<p>Diet: - For the patient waiting rooms, posters highlighting targeted behaviours were created to encourage dialogue during well child care visits. For the</p>		<p>- Prior to the start of study, negotiated with the regional insurance companies to pay for up to four visits for both overweight and obese patients in the first year of study. - To further support behaviour change, the nurse practitioners provided small incentives such as water bottles, books, and snack containers. In addition, the nurse practitioners offered interested families an electronic TV monitoring device to assist with the goal of reducing TV viewing.</p>	<p>- Major components of the intervention involved changes to the health care system. All members of the practice team were trained to play an active role in the intervention. The electronic medical record system was enhanced. The delivery of primary and acute care was reorganized.</p>

Clinic setting (micro)					
Studies	Individual environment	Physical environment	Socio-cultural environment	Economic environment	Political environment
Schroeder et al. (2015) C: ?	<ul style="list-style-type: none"> - Paediatrician, nurse practitioners and clinic staff led intervention. The intervention consisted of materials aimed at promoting an exchange between patient and paediatrician about nutrition, feeding, and physical activity, providing useful information to parents in order to enhance self-efficacy for the daily care of their infants, and helping parents make healthy food choices for the infants and for themselves and make physical activity a part of daily life. - 12 sets of educational brochures were presented and discussed with caregivers at paediatric visits at 1, 2, 4, 6, 9, 12, 15, 18, and 24 months of age and at annual visits thereafter up to age five years. While the brochures emphasize a few key points, they also provide detailed advice on infant feeding practices, PA, and developmental milestones related to eating patterns. - In between visits, parents received a phone call every month, providing encouragement and answering questions. - All participating paediatricians, nurse practitioners, and clinic staff attended training sessions before start of the study. Refresher sessions were held every 2-3 months. 	<ul style="list-style-type: none"> - Parents received reminder post cards which contained short educational messages. 			
Spence et al., 2013 C: Received usual care in their local area in addition to newsletters on topics unrelated to food, PA or weight	<p>Diet:</p> <ul style="list-style-type: none"> - Dietitian-led group intervention for parents. Sessions took an anticipatory guidance approach and included peer discussion of facilitators and barriers to improving dietary intakes and food-related behaviours. - Families were provided with purpose-designed written resources and a DVD reinforcing the messages. 				
Stark et al. (2018) C: Were	<p>Diet and PA:</p> <p>Two intervention groups</p> <p>Learning about activity and understanding for</p>		<p>Diet and PA:</p> <p>LAUNCH incorporated home visits to facilitate</p>		

Clinic setting (micro)					
Studies	Individual environment	Physical environment	Socio-cultural environment	Economic environment	Political environment
informed of their child's weight status during the recruitment process, but there was not any treatment	<p>child health (LAUNCH):</p> <ul style="list-style-type: none"> - An 18 session clinic and home family-based behavioural weight management intervention, consisting of a three month intensive treatment phase followed by a three month maintenance phase. Intervention sessions alternated between clinic (10 sessions) and home (8 sessions) visits. - Parent clinic-based sessions were led by a clinical psychologist and consisted of education and problem-solving around parent and child diet, dietary and PA changes, and child behaviour management strategies. - Sessions 1–7 focused on dietary changes (with dietary tracking conducted throughout treatment), Sessions 8–10 focused on changing sedentary and physical activity, and Sessions 11–18 focused on bringing all the skills together and problem-solving barriers to recommended lifestyle changes. - A simultaneously held child group provided education about healthy eating, opportunities for moderate to vigorous physical activity, and exposure to a variety of fruits and vegetables through a meal. <p><u>Motivational interviewing:</u></p> <ul style="list-style-type: none"> - This parent-only intervention group consisted of 18 sessions over 6 months. At the initial sessions parents met with a paediatrician trained in MI during which they completed questionnaires to assess their values and motivation for change, and they were given information about their child's BMI and a packet of publicly available materials/brochures from the "Let's Go 5-2-1-0 programme". Subsequent MI intervention sessions were delivered in either the family's home or telephone and focused on goal setting. 		<p>generalization of the clinic taught skills to the home including parenting skills and changing the home environment using instruction, modelling and rehearsal of dietary, physical activity, parenting, and stimulus control techniques.</p>		

Appendix 3.5: Other settings

Other settings (micro)					
Studies	Individual environment	Physical environment	Socio-cultural environment	Economic environment	Political environment
Barkin et al. (2018) C: A school-readiness programme	<p>Diet and PA</p> <ul style="list-style-type: none"> - Intervention was a 12 week intensive phase with 90 minute skills-building sessions either group based or via telephone calls, a nine month maintenance phase with monthly coaching telephone calls, and a 24 month sustainability phase providing frequent cues to action (e.g. texts, personalized letters, monthly calls) to use parks and recreation programming for healthy family behaviours. - The intervention focused on behaviour change techniques including goal setting, self-monitoring and problem solving in the context of participants' home and community environments. - Intervention content included skills building for parents and children regarding nutritional choices, physical activity habits, use of the family and built environment, engaged parenting, healthy sleep, and reduced media time. Participants created self-defined goals about family health behaviours. The intervention included an adaptive component, an additional coaching telephone call that provided BMI results and additional guided goal setting and problem solving; this occurred when a child's BMI category increased or remained obese at a data collection time point. 				
Handel et al. (2017) C: Met with a health consultant twice	<p>PA:</p> <ul style="list-style-type: none"> - Health-consultant led intervention of 15 months. The content of the consultations in the intervention were based around four main themes: optimizing diet and PA, together with sleep and stress management. Each of the four consultation themes had selected key points. The most relevant key points related to this study were to: increase the time the child spend outdoor, reduce the child's television viewing and promote an active type of transport (walking or biking) 		<p>Diet and PA:</p> <ul style="list-style-type: none"> - The intervention was a non-standardized package and focused on the entire participating family's individual needs and resources, and hence not only on the child. 		

Other settings (micro)					
Studies	Individual environment	Physical environment	Socio-cultural environment	Economic environment	Political environment
	<ul style="list-style-type: none"> - The families in the intervention group were also invited to participate in optional monthly play events as a supplement to the consultations. The purpose of the play events was to convert theory obtained from the consultations into practice and to encourage the families to be more physically active together. 				
Rohde et al. (2017) C: Met with a health consultant twice	<p>Diet:</p> <ul style="list-style-type: none"> - Health-consultant led intervention of 15 months. The consultations in the intervention were focused around four themes: optimizing diet and PA, together with sleep and stress management. - All children were given a Y-plane that was visually divided into three spaces: 1/5 (fish, meat, poultry and eggs), 2/5 (pasta, rice, potatoes and whole grains) and 2/5 (fruit and vegetables). - The families were also invited to participate in group-based bimonthly cooking classes and monthly play and activity events. The purposes of the cooking classes were to help the parents convert theory obtained from the consultations into practice and to encourage them to involve the children in meal preparation. Each class had a different theme. - Beside the consultations and cooking events, the families could get inspiration for cooking healthy meals on the intervention website. 				
Skouteris, Hill, McCabe, Swinburn, & Busija (2016) C: Delayed treatment	<p>Diet and PA:</p> <ul style="list-style-type: none"> - The intervention consisted of a ten weekly workshop relating to general nutrition and physical activity, where parents and their children attended together. - Each session involved guided active play where parents could learn how to play with their children, healthy snack time based on a technique to promote acceptance and increase intake of fruit and vegetables, and time where 				

Other settings (micro)					
Studies	Individual environment	Physical environment	Socio-cultural environment	Economic environment	Political environment

the children participate in supervised crèche-style, creative play activities and concurrently the parents attend an interactive education and skills development session.

Appendix 4: Interview guides

4.1 Interview guide NHS Ayrshire and Arran

Interview guide Ayrshire and Arran	
Topics	Example questions
Introduction	Can you tell me shortly your function within the health board?
(Childhood) obesity in general	How important acting against obesity in your board? Does the focus lie on prevention or treatment of obesity?
Interventions/prevention and weight management services	Does your health board offer obesity prevention or weight management services? What does this entail? Do you know why was chosen for these strategies? On what age groups do these services focus? Is there a reason that there are currently no programmes or services for children below the age of 5? Were there any services or programmes you offered <u>in the past</u> for children below the age of 5? Are you aware of the 'Standards' for weight management services for children and young people that NHS Health Scotland published this year? Are these Standards taken into account when developing weight management services for children and young people?
Targets and role modelling	Which kind of people are offered obesity prevention or weight management services? Are only children targeted or are parents also included? Are parents encouraged to have a healthy lifestyle for their children? How?
Settings	In which kind of settings do you offer (or are you planning to offer) prevention or weight management services? Think of for example of a preschool setting, day care setting, and community setting. Who conducts (or will conduct) the interventions in different settings?
Disciplines	Which disciplines are involved?
Evaluation	How will you evaluate current prevention and weight management services? Do you have other plans for evaluation?
Future	Does the board have plans in the future to offer obesity prevention or weight management services for children below 5 years? Does the board have other future plans to tackle childhood obesity?
Ending	Do you have any other information or something else you would like to talk about?

4.2 Interview guide NHS Lothian

Interview guide Lothian	
Topics	Example questions
Introduction	Can you tell me shortly your function within the health board?
(Childhood) obesity in general	How important is acting against obesity in your board? Does the focus lie on prevention or treatment of obesity?
Interventions/prevention and weight management services	What kind of childhood obesity prevention and weight management services does your health board offer? Do you know why was chosen for these strategies? On what age groups do these services focus? At what child age do these services start? Are you aware of the 'standards' for weight management services for children and young people that NHS Health Scotland published this year? Are these standards taken into account when developing weight management services for children and young people?
Targets and role modelling	Which children are offered obesity prevention or weight management services? Are only children targeted or are parents also included? Are parents encouraged to have a healthy lifestyle for their children? How?
Settings	In which kind of settings do you offer childhood obesity prevention or weight management services? Think of for example of a preschool setting, day care setting, and community setting. Who conducts the interventions in different settings?
Disciplines	Which disciplines are involved?
Evaluation	How will you evaluate current prevention and weight management services? Do you have other plans for evaluation?
Future	Are there future plans of the health board to tackle childhood obesity?
Ending	Do you have any other information or something else you would like to talk about?

Appendix 5: Interviewee information

Interviewee Information

Thank you for agreeing to help us with this research. It will involve a single interview lasting up to one hour, for the work of “Childhood obesity in Scotland – Investigating trends and evidence”.

The research questions

We aim to broaden the understanding of effective childhood obesity prevention programmes and to give an overview of the current childhood obesity situation in Scotland. The following questions are the basis of this work:

1. What is the impact of childhood obesity prevention programmes on children’s BMI, diet and physical activity level, among children from conception to five years of age, in comparison to children (or their parents in case of pre-natal period) not exposed to childhood obesity prevention programmes?
2. **What types of obesity prevention programmes for children until five years of age are offered in Scottish NHS boards?**

We requested your help to answer second question. During the interview, questions will be asked about childhood obesity prevention and weight management strategies of the NHS health board you work for.

Interviewer

The interviewer, Rosa Brunekreeft, is a student of Health and Society specialization master’s programme in Wageningen University, the Netherlands. She is completing her master’s programme placement with Obesity Action Scotland in Glasgow and is the interviewer for this work.

Thank you

Your time and effort to participate in this interview are highly appreciated. As a thank you, you will receive graphic illustration of Primary 1 childhood obesity trends in your NHS health board based on ISD data, in PDF format. This will be emailed to you mid-December after the latest data of school year 2018/2019 is published. Hopefully you will find it useful for your records or presentations.

Rosa Brunekreeft and Obesity Action Scotland

November, 2019

Appendix 6: Informed consent

Informed Consent

For an interview of the work of “Childhood obesity in Scotland – Investigating trends and evidence”

I hereby declare that:

- I know the subject and purpose of the interview.
- I had the opportunity to ask questions, and any questions I had were answered to my satisfaction.
- Personal information will be treated confidentially. My answers will be analysed for the purpose of this work, but my name and function will not be presented anywhere.
- I agree to audio recording of the interview.
- I participate in the interview completely voluntarily. When I do not wish to participate anymore, I can decide at any moment to stop. I do not have to present a reason for this.
- I can refuse to answer a question at any time, without any consequences.

Interviewee

Date: _____

Name: _____

Signature:

Interviewer

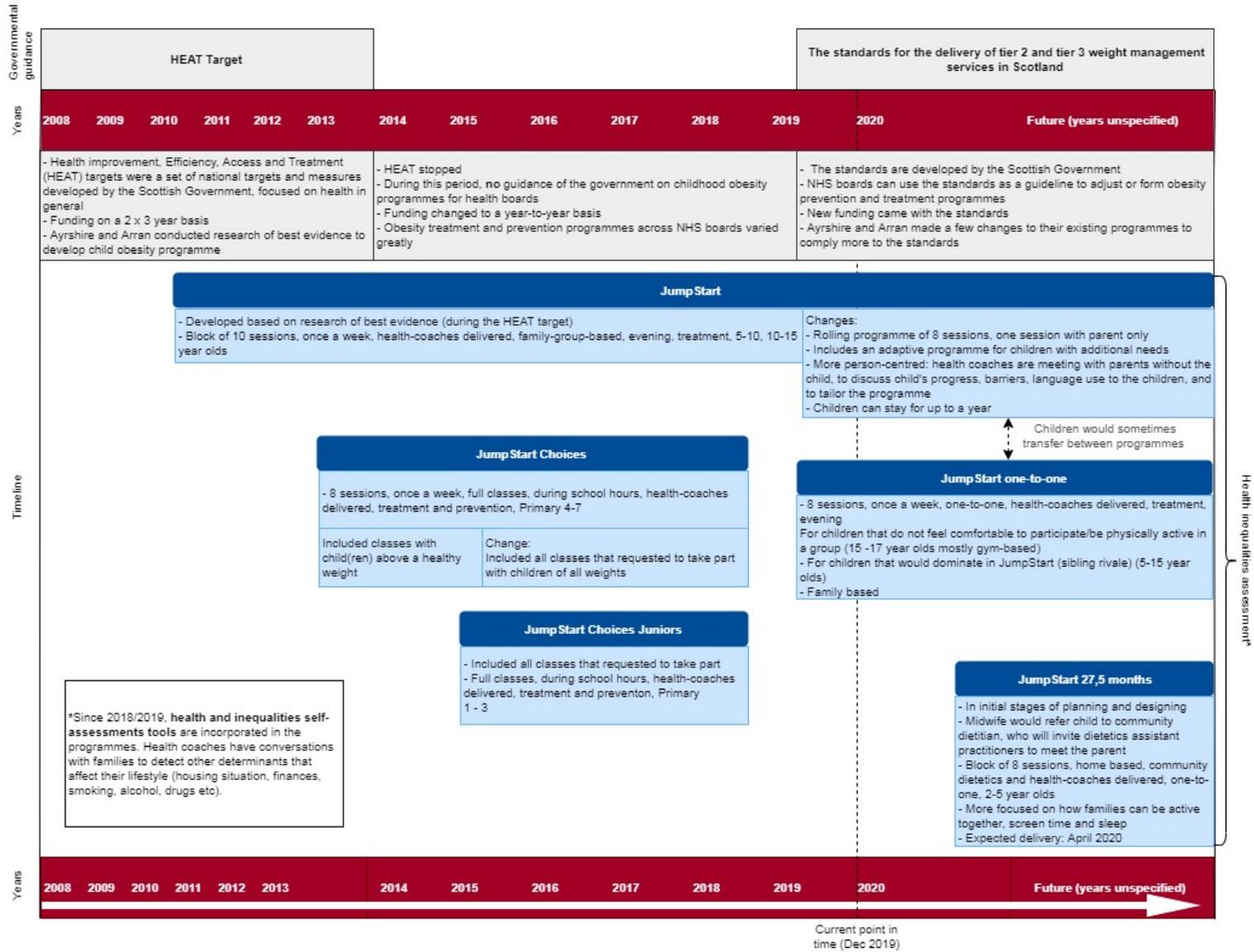
Date: _____

Name: _____

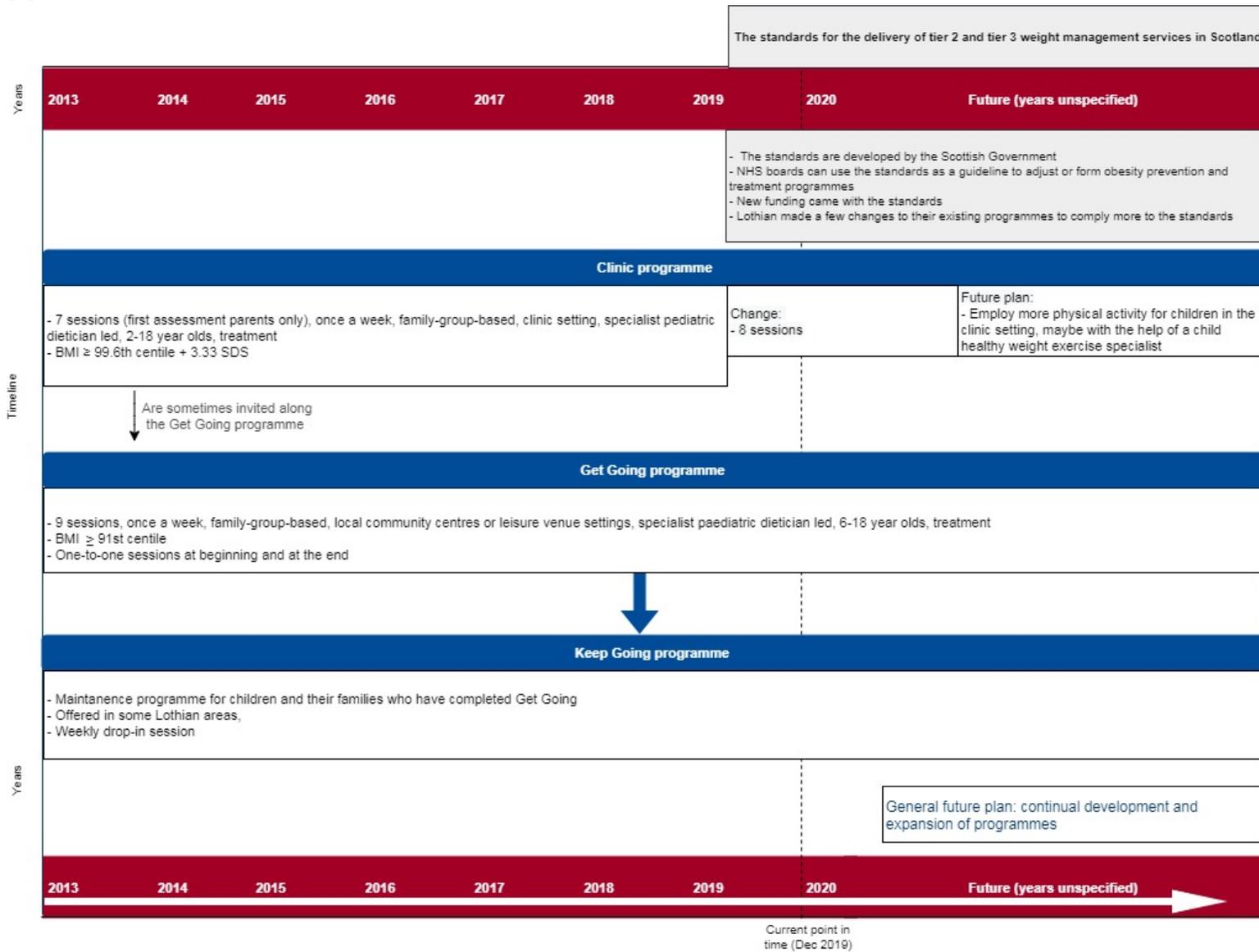
Signature:

For any questions you may have after the interview, you can contact me via email:
rosa.brunekreeft@wur.nl

Appendix 7: Visual timeline NHS Ayrshire and Arran



Appendix 8: Visual timeline NHS Lothian



Do you have concerns that your child could be above a healthy weight?

JumpStart is a Fun, Free ten week healthy lifestyle and weight management programme for families with children between the age of five and fifteen who are above a healthy weight.

The programme offers:

- Physical activity sessions
- Advice for keeping a healthy lifestyle
- Practical tips for healthy eating
- Parents discussion sessions
- Weekly games and activities

For more info
Please call us:

01292
885891

Six months
Free
Kids Leisure
Pass

 @NHSaaa  fb.com/nhsaaa  www.nhsaaa.net

Working together to achieve the healthiest
life possible for everyone in Ayrshire and Arran

All of our publications are available in other formats

