Obesity prevention during early life: Developing the evidence base to maximise the effectiveness of interventions delivered by health professionals

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Degree of Doctor of Philosophy (Arts, Humanities and Social Sciences)

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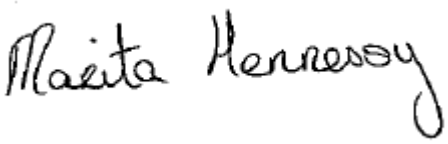
Declaration and Statement of contribution

Declaration

I declare that this thesis has not been submitted as an exercise at this or any other university.

I declare that this thesis is entirely my own work.

Signed: 

Marita Hennessy

Statement of contribution

The candidate was responsible for the design, data collection, analysis and write-up of each of the three studies conducted in this research. The supervisory team, Graduate Research Committee, and local experts advised and provided support in conducting the research.

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This research was funded by the Health Research Board SPHeRE/2013/1.

The POCKETS workshop that formed part of Study 1 was funded by the Irish Research Council's New Foundations Scheme 2016, awarded to Marita Hennessy.

The funders had no role in study design, data collection and analysis, decision to publish any of the material, or preparation of this thesis.

Preface

I thought a preface might be more apt than an acknowledgments section for this thesis. There are so many people to thank, I fear leaving someone out. This has been an important part of my life, yet it is just the continuation of a life-long quest to 'make a difference' – something I probably inherited in part from my dad. It took me 14 years to decide to do a PhD after I completed my undergraduate nutrition degree. I learned so much along the way, through various jobs and roles, and meeting – or reading the work of – so many fantastic people. While I always felt that I was 'a jack of all trades, master of none', I only came to realise during my PhD that this is in fact a strength.

While I toyed with the idea of doing a PhD for many years, it was working in a research support role that finally made me realise that it was what I had to do. I am very grateful to researchers at Waterford Institute of Technology (particularly Kieran Sullivan) who enabled me to realise this. Instead of solely advising and supporting others to pursue their research dreams, I needed (and had the ability) to chase my own.

Over the years I have had wonderful mentorship from various people – including Dr Patricia Mannix McNamara (University of Limerick), Dr Michelle Share (Trinity College Dublin), and Prof Linda Sharp (Newcastle University, formerly National Cancer Registry, Ireland). I can proudly add my PhD supervisors - Dr Caroline Heary, Prof Molly Byrne, and Dr Rachel Laws - to this list. They gave me freedom to explore and grow throughout the PhD, but were always there on the side-line to cheer me on – and believe me, I needed it. Their expertise, integrity and compassion guided me along the way. I fell in love with NUI Galway from the beginning. Though initially cautious about not being a psychologist in a School of Psychology, and specifically the Health Behaviour Change Research Group, I found a home there. The supportive environment amongst fellow postgrad researchers on the bottom floor is second to none, most especially in #UpG055. I am very grateful to everyone for taking me in and for their continuous encouragement and support. During the PhD I was fortunate to learn more about qualitative research in trials through my involvement with the Qualitative Research in Trials (QUESTS) Centre in the School of Nursing and Midwifery. QUESTS Co-Chair Dr Catherine Houghton

has been another wonderful mentor, and friend, to me throughout. I am very grateful to the SPHeRE Programme – particularly Prof John Browne and Prof Anne Hickey – for placing me within such a supportive and innovative environment.

I often say that I would not have done the PhD if it weren't for the SPHeRE Programme. It is a wonderful structured PhD programme, funded by the Health Research Board, which supports scholars in population health and health services research. I have always felt supported and encouraged by all of those involved on the Programme, especially my fellow scholars. While each of us came from different backgrounds, we shared a passion to affect change, and have the craic whilst doing so. Having worked with PhD students and supervisors previously as a research funding officer, I appreciated the value of a good funding programme. I am incredibly grateful to the Health Research Board for my PhD funding, and also the Irish Research Council for my POCKETS funding. I also recognise the privilege that I have had through my scholarship, and that many PhD students do not have such funding and support. I will continue to advocate for better funding and support for research at all levels.

Over the course of the PhD I had the opportunity to work with a variety of national groups in a support/advisory role – the Health Service Executive Healthy Weight for Children Working Group, the Association for the Study of Obesity on the island of Ireland Committee, and the Irish Heart Foundation Nutrition Council. I learned so much from these groups, and could also share my PhD work with them as I progressed. Working with the HSE – in particular Dr Phil Jennings and Sarah O'Brien – was hugely beneficial and rewarding. I am grateful to SPHeRE for the opportunity to do my national placement with Phil in Year 1; it has led to lots of positive collaborative activity. Joining the ASOI Committee was also a key moment for me – in particular, working with patient advocates. Sven Schubert and Susie Birney – and all of the other patient advocates I have met along the way – inspire me on both a professional and personal level.

I realised that I needed to do a PhD in 2015. I missed being a researcher, and having contact with research participants and being able to advocate for change through research. For me, this PhD has been about becoming a better researcher, but also trying to make an impact/contribution for those directly affected by my research, parents and infants in particular. I am very grateful to the members of the Parent Advisory Group (Eva, Jan, Joanne and Rachael) and the mums and dads who

took part in my qualitative study – allowing me into their homes, and lives. Much thanks is also due to those who helped me with participant recruitment, including Maria O'Dwyer (Paul Partnership, ABC Start Right Limerick) and Doughiska Family Resource Centre. Thanks also to Karen Farrell and Louise Tully for their assistance during the parent advisory group meetings.

In the last year of the PhD I got a lot of questions about my post-PhD plans. I found myself saying 'I've found my voice; I don't want to lose it again'. My confidence in my own ability has grown throughout the PhD (admittedly, I still have a long way to go). Support from Caroline, Molly and Rachel, and others mentioned, has definitely contributed to this, along with interactions with a tribe of people with similar interests/concerns that I have met through social media – yes, Twitter. I initially used it as a diary of sorts, to track what I was reading or events I was interested in and to share information, but it grew into something so much bigger. I have learned so much, met so many incredible people, and have developed a lot of collaborations through it (which has involved much letter-writing). In particular I was very fortunate to meet Sarah Dempster, Fiona Quigley, Helen West and Oli Williams, who have kept my intellectual curiosity and activism aroused concerning all things weight, stigma, and social justice, and me going with laughs, threats, and inspiration in the final year of the PhD.

I hope as you read this thesis, you will see evidence of all of the above, and that this work will, in some form, contribute towards making a difference.

Dedication

This thesis is dedicated to the memory of Siobháin O'Doherty, a wonderful friend to all who knew her, and fellow SPHeRE Scholar

The Lake Isle of Innisfree

I will arise and go now, and go to Innisfree,

And a small cabin build there, of clay and wattles made;

Nine bean-rows will I have there, a hive for the honey-bee,

And live alone in the bee-loud glade.

And I shall have some peace there, for peace comes dropping slow,

Dropping from the veils of the morning to where the cricket sings;

There midnight's all a glimmer, and noon a purple glow,

And evening full of the linnet's wings.

I will arise and go now, for always night and day

I hear lake water lapping with low sounds by the shore;

While I stand on the roadway, or on the pavements grey,

I hear it in the deep heart's core.

Yeats, W. B. (William Butler), 1865-1939. (1924). The Lake Isle of Innisfree. San Francisco: J.H. Nash.

PhD requirements

This PhD was in accordance with the guidelines for an article-based PhD, as set by the School of Psychology at the National University of Ireland, Galway. Requirements for an article based PhD were met in this thesis, as these state that three articles should make up the core of the PhD, with two of these articles accepted for publication and the third submitted for review. The following manuscripts, published or awaiting submission for publication, form the empirical chapters within this thesis.

Published

Hennessy, M., Byrne, M., Laws, R., Mc Sharry, J., O'Malley, G., & Heary, C. (2019). Childhood obesity prevention: priority areas for future research and barriers and facilitators to knowledge translation, coproduced using the nominal group technique. *Translational Behavioral Medicine*, *9*(4), 759–767. Retrieved from http://dx.doi.org/10.1093/tbm/iby074. doi:10.1093/tbm/iby074

Hennessy, M., Heary, C., Laws, R., van Rhoon, L., Toomey, E., Wolstenholme, H., & Byrne, M. (2019a). The effectiveness of health professional-delivered interventions during the first 1,000 days to prevent overweight/obesity in children: A systematic review. *Obesity Reviews*, *20*(12), 1691-1707. Retrieved from https://doi.org/10.1111/obr.12924. doi: 10.1111/obr.12924

Hennessy, M., Heary, C., Laws, R., Van Rhoon, L., Toomey, E., Wolstenholme, H., & Byrne, M. (2019b). Health professional-delivered obesity prevention interventions during the first 1,000 days: A systematic review of external validity reporting. *HRB Open Research*, *2*, 14. Retrieved from https://hrbopenresearch.org/articles/2-14/v1files/39675/2-14.html. doi:10.12688/hrbopenres.12924.1

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Hennessy, M., Byrne, M., Laws, R., & Heary, C. (2020) "They just need to come down a little bit to your level": A qualitative study of parents' views and experiences of early life interventions to promote healthy growth and associated behaviours. *International Journal of Behavioural Nutrition and Physical Activity*.

Abstract

Background: Childhood obesity is a global public health challenge. Research priorities have not been established for obesity prevention research across childhood, however. Coproduction of research priorities leads to research which may be more translatable to policy and practice. Childhood obesity prevention is advocated, particularly during the first 1,000 days – the period between conception and a child's second birthday. This is a critical window of opportunity to promote healthy growth and associated behaviours. Health professionals can play an important role in part due to the large number of routine contacts they have with parents. While there is some evidence of the effectiveness of health professional delivered interventions in impacting on obesity-related outcomes, reviews have not examined the impact of provider type, and the active ingredients of interventions have not been explored. The extent to which interventions are generalisable to populations or settings beyond those in the original study is also unclear. Furthermore, there is an absence of research on parental views and experiences of early life health professional-delivered obesity prevention interventions.

Aims: The aim of this research is to examine opportunities for, and the effectiveness of, interventions delivered by health professionals during the first 1,000 days which aim to prevent childhood obesity. This will provide a basis for the development, adaptation and/or scale-up of future interventions.

Methods: A mixed methods approach was taken. In study 1, a nominal group technique was used to co-produce research priorities, and generate information on facilitators and barriers to knowledge translation, in childhood obesity prevention. In study 2a, a systematic review was conducted to examine the effectiveness of health professional-delivered early life obesity prevention interventions, and what behaviour change theories and/or techniques were associated with more effective intervention outcomes. In study 2b, included studies within the systematic review were further examined to determine the extent to which they reported on elements that can be used to inform generalizability across settings and populations. Finally, in study 3, qualitative interviews with parents were conducted to examine their views and experiences of early life interventions to promote healthy growth, particularly

those delivered by health professionals. Data were analysed using reflexive thematic analysis.

Findings: Key themes identified during the research prioritization exercise were the importance of funding and resources, coproduction of research, and a focus on both implementation research and social determinants within the field of childhood obesity prevention. The systematic review identified 39 trials involving 46 intervention arms. There was some evidence of intervention effectiveness: only four interventions were effective on a primary (adiposity/weight) and secondary (behavioural) outcome measure, while twenty-two were effective on a behavioural outcome only. Several methodological limitations were noted, impacting on efforts to establish the active ingredients of interventions. Reporting of external validity dimensions varied; elements that were poorly described included: representativeness of individuals and settings, treatment receipt, intervention mechanisms and moderators, cost effectiveness, and intervention sustainability and acceptability. Two central themes were generated from the qualitative data: (1) navigating the uncertainty, stress, worries, and challenges of parenting whilst under scrutiny and (2) accessing support in the broader system. Becoming a parent brings challenges relating to lack of knowledge and/or confidence in this role, and feeling judged for parenting/feeding decisions. Parents require support and face barriers to accessing and engaging with supports and services. They are often in the receiving end of uninformed, conflicting, confusing, changing and/or unsolicited advice. Relationships and relatability are key, and tailored information and support is required.

Conclusion: The findings of this research contribute important insights into early life obesity prevention interventions, with implications for the conduct and reporting of research, and knowledge translation efforts. The identified research priorities may help to shape the agendas of funders and researchers, and aid in the conduct of policy-relevant research and the translation of research into practice in childhood obesity prevention. Health professional-delivered early life obesity prevention interventions show some evidence of effectiveness and there is some evidence that more active engagement strategies—such as problem solving, review behavioural goal(s), feedback on behaviour, feedback on outcome(s) of behaviour, and social support (unspecified) — should be incorporated into practice. More emphasis is needed on research designs that consider generalisability, and the reporting of

external validity elements. Parents are receptive to, and would welcome, support during this critical time period, particularly around feeding. Such support, however, needs to be practical, realistic, evidence-based, timely, accessible, non-judgemental, and from trusted sources, including both health professionals and peers. Various levels of support and intervention are required, at individual, inter-personal, organisational, community, and policy levels. Interventions to promote healthy growth and related behaviours need to be developed/adapted and implemented in a way that supports parents, their views and circumstances.

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List of abbreviations

ASOI	Association for the Study of Obesity on the Island of Ireland
ASO UK	Association for the Study of Obesity in the UK
BCT	Behaviour Change Technique
BMI	Body Mass Index
CDC	Centers for Disease Control
COREQ	COnsolidated criteria for REporting Qualitative research
DOHaD	Developmental Origins of Health and Disease
EASO	European Association for the Study of Obesity
ESPGHAN	European Society for Paediatric Gastroenterology, Hepatology, and Nutrition
EU	European Union
GP	General Practitioner
GUSTO	Growing Up in Singapore Towards healthy Outcomes
GWG	Gestational Weight Gain
HBCRG	Health Behaviour Change Research Group
HSE	Health Service Executive
InFANT	Infant Feeding Activity and Nutrition Trial
IOM	Institute of Medicine
IOTF	International Obesity Task Force
ISCO	International Standard Classification of Occupations
MRC	Medical Research Council
NICE	National Institute for Health and Care Excellence
NIHBCC	National Institutes of Health Behaviour Change Consortium
NGT	Nominal Group Technique
NRC	National Research Council

PHN	Public Health Nurse
POCKETS	Prevention Of Childhood obesity-Knowledge Exchange and TranSlation
POI	Prevention of Overweight in Infancy (POI)
PPI	Patient and Public Involvement
PRISMA	Preferred Reporting Items for Systematic-Reviews and Meta-Analyses
PROBIT	PROmotion of Breastfeeding Intervention Trials
PROSPERO	International Prospective Register of Systematic Reviews
RCPI	Royal College of Physicians of Ireland
RCT	Randomised Controlled Trial
RE-AIM	Reach Effectiveness-Adoption Implementation Maintenance
SD	Standard Deviation
SRQR	Standards for Reporting Qualitative Research
TIDieR	Template for Intervention Description and Replication
WHO	World Health Organisation

Chapter 1 Introduction

1.1 Chapter overview

This thesis aims to build the evidence base to maximise the effectiveness of early life obesity prevention interventions delivered by health professionals. This introductory chapter will set the scene for the research by providing an overview and critical discussion of the relevant literature and issues. This includes the importance of early intervention to promote healthy growth and prevent childhood obesity, the protective and risk factors that should be targeted, and the state of the evidence concerning the effectiveness of interventions. The latter will explore the use of behaviour change theories and techniques and highlight gaps which need to be addressed. The role of health professionals and parents will also be discussed, in addition to the challenges in translating research into practice. Finally, the rationale and aims of the current programme of research will be summarised, and the thesis structure outlined.

A word on language and scope at the outset. There is much debate, and no agreement, at present around the most appropriate language to use when speaking about weight issues (British Psychological Society, 2019). The general consensus is that individuals should be asked what their preferred terms are. I use 'person first' language when referring to overweight and obesity throughout this thesis. I describe children as having overweight or obesity, rather than as being overweight or obese; in instances of overweight and obesity, I use the term 'higher weight'. I also use the term 'healthy weight' throughout to describe weight status that is classified with the 'healthy weight range' according to body mass index (BMI) (i.e. 18.5-24.9). I place this term in inverted commas as its meaning and use is challenged, but I use it throughout to be somewhat consistent with the wider literature. I also recognize that the focus of this thesis is in a very discrete area – behavioural interventions delivered by health professionals. This is not to say that I advocate a singular focus on individual behaviours and/or responsibility in this area. Such a focus would be problematic and detract from addressing necessary policy and system level changes. There is no one intervention that will address obesity on its own (Rutter, 2012). I focus on this specific issue for the purposes of this thesis, but recognise that while individual-level changes are a necessary component of obesity prevention, they are

only one part of a whole system response, and must be supported by upstream actions that focus on promoting healthier physical, economic and social environments (Rutter et al., 2017). This is further discussed in section 1.6.

1.2 Childhood obesity: a global public health issue

Childhood obesity is a global public health challenge (World Health Organisation, 2016b). In 2016, 124 million children and adolescents aged 5-19 years were classified as having obesity – a 10-fold increase from 11 million in 1975; an additional 213 million were classified as having overweight (Abarca-Gómez et al., 2017). Obesity rates increased from less than 1% (equivalent to five million girls and six million boys) in 1975 to nearly 6% in girls (50 million) and nearly 8% in boys (74 million) in 2016 (Abarca-Gómez et al., 2017). Despite global efforts to address childhood obesity, rates are increasing, or, at best, stabilising. In the US, there is no evidence of a decline in obesity prevalence in any age group of children and adolescents aged 2 to 19 years (Skinner, Perrin, & Skelton, 2016). While overall prevalence rates of childhood overweight and obesity are high, they have stabilized in most European countries, including Ireland (Garrido-Miguel et al., 2019). Similar to rates in other developed countries, one in four children in Ireland have a higher weight; this is evidenced in nine-year-olds, but also in children as young as three years of age (Layte & McCrory, 2011; Williams, Murray, McCrory, & McNally, 2013). Furthermore, inequalities in children's BMI (as measured by maternal education levels) are evident in children as young as three years of age, and widen across childhood into adolescence (McCrory et al., 2019). While rates appear to be stabilizing in school-aged children in Ireland, albeit at a high level, rates among those from lower socio-economic groups are increasing (Bel-Serrat et al., 2017). Thus, both the levels of childhood obesity, and the inequalities therein, are important to focus on.

Obesity is also an issue amongst very young children. In 2016, an estimated 41 million children worldwide under the age of five were classified as having a higher weight (World Health Organisation, 2018). Using data from the Growing Up in Ireland study, Jabakhanji, Pavlova, Groot, Boland, and Biesma (2017) found that one in five 9-month-olds were classified as having obesity, and a further one in five with overweight, in 2008; this increased by 3% and 1%, respectively, by 2011 when

these children were 3 years of age. They observed no differences by socio-economic grouping when confounders were adjusted for (Jabakhanji et al., 2017). It should be noted that there is a lot of variation in weight status during early childhood, however. For example, data from the Growing Up in Ireland study show that while similar rates of children were categorized as having a 'normal' weight at the ages of 3 and 7/8 years (68%), similar numbers of children (10%) moved between the non-overweight and overweight category during this time; 10% were classified as having overweight/obesity at both ages (Growing Up in Ireland, 2017). Thus, while there is a degree of variation between individuals, the overall prevalence of overweight and obesity during early childhood is of concern, for a variety of reasons.

Obesity in childhood is associated with several co-morbidities (Sharma et al., 2019). These include cardiovascular risk factors, such as hypertension, insulin resistance and hyperlipidemia (Cote, Harris, Panagiotopoulos, Sandor, & Devlin, 2013; Umer et al., 2017); digestive diseases, such as non-alcohol fatty liver disease (Anderson et al., 2014; Ayonrinde et al., 2015); musculoskeletal conditions (Paulis, Silva, Koes, & Middelkoop, 2014); respiratory diseases such as sleep apnoea (Narang & Mathew, 2012) and asthma (Mebrahtu, Feltbower, Greenwood, & Parslow, 2015). Indeed a recent meta-analysis found that children and adolescents with obesity were 1.4 times more likely to have prediabetes, 4.4 times more likely to have high blood pressure, 26.1 times more likely to have non-alcohol fatty liver disease, and 1.7 times more likely to have self-reported asthma (Sharma et al., 2019). Numerous psycho-social consequences have also been identified, including: bullying and victimisation (Lumeng et al., 2010; Puhl, Luedicke, & Heuer, 2011; van Vuuren et al., 2019), reduced self-esteem (Griffiths, Parsons, & Hill, 2010; Sanders, Han, Baker, & Cobley, 2015) and quality of life (Griffiths et al., 2010; Lebacq et al., 2018; Sanders et al., 2015); and depression and depressive symptoms (Quek, Tam, Zhang, & Ho, 2017; Sanders et al., 2015). Children and adolescents with obesity experience stigma (Pont et al., 2017). Weight bias is prevalent in educational settings, among peers as well as teachers, and negatively impacts students' health and educational experiences (Nutter et al., 2019). Children as young as three years of age have been found to demonstrate a preference for thin and average-size bodies and an aversion towards bodies of a higher weight (Harriger, 2015; Harriger, Schaefer, Kevin Thompson, & Cao, 2019; Patel & Holub, 2012; Spiel, Paxton, & Yager, 2012; Su & Aurelia, 2012).

In addition to impacting on child health and wellness, obesity in infancy and early childhood tracks into later childhood and adulthood (Geserick et al., 2018; Simmonds et al., 2015; Simmonds, Llewellyn, Owen, & Woolacott, 2016; Singh, Mulder, Twisk, Van Mechelen, & Chinapaw, 2008; Stuart & Panico, 2016). A systematic review found that children and adolescents with obesity were around five times more likely to be affected by obesity in adulthood than those who did not have obesity (Simmonds et al., 2016). It also found that approximately 55% of children with obesity go into adolescence with obesity, 80% of adolescents with obesity will still be affected by obesity in adulthood, and 70% will be affected by obesity over the age of 30 (Simmonds et al., 2016). The impacts on weight status in adolescence appear to be enhanced amongst children classified as having obesity at 3 years of age in comparison to younger ages (Geserick et al., 2018). Such tracking of obesity can also result in morbidities in later life (Simmonds et al., 2016). It should be noted, however, that while there is evidence that overweight and obesity in childhood and adolescence is associated with increased risk of premature mortality and physical morbidity in adulthood, the majority of adult obesity-related morbidity occurs in adults who had a healthy weight in childhood (Llewellyn, Simmonds, Owen, & Woolacott, 2016). Seventy percent of adults with obesity were not classified as having obesity in childhood or adolescence, in a meta-analysis conducted by Simmonds et al. (2016). Similarly, most infants who go on to have obesity are not necessarily infants with higher weights; the majority of infants with a higher weight revert to overweight or normal weight in childhood, even though they have an increased risk of obesity compared to infants with a BMI within the normal range (Wright, Marryat, McColl, Harjunmaa, & Cole, 2018). This underscores the importance of promoting healthy growth, and maintaining healthy weight, in children from a young age.

Childhood obesity has a variety of socio-economic consequences, such as increased need for supports and services, as well as ability to engage in activities related to productivity such as employment, which may be important to them as individuals, as well as society. In their systematic review, Hamilton, Dee, and Perry (2018) estimated the mean total lifetime cost of a child or adolescent with obesity in Ireland was €149,206 for a boy and €148,196 for a girl. This was divided into an average of €16,229 in healthcare costs and €132,977 in productivity losses for boys and €19,636 and €128,560, respectively, for girls. The lifetime direct and indirect

costs of childhood obesity were estimated at €4.6 billion in Ireland in 2015 (Perry et al., 2017); one-fifth (21%) of these lifetime costs were direct healthcare costs, while the remainder (79%) were indirect costs. Young children with obesity experience greater healthcare utilization. Kelly et al. (2019) observed that, compared to children with a healthy weight, children with obesity (from the age of 5-8 years) had additional estimated costs of general practitioner (GP) appointments and prescriptions of £28 a year. An Australian study found that the healthcare costs of children with obesity (aged 2-5 years) were 1.62 times those of children with a healthy weight (Hayes et al., 2016). While such research could be construed as stigmatising to those with a higher weight, i.e. the 'burden' they place on the health system and/or society, it should be framed in support of children's rights and also ensuring that adequate supports are available. Childhood obesity is a child rights issue, one which must be addressed across society, and it is the responsibility of the state to ensure that children grow up in healthy environments and have a fair chance in life (Mytton, Fenton-Glynn, Pawson, Viner, & Davies, 2019).

1.3 Defining overweight and obesity in children: a contested area?

Methods used to investigate associations between early growth and future risk of obesity vary considerably and have an important effect on the interpretation of growth (Rolland-Cachera & Péneau, 2011). Overweight and obesity in children, and adults, is commonly measured and defined at a population level by BMI, the ratio of weight in kilos divided by height in metres squared. On an individual level, BMI cannot distinguish between the relative proportion of fat and muscle mass, or body fat distribution, even in young children (Delisle Nyström et al., 2018; Forsum et al., 2019). While BMI is a poor surrogate for fatness, it has utility in epidemiology, however, given that height and weight are easily measured at scale, with recognised limits to self-reported measurements (Blundell, Dulloo, Salvador, Frühbeck, & on behalf of the EASO SAB Working Group on BMI G., 2014; Gutin, 2018). Some studies have questioned the utility of BMI when investigating overweight and obesity in early life (Henriksson et al., 2017) and a range of other measures have been suggested. For example, Hawkes et al. (2016) found that the weight z-score (i.e. standard deviation score) at two months is as good at predicting BMI at two years as body composition parameters, while Perng et al. (2017) suggest that change in BMI z-score (compared with weight-for-age z-score) is the best

indicator of fat accrual during the first five postnatal months. The general consensus, however, is that BMI is the optimal measure of excess adiposity in children (Bell et al., 2018; Simmonds et al., 2015; Styne et al., 2017), including infants (Roy et al., 2016), and is acceptable to children and their carers (Simmonds et al., 2015). It is also argued that BMI or BMI % are the optimal measures of change in adiposity in growing children; while BMI z-score is optimal for assessing adiposity on a single occasion, it is not necessarily the best scale for measuring change in adiposity, as the within-child variability over time depends on the child's level of adiposity (Cole, Faith, Pietrobelli, & Heo, 2005).

To assess a child's BMI, both the age and sex of the child need to be taken into account as a child's BMI changes as they mature and patterns of growth differ between boys and girls. Adults are usually classified as having obesity if their BMI exceeds 30kg/m², or overweight if their BMI is greater than 25kg/m²; adults with a BMI of less than 18.5kg/m² are considered underweight. Child BMI thresholds on the other hand are defined in terms of a specific z-score, or centile, on a child growth reference, e.g. the UK90 (0-23 years), International Obesity Taskforce (IOTF) (2-18 years), Centers for Disease Control (CDC) (2-20 years) and World Health Organization (WHO) charts (0-5 years and 5-19 years) (Dinsdale, Ridler, & Ells, 2011). The WHO growth chart 0-4 years (de Onis, Garza, Onyango, & Martorell, 2006; WHO Multicentre Growth Reference Study Group, 2006b) is based on a longitudinal multi-centre study of infants in Brazil, Ghana, India, Norway, Oman, and the United States. Infants represented in the WHO growth standards were single-birth, term infants of non-smoking healthy mothers, with no known health or environmental constraints to growth who were exclusively breastfed for 4 months, with complementary foods introduced by 6 months of age, and breastfeeding continued to 12 months of age; thus providing an indicator of optimal growth (WHO Multicentre Growth Reference Study Group, 2006a). The CDC charts represent the growth of infants to 36 months of age collected in 3 cross-sectional surveys conducted between 1971 and 1994, with some added data because of the limited number of younger-age infants in the initial surveys. The CDC growth charts exclude very low birth weight infants (1500 g) but have no inclusion or exclusion criteria related to feeding or environmental variables (Kuczmarski et al., 2000). In Ireland, the UK-WHO (Ireland) growth charts (0-4 years) are used to monitor the growth of very young children (Health Service Executive, 2019b).

Some researchers have cautioned a focus on infant BMI reduction as an early-life obesity prevention target as they found that infants with higher BMI incur greater and longer-term gains in fat-free mass, rather than greater adiposity, and that beyond young adulthood, infant BMI may have limited consequences for body composition (Johnson et al., 2017). Indeed, it has also been argued that modifiable causal factors, such as diet and/or physical activity, rather than markers of risk such as BMI, should be the explicit targets of obesity prevention programmes (Chiolero, 2018).

1.4 Early life obesity prevention: the importance of the first 1,000 days

The first 1,000 days is the period from conception to a child's second birthday. The perinatal period (conception to birth) is a critical window of opportunity to influence long-term obesity and non-communicable disease risk for women and their child(ren), as well as maternal weight status for subsequent pregnancies (Farpour-Lambert, Ells, Martinez de Tejada, & Scott, 2018). During the first year of life, an infant's birth weight is doubled by six months and tripled by one year, with an increase in length of 50% (Thomas & Bishop, 2007); optimum nutrition is therefore key during this period. Indeed, the first two years of a child's life is a critical period as it is when lifelong eating habits, behaviours and patterns are established (Birch & Doub, 2014; Cashdan, 1994; Cooke, 2007). Furthermore, dietary patterns and food preferences established in early life track into later childhood and young adulthood (Nicklaus, Boggio, Chabanet, & Issanchou, 2005; Reidy et al., 2017; Rose, Birch, & Savage, 2017; Skinner, Carruth, Bounds, Ziegler, & Reidy, 2002). While food preferences can be modified over time, they are often resilient to change (Hawkes et al., 2015), thus underscoring the importance of establishing good habits and behaviours from an early age. Healthful dietary behaviours throughout childhood are also associated with less adiposity in early adolescence (Gingras, Rifas-Shiman, Taveras, Oken, & Hivert, 2018). Obesity-related behaviours, including diet and physical (in)activity behaviours, also track from childhood into adulthood (Craigie, Lake, Kelly, Adamson, & Mathers, 2011).

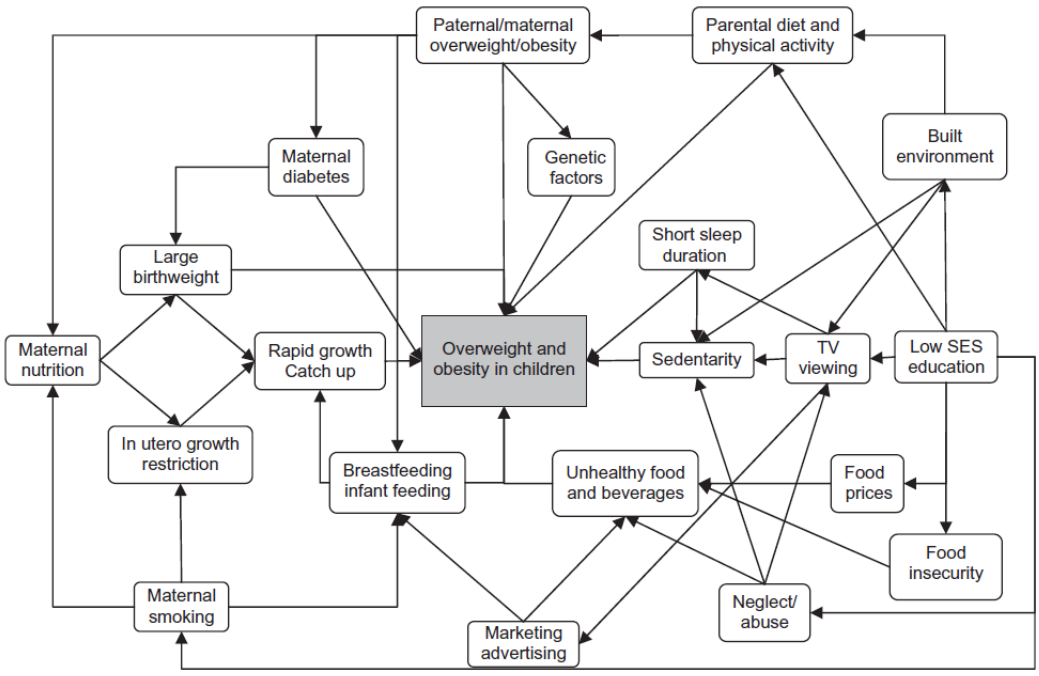
Several risk factors, identifiable during the first 1,000 days, are associated with the development of childhood overweight/obesity (Monasta et al., 2010; Weng, Redsell, Swift, Yang, & Glazebrook, 2012; Woo Baidal et al., 2016). These include

maternal pre-pregnancy overweight, smoking during pregnancy, high infant birth weight and rapid weight gain; breastfeeding and the late introduction of solid foods are moderately protective factors (Weng et al., 2012). Definitions of 'late introduction to solid foods' vary by study; in the latter systematic review, this concept was generally defined as the introduction of solids beyond four, or six months of age. Having a greater number of early-life risk factors is associated with large differences in adiposity and risk of overweight and obesity in later childhood (Robinson et al., 2015). It must be noted, however, that while randomized controlled trials are considered the gold standard study design, they are not feasible in many cases. Associations identified in observational studies between several risk factors – such as breastfeeding and prenatal smoking – are likely therefore to be confounded with genetic, environmental, and familial factors (Hawkins, Baum, Rifas-Shiman, Oken, & Taveras, 2019). For example, a recent study by Smith et al. (2019) found that breastfed infants were heavier at birth (measured within 72 hours of delivery), but their percentage fat mass was lower than that of exclusively formula-fed infants, indicating that differences in intra-uterine exposures, irrespective of early diet, may partly explain an infant's obesity risk. There are several modifiable risk and protective factors therefore which are amenable to intervention during this period. It is important therefore to place such risk and/or protective factors within the broader context of the various other factors that influence a child's weight.

Child growth is influenced by a variety of genetic, intrauterine, environmental and behavioural factors (Baranowski, Motil, & Moreno, 2019; Birch, 2006; Elks et al., 2012; Maes, Neale, & Eaves, 1997; Min, Chiu, & Wang, 2013; Schrempft et al., 2018; Silventoinen et al., 2016; Wilding, Ziauddeen, Smith, Roderick, & Alwan, 2019). Potential early-life determinants of overweight and obesity in children aged 0-5 years are outlined in Figure 1.1. Over 100 twin and family studies have established that 50–90 per cent of weight differences between people can be explained by genetic influences (Elks et al., 2012). Obesity results, in part, from an interaction between genetic susceptibility to overeating and exposure to an 'obesogenic' food environment (Llewellyn & Fildes, 2017). Indeed, Schrempft et al. (2018) found that the heritability of BMI standard deviation (SD) score was significantly higher among children living in overall higher-risk home environments compared with those living in overall lower-risk home environments. Thus, it is important to create and sustain such supportive environments by including a focus

on the risk and protective factors outlined above. It should also be recognized, however, that research on the developmental origins of health and disease (DOHaD) has traditionally focused on how maternal exposures around the time of pregnancy might influence offspring health and disease risk with little focus on other factors such as paternal factors and postnatal exposures in later life (Sharp, Lawlor, & Richardson, 2018). This can overburden mothers with responsibility for children's health, minimizing the roles of others, at an individual, community and societal level (McKerracher, Moffat, Barker, Williams, & Sloboda, 2018). The role of fathers in influencing the obesity risk of children during early life is underappreciated yet paternal factors play a role during pre-conception and pregnancy, and are influenced by social structures including poor diet and stress (Milliken-Smith & Potter, 2018). Evidence is accumulating to support paternal influences on the risk of obesity in offspring (Noor et al., 2019; Sharp & Lawlor, 2019).

Figure 1.1 Potential early-life determinants of overweight and obesity (0-5 years)



Source: Monasta et al. (2010) (© 2010 The Authors; © 2010 International Association for the Study of Obesity), used under the terms and conditions of the licence provided by John Wiley and Sons and Copyright Clearance Center

1.5 Risk and protective factors for childhood obesity during the first 1,000 days: evidence and prevalence

In this section, key risk and protective factors for early life obesity prevention will be described and prevalence rates outlined. These include maternal pre-pregnancy overweight, smoking during pregnancy, high infant birth weight, rapid infant weight gain; breastfeeding, and the appropriate introduction of solid foods (Weng et al., 2012). Twenty-four-hour movement behaviours (physical activity, sedentary behaviour, and sleep) and childcare will also be discussed, as they are increasingly recognized as potentially important influences on child weight.

1.5.1 Maternal pre-pregnancy overweight

Several studies report a positive association between a high pre-pregnancy BMI and childhood obesity (Adane, Dobson, Tooth, & Mishra, 2018; Heslehurst et al., 2019; Ohlendorf, Robinson, & Garnier-Villarreal, 2019; Schoppa et al., 2019; Weng et al., 2012). Pre-pregnancy obesity is an important risk factor for macrosomia, i.e. high infant birth weight (Dai, He, & Hu, 2018), which is also associated with increased risk of overweight (Schellong, Schulz, Harder, & Plagemann, 2012). Most of the effect of pre-pregnancy obesity on childhood weight-related outcomes appears to be via a natural direct effect (e.g. potentially increased fetal growth, in utero programming effect, or shared familial factors), however, not mediated through infant birth weight (Adane, Tooth, & Mishra, 2019). Indeed it is argued that preventive interventions for childhood obesity should focus on maternal BMI rather than on pregnancy complications such as gestational diabetes (Golab et al., 2018). Promoting a healthy pre-pregnancy weight is also key to addressing socioeconomic inequalities in healthy fetal growth (Ballon et al., 2019).

Picking up the earlier point about not placing undue responsibility on mothers, some recent research has also found associations between paternal weight status and childhood overweight. In a study by Aris et al. (2018), children exposed to maternal pre-pregnancy or paternal overweight status had the largest individual predicted probability of child overweight/obesity, Sørensen et al. (2016), however, found stronger associations between child BMI and maternal BMI, than child BMI and paternal BMI, at birth, but differences declined with increasing child age. Lindkvist, Ivarsson, Silfverdal, and Eurenius (2015) found high levels of overweight

(33%) and obesity (14%) in a sample of toddlers in Sweden: the risk of a higher weight increased if one parent was overweight and increased even more if both parents were overweight.

Rates of pre-pregnancy overweight / obesity vary across the globe: USA (42%), Europe (30%) and Asia (10%) (Goldstein et al., 2018). Data in Ireland on maternal (and paternal) obesity is limited, and not routinely reported at a national level. In Irish study by Kelly et al. (2011), 16% of mothers-to-be and 14% of fathers-to-be had a BMI >29.9kg/m^2, (i.e. with obesity), while 26% and 50%, respectively, had a BMI of 25.0-29.9 kg/m^2 (i.e. with overweight). Clinical reports from the four largest maternity hospitals indicate that fewer than half of women have a BMI in the healthy range at first booking visit, with the majority of women classified as overweight (Department of Health, 2016a). While overall rates of obesity remained stable in women presenting in one large maternity hospital in Ireland from 2009 to 2013 (approximately 16.8%), they have since increased, to 18.9% in 2017 (Reynolds et al., 2019). Rates of severe obesity (BMI ≥40.0 kg/m^2) increased by 48.5% from 2009 to 2013 (McKeating et al., 2015). Heslehurst et al. (2007) also observed increasing rates of maternal obesity in the UK, with rates increasing significantly, from 9.9 to 16.0% between 1990-2004. In these studies, obesity incidence increased with increasing parity, advancing age and socioeconomic disadvantage (Heslehurst et al., 2007; McKeating et al., 2015; Reynolds et al., 2019).

National Institute for Health and Care Excellence (NICE) guidelines recommend that health professionals should advise, encourage and help women with a BMI of 30 or more to reduce weight before becoming pregnant and provide information and support about healthy eating and physical activity during pregnancy; weight loss should be avoided during pregnancy (NICE, 2010). In Ireland and the UK, guidelines state that all pregnant women should have their weight and height measured using appropriate equipment, and their BMI calculated at the antenatal booking visit, with no repeat measurements of maternal weight during pregnancy (Denison et al., 2018; Institute of Obstetricians and Gynaecologists Royal College of Physicians of Ireland & Clinical Strategy and Programmes Directorate Health Service Executive, 2011). There is a lack of consensus on optimal gestational weight gain. Indeed, UK guidance states that, until further evidence is available, a focus on a healthy diet may be more applicable than prescribed weight gain targets (Denison et al., 2018). There are no guidelines on gestational weight gain in the UK or Ireland,

however, the Institute of Medicine (IOM) guidelines are often cited. The IOM recommendations for weight gain in pregnancy vary by BMI category: those with a BMI of <18 ('underweight') should gain 12.5-18.0 kg; BMI of 18.5-24.9 ('normal weight'): 11.5-16.0 kg; BMI of 25- 29.9 ('overweight'): 7.0-11.5 kg; BMI of ≥30 ('obese'): 5.0-9.0 kg (IOM (Institute of Medicine) & NRC (National Research Council), 2009).

1.5.2 Smoking during pregnancy

Several studies have found a positive association between smoking during pregnancy and increased risk of childhood overweight and obesity (Albers et al., 2018; Fairley et al., 2015; Hawkins, Cole, Law, & Millennium Cohort Study Child Health Group, 2009; Rayfield & Plugge, 2017; Salahuddin, Pérez, Ranjit, Hoelscher, & Kelder, 2018; Weng et al., 2012). It is suggested that the association between maternal smoking during pregnancy and childhood overweight/obesity may reflect confounding by shared familial characteristics (Fairley et al., 2015). The global prevalence of smoking during pregnancy is estimated to be 1.7%, however rates vary across the world (Lange, Probst, Rehm, & Popova, 2018). According to Growing Up in Ireland data, 18% of mothers whose children were born in 2007 reported that they smoked during pregnancy (McCrory & Layte, 2012b), while a study conducted in the Coombe maternity hospital in Dublin recorded prevalence rates dropping from 14.3% to 10.9% between 2011 and 2015 (Reynolds et al., 2017).

1.5.3 High infant birthweight

Studies report an association between high infant birthweight and childhood obesity (Hawkins et al., 2009; Weng et al., 2012). The Health Service Executive (HSE) defines macrosomia as >4,000g (Health Service Executive, 2018c), while the American College of Obstetricians and Gynecologists and Royal College of Obstetricians and Gynecologists define it as ≥4,500g (American College of Obstetricians and Gynecologists' Committee on Practice Bulletins-Obstetrics, 2016). In 2016, there were 63,870 were live births (61,440 singleton and 2,430 multiple), of which 15.0% were ≥4,000 grams and 2.2% were ≥4,500g (Healthcare Pricing Office, 2018).

1.5.4 Rapid weight gain

While the definition for rapid weight gain varies, it is most commonly defined as > +0.67 change in weight SD score (Monteiro & Victora, 2005; Ong & Loos, 2006). This 0.67 SD represents the difference between the displayed centile lines on growth charts, and clinically relevant rapid weight gain is indicated by upward centile crossing through at least one of these centile bands (Ong & Loos, 2006). In the Growing Up in Ireland Infant Cohort, Layte and McCrory (2014) established that 25 per cent of infants experienced rapid weight gain.

Rapid weight gain during infancy is associated with later overweight or obesity (Monteiro & Victora, 2005; Ong & Loos, 2006; Weng et al., 2012; Zheng et al., 2018). In the most recent systematic review and meta-analysis published on this topic, (Zheng et al., 2018) found that infants who experienced rapid weight gain were 3.66 times more likely to have overweight/obesity than those who did not. They also found that rapid weight gain during infancy was associated with higher odds of overweight/obesity in childhood than in adulthood, and rapid weight gain from birth to 1 year was associated with higher odds of overweight/obesity than that from birth to 2 years (Zheng et al., 2018).

In developed countries, longer duration of breastfeeding (exclusive and partial) tend to be associated with slower growth rates during infancy (Kavian, Scott, Perry, & Byrne, 2015; Layte & McCrory, 2014; Oddy et al., 2014; Patro-Gołąb, Zalewski, Polaczek, & Szajewska, 2019); these associations seem to be dose-dependent and more pronounced in exclusively versus partially breastfed infants (Patro-Gołąb et al., 2019). Associations between bottle-feeding and rapid weight gain may be moderated by infant characteristics and maternal feeding practices. A systematic review by Appleton, Russell, et al. (2018) found limited evidence of which, if any, formula feeding practices are likely to be associated with rapid weight gain in infancy; they did however suggest some potential recommendations that may reduce excess/rapid weight gain, such as providing formula with lower protein content, not adding cereals into bottles, not putting a baby to bed with a bottle, and not overfeeding formula.

1.5.5 Breastfeeding

Many reviews and meta-analyses support the protective effects of breastfeeding; however, the evidence is not conclusive (Weng et al., 2012). This is in part due to the nature of observational evidence mentioned earlier, along with the varying definitions and measurement of 'breastfeeding' within studies. Many studies report positive associations between breastfeeding and lower BMI/rates of overweight/obesity, in both childhood and adolescence (Harder, Bergmann, Kallischnigg, & Plagemann, 2005; Moss & Yeaton, 2014; Patel et al., 2018; Patro-Gołąb et al., 2016; Pattison et al., 2019; Rito et al., 2019; Wallby, Lagerberg, & Magnusson, 2017; Zamora-Kapoor et al., 2017; Zheng et al., 2020). Using data from the Growing Up in Ireland study, McCrory and Layte (2012a) observed that being breastfed (any breastmilk) for 13-25 weeks was associated with a 38% reduction in the risk of obesity at nine-years of age, while being breastfed for 26 weeks or more was associated with a 51% reduction in the risk of obesity at that age. A meta-analysis by Yan, Liu, Zhu, Huang, and Wang (2014) showed children breastfed for ≥7 months had a 20% decrease in the risk of childhood obesity compared to those who were never breastfed, while those breastfed for <3 months showed about 10% decrease. Interestingly, Azad et al. (2018) recently demonstrated that breastfeeding is inversely associated with weight gain velocity and BMI associations; such associations are dose dependent however, partially diminished when breast milk is fed from a bottle, and substantially weakened by formula supplementation after the neonatal period. This suggests that mode of feeding of breastmilk is important, not just the receipt of breastmilk. Other studies have not found any association between duration of breastfeeding and child BMI (Durmuş et al., 2014; Gunnarsdottir et al., 2010; Kramer et al., 2007; Moschonis et al., 2017; Mullaney et al., 2014a). Most notable amongst these is the Promotion of Breastfeeding Intervention Trial (PROBIT), a cluster-randomized trial of a breastfeeding promotion intervention based on the WHO/UNICEF Baby-Friendly Hospital Initiative, which found no association between prolonged and exclusive breastfeeding BMI or other measures of adiposity in 6.5-y-old Belarussian children (Kramer et al., 2007).

The World Health Organisation recommends exclusive breastfeeding up to six months of age with continued breastfeeding along with appropriate complementary foods up to two years of age or longer (World Health Organisation, 2001; World Health Organization (WHO) 55th World Health Assembly, 2002). On

the other hand, the European Society for Paediatric Gastroenterology, Hepatology, and Nutrition (ESPGHAN) Committee on Nutrition recommend exclusive or full breast-feeding should be promoted for at least 4 months (17 weeks) and exclusive or predominant breast-feeding for approximately 6 months (26 weeks) (Fewtrell et al., 2017). There is ongoing debate surrounding the WHO recommendation; some have called for the evidence to be reappraised in light of research which concluded that complementary foods may be introduced safely between four and six months (Fewtrell, Wilson, Booth, & Lucas, 2011), while others have found no evidence to support changes to the recommendation (Kramer & Kakuma, 2012; Pérez-Escamilla, Buccini, Segura-Pérez, & Piwoz, 2019). In 2003, the Department of Health and Children in Ireland revised their infant feeding guidelines, in line with the WHO (2001) revised recommendation, from 'exclusive breastfeeding for 4-6 months' to 'exclusive breastfeeding for 6 months/26 weeks' (Department of Health and Children, 2003). Ireland, however, has one of the lowest rates of breastfeeding in the world (Victora et al., 2016). In 2016, 60% of babies recorded any breastfeeding at hospital discharge, while 49% were exclusively breastfed (Healthcare Pricing Office, 2018). In March 2019, 40.1% of babies were breastfed (exclusively and not exclusively) at the 3-month developmental check (Health Service Executive, 2019c). Breastfeeding rates at 6 months are not routinely reported. In the Growing Up in Ireland infant cohort, 3.4% of babies were exclusively breastfed at 6 months (i.e. 6% of the 56% that initiated breastfeeding) (Layte & McCrory, 2014), while only 2.4% of mothers in a separate longitudinal national cohort survey of 2,527 mothers were exclusively breastfeeding at 6-7 months (Gallagher, Begley, & Clarke, 2016). Globally, high-income countries have shorter breastfeeding duration than low-income and middle-income countries; however, even in low-income and middle-income countries, only 37% of infants younger than 6 months are exclusively breastfed (Victora et al., 2016).

A variety of factors influence a woman's decision to breastfeed; these include: support from partner/husband (Lok, Bai, & Tarrant, 2017; Yang, Ip, & Gao, 2018); previous breastfeeding experience (Kronborg, Foverskov, Væth, & Maimburg, 2018; Lok et al., 2017; Wagner et al., 2019; Yang et al., 2018); in experienced mothers, self-efficacy (Bartle & Harvey, 2017; Kronborg et al., 2018); attendance at antenatal classes (Lok et al., 2017; Yang et al., 2018); subjective norm and attitude to formula feeding (Bartle & Harvey, 2017). Women more likely to

initiate breast-feeding and practise exclusively breastfeeding for longer include those who: have higher education levels (Healthcare Pricing Office, 2018; Sarki, Parlesak, & Robertson, 2019; Smith et al., 2015); are older (Healthcare Pricing Office, 2018; Magarey, Kavian, Scott, Markow, & Daniels, 2015; Smith et al., 2015); were breastfed themselves as infants (Mullaney et al., 2014a, 2014b; Yang et al., 2018); have previous breastfeeding experience (Wagner et al., 2019); exclusively breastfed in hospital (Vehling et al., 2018); have a longer duration of maternity leave (Smith et al., 2015); attend antenatal classes (Cox, Giglia, & Binns, 2017). Women with larger bodies are less likely to breastfeed and/or have a shorter breastfeeding duration (Flores, Mielke, Wendt, Nunes, & Bertoldi, 2018; Huang, Ouyang, & Redding, 2019; Mullaney et al., 2014b).

1.5.6 Introduction of solid foods

Evidence relating to the effect of early introduction of solid foods on infant weight and weight gain is conflicting, with no consistent evidence of association (Patro-Gołąb et al., 2016; Weng et al., 2012). Some studies show that early introduction of solids foods is associated with increased BMI and/or rates of overweight/obesity in children (Moss & Yeaton, 2014; Pluymen et al., 2018; Sun et al., 2016; Wang et al., 2016). The duration of breastfeeding can also modify the association between complementary food introduction and overweight, with some studies showing that the early introduction of solid foods is not associated with overweight/obesity amongst infants exclusively breastfed compared with those who were not/formula fed (Huh, Rifas-Shiman, Taveras, Oken, & Gillman, 2011; Pluymen et al., 2018). Other systematic review studies conclude that the early introduction of solids has no clear effect on child growth (Moorcroft, Marshall, & McCormick, 2011; Pearce, Taylor, & Langley-Evans, 2013; Vail et al., 2015). Again, evidence is mixed given the limitations of observational evidence.

In line with breastfeeding guidelines, the WHO recommends the introduction of solids from six months onwards (World Health Organisation, 2019a). The ESPGHAN Committee on Nutrition recommend that complementary foods (solids and liquids other than breast milk or infant formula) should not be introduced before four months but should not be delayed beyond six months. The timing, content, and method of infant feeding is stressed in guidelines (Fewtrell et al., 2017; World

Health Organisation, 2019a). Infants should be also be offered foods with a variety of flavours and textures and parents should be encouraged to respond to their infant's hunger and satiety cues and to avoid feeding to comfort or as a reward (Fewtrell et al., 2017). While national guidelines in Ireland support exclusive breastfeeding to six months of age, they state that complementary feeding should start around six months, no earlier than 17 weeks and no later than 26 weeks (Health Service Executive, 2019g). Much evidence demonstrates however that infants across the globe are not being fed in accordance with complementary feeding guidelines.

Worldwide, nearly a third of infants aged 4–5 months have already been introduced to solid foods and 28% of children aged 6–23 months receive at least a minimally diverse diet (White, Bégin, Kumapley, Murray, & Krasevec, 2017). In a European study involving infants from five European countries, Schiess et al. (2010) observed that 37% of formula fed infants and 17% of breastfed infants received solid foods at four completed months. In an analysis of data from the French national birth cohort ELFE, 26% of infants started complementary feeding before 4 months of age, while 62% started between 4 and 6 months of age (Bournez et al., 2017). Routine data on the introduction of solid foods to a child's diet is not collected in Ireland, but rates of introduction of solids before 4 months range from 10-18% (Bennett, 2017; Castro, Kearney, & Layte, 2015; O'Donovan et al., 2015). There are also concerns about the type of foods given to infants during the weaning period, for example, over-reliance on puréed foods and not moving through the three phases of weaning (i.e. puréed foods, thicker textures, family meals), when following the traditional weaning approach (Bennett, 2017; O'Donovan et al., 2015).

Predictors of the early introduction of solids (usually <17 weeks, but definitions vary) include: low/young maternal age (O'Donovan et al., 2015; Schrempft, van Jaarsveld, Fisher, & Wardle, 2013; Wijndaele, Lakshman, Landsbaugh, Ong, & Ogilvie, 2009); low education level (Magarey et al., 2015; O'Donovan et al., 2015; Wijndaele et al., 2009); low socio-economic status (Wijndaele et al., 2009; Wright, Parkinson, & Drewett, 2004); maternal smoking/mother smoking prior to pregnancy (Bournez et al., 2017; O'Donovan et al., 2015; Schiess et al., 2010; Scott, Binns, Graham, & Oddy, 2009; Wijndaele et al., 2009); high maternal BMI (Bournez et al., 2017; Castro et al., 2015; Doub, Moding, & Stifter, 2015; Schrempft et al., 2013; Vadiveloo, Tovar, Østbye, & Benjamin-Neelon, 2019); feeding mode/not fully breastfeeding at 4 weeks postpartum/absence

or short duration of breastfeeding/timing of formula feeding commencement (Barrera, Hamner, Perrine, & Scanlon, 2018; Bournez et al., 2017; Castro et al., 2015; Doub et al., 2015; O'Donovan et al., 2015; Roess et al., 2018; Schrempft et al., 2013; Scott et al., 2009; Wijndaele et al., 2009; Wright et al., 2004). Other factors include: parents' perception that their baby was hungry (Baughcum, Burklow, Deeks, Powers, & Whitaker, 1998; Vadiveloo et al., 2019; Wright et al., 2004); mothers' beliefs about feeding infants solid food prior to 6 months of age (Doub et al., 2015); poor understanding of the guidelines (Moore, Milligan, & Goff, 2014; Moore, Milligan, Rivas, & Goff, 2012); perception that introducing solids will help the baby sleep (Vadiveloo et al., 2019).

1.5.7 Twenty-four-hour movement behaviours

In recent years, increasing attention is being placed – across the life course – on the importance of physical activity, sedentary behaviour, and sleep, which are collectively termed 'twenty-four-hour movement behaviours'. In 2019, the WHO released guidelines on 24-hour movement behaviours for children under five years of age (World Health Organisation, 2019b). These state that, in a 24-hour period, infants (children aged less than 1 year) should have at least 30 minutes of physical activity and not be restrained for more than 1 hour at a time; no screen time; have 14–17h (0–3 months of age) or 12–16h (4–11 months of age) of good quality sleep, including naps. Children 1-2 years of age should have at least 180 minutes of physical activity and not be restrained for more than 1 hour at a time; no sedentary screen time for 1-year-olds, sedentary screen time, while for those aged 2 years, sedentary screen time should be no more than 1 hour; have 11–14h of good quality sleep (World Health Organisation, 2019b). Similar guidelines exist in Ireland (Health Service Executive, 2019a, 2019f). Some studies find, however, that compliance with such 24-hour movement guidelines is not associated with BMI z-scores (Lee et al., 2017; Meredith-Jones et al., 2019; Santos et al., 2017; Taylor, Haszard, et al., 2018). In a systematic review of the relationships between combinations of movement behaviours and health indicators in the early years (0-4 years), there was mixed evidence for associations between the most ideal combinations of sedentary behaviour and physical activity (i.e. high sleep, low sedentary behaviour, high physical activity) and reduced adiposity among toddlers, and no associations with growth among toddlers. The most ideal combinations of sleep and sedentary

behaviour (i.e. high sleep and low sedentary behaviour) were favourably associated with adiposity among infants and toddlers (Kuzik et al., 2017). Quality of evidence ranged from “very low” to “moderate”. Evidence also varies with regard to support for these individual behaviours in terms of child weight.

Systematic reviews support a cross-sectional and longitudinal association between children’s sleep duration and obesity, with differences according to age and sex (Chaput et al., 2017; Matricciani, Paquet, Galland, Short, & Olds, 2019; Miller, Kruisbrink, Wallace, Ji, & Cappuccio, 2018). Shorter sleep duration during the early years is also shown in some studies to be associated with weight-related behaviours such as increased screen time use in children (Chaput et al., 2017; Chen et al., 2019) and higher energy intake and/or poorer diet quality (Rangan, Zheng, Olsen, Rohde, & Heitmann, 2018; Ward et al., 2020). Some studies, however, find no associations between sleep duration in infancy and weight-related measures, in adolescence (Derks, Gillespie, Kerr, Wake, & Jansen, 2019). The need to examine characteristics of sleep, such as sleep quality, timing and variability, other than sleep duration, as independent predictors of adiposity has been noted (Matricciani et al., 2019). Sleep promotion is not often included in family-based interventions to prevent childhood obesity (Agaronov, Ash, Sepulveda, Taveras, & Davison, 2018). The National Institutes of Health has recently identified ‘sleep and obesity’ as one of three important research gaps in obesity knowledge (e.g. more research is needed to better understand how intervention approaches including sleep can lead to the prevention and treatment of obesity) (Arteaga et al., 2018).

Sedentary behaviour and/or low physical activity levels are also risk factors for obesity (Taylor, Gray, et al., 2018). Evidence to date is quite mixed however, and subject to limitations. Timmons et al. (2012) found low- to moderate-quality evidence in their systematic review to suggest that increased or higher physical activity in infants was positively associated with improved measures of adiposity, while in a later review, Carson et al. (2017) concluded that physical activity in 0-4 year olds was not associated with adiposity/BMI. In a systematic review of reviews, Stiglic and Viner (2019) observed moderately strong evidence that higher television screen-time was associated with greater adiposity in children and adolescents, but concluded that there was insufficient evidence for an association with overall screen-time or non-television screen-time. A further systematic review found increased overweight/obesity risk among children aged <18 years when screen time (including

total screen time, television time and computer time) was ≥ 2 hours/day (OR=1.67; 95%CI:1.48,1.88, P<0.0001) (Fang, Mu, Liu, & He, 2019). Poitras et al. (2017) found unfavourable or null associations between screen time and indicators of adiposity in children aged 0 to 4 years, and also between time spent seated (e.g., in car seats or strollers) or in the supine position, and indicators of adiposity. They also found predominantly null associations between objectively measured total sedentary time and indicators of adiposity. It should be noted that evidence quality ranged from "very low" to "moderate". There is some evidence therefore, however limited, that movement behaviours may be important for the promotion of healthy growth early in life.

There is no Irish data on movement behaviours (including screen-time) in children aged 0-2 years. Non-compliance with 24-hour movement guidelines – overall and for individual behaviours – amongst very young children in a number of countries has been reported, including Australian infants (only 3.5% met all 4 guidelines, (Okely et al., 2017)[1]) (Hesketh et al., 2017), Australian toddlers (8.9% compliance) (Santos et al., 2017), and Canadian toddlers (only 11.9% compliance) (Lee et al., 2017). There are also considerable changes in compositional time from infancy to toddlerhood and beyond, for example, increases in light intensity activity (Meredith-Jones et al., 2019; Taylor, Haszard, et al., 2018). That said, there are still insufficient levels of compliance with movement behaviours, for example, moderate-to-vigorous physical activity (Armstrong, Covington, Hager, & Black, 2019; Bruijns, Truelove, Johnson, Gilliland, & Tucker, 2020), and screen/TV-viewing/sedentary time (Aishworiya et al., 2019; Bruijns et al., 2020; Chen et al., 2019; Tooth, Moss, Hockey, & Mishra, 2019), from infancy onwards.

1.5.8 Childcare

Systematic reviews of the association between childcare and overweight/obesity report mixed results. Black, Matvienko-Sikar, and Kearney

[1] For children under 1 year of age the Australian 24-hour Movement Guidelines for the Early Years recommend that children engage in: (1) Physical activity: Being physically active several times in a variety of ways, particularly through interactive floor-based play; more is better. For those not yet mobile, this includes at least 30 min of tummy time (time spent on the child's stomach while awake) spread throughout the day while awake; (2) Sedentary behaviour: Not being restrained for more than 1 h at a time (e.g., in a stroller, car seat or high chair). Screen time is not recommended; and (3) Sleep: 14–17 h (0–3 months) and 12–16 h (4–11 months) of good quality sleep, including naps.

(2017) found that early (<3 years) informal care, especially by a relative, was associated with increased risk of overweight/obesity. In this review, higher intensity childcare, especially when commenced early (<1 year), increased overweight/obesity risk, while later (≥3 years) centre care was associated with a decreased risk of overweight/obesity (Black et al., 2017). A review of longitudinal studies of the impact of childcare in infancy and later obesity (using measured data only) found mixed results, however, noting challenges in study heterogeneity in a range of areas including definitions of childcare, and categorisation of different types of childcare (Costa, Adams, Gonzalez-Nahm, & Benjamin Neelon, 2017). A further review of longitudinal associations between non-parental childcare during early childhood, and diet and activity behaviours, found limited and mixed evidence due to a paucity of research in this area (Costa, Benjamin-Neelon, Winpenny, Phillips, & Adams, 2019).

There are various ways in which childcare could contribute to childhood obesity. Parents and informal caregivers participating in a study by Lidgate, Li, and Lindenmeyer (2018) suggested: cross-generation conflict preventing adoption of healthy practices; the trade-off for parents between receiving childcare and maintaining control; reduced energy capacity of carers; increased snacking. Grandparents in caregiving roles can negatively influence the dietary intake and weight status of their grandchildren (Chambers, Rowa-Dewar, Radley, & Dobbie, 2017; Young, Duncanson, & Burrows, 2018). Other research shows mixed effects. Farrow (2014) observed that grandparents reported using significantly more maladaptive feeding practices (e.g. using food to regulate emotions and restricting food), but more positive practices such as providing a healthy food environment. Furthermore, the more hours that grandparents spent caring for children the more their feeding practices resembled those broadly reported by parents (Farrow, 2014). Differences in child feeding attitudes and behaviours between parents and grandparents can create conflict and tensions, often resulting in poor feeding practices (Young et al., 2018). In contrast to food, there appears to be less tension between parents and grandparents in relation to parenting practices around activity (Chambers et al., 2017). There can also be tensions between staff in early childhood education and care settings and parents, e.g. around the timing of the introduction of complementary foods, the feeding and handling of expressed breastmilk, pacifier use, bottle cessation for formula, provision of energy-dense – nutrient-poor foods and parental engagement (McGuire, Irvine, Smith, & Gallegos, 2019). Childcare

centres can vary in their adherence to physical activity, sedentary behaviour and recommendations for infants. In a study combining data from Australia, Canada and the US, Hewitt et al. (2018) observed that childcare centres were most compliant (74%–95%) with recommendations to: provide daily indoor opportunities for infants to move freely under adult supervision, daily tummy time for infants less than 6 months of age, indoor and outdoor recreation areas that encourage infants to be physically active, and discourage screen time. Centres were least compliant (38%-41%) however with adhering to recommendations to: limit the use of equipment that restricts an infant's movement and provide education about physical activity to families. There is a lack of Irish data in this area.

1.6 The policy context for childhood obesity prevention

Actions are being taken at international, European and national levels to address childhood obesity. These include the implementation of several policies and action plans such as the five-year Pan-American Health Organization Plan of Action for the Prevention of Obesity in Children and Adolescents (Pan American Health Organization World Health Organisation Regional Office for the Americas, 2014), the Report of the Commission on Ending Childhood Obesity (World Health Organisation, 2016b), the EU Action Plan on Childhood Obesity 2014–2020 (European Commission, 2014), and in Ireland, 'A Healthy Weight for Ireland: Obesity Policy and Action Plan 2016-2025' (Department of Health, 2016b) and the associated 'Healthy Weight for Children (0-6 years) Framework (Health Service Executive, 2018d).

In Ireland, several policies and action plans also exist for related issues, target behaviours and/or life stages such as health (Government of Ireland, 2013), physical activity (Government of Ireland, 2016), breastfeeding (Health Service Executive, 2016), maternity/pregnancy (Department of Health, 2016a), and the early years (Government of Ireland, 2018). Early intervention is recognised as a key strategy within each of these documents. In 2017, the Council of the EU invited member states to integrate measures to address childhood overweight and obesity into their activities, including early life interventions focused on nutrition and physical activity during pregnancy, breastfeeding, complementary feeding, and measures to maximise the key role of primary health care (The Council of the European Union, 2017). In

Ireland, various governmental and non-governmental reports have also called for greater action on childhood obesity focusing on these areas. In its report on childhood obesity, the Houses of the Oireachtas Joint Committee on Children and Youth Affairs (2018) made several recommendations, including the need for increased supports for breastfeeding in Ireland. The Irish Heart Foundation highlighted early intervention, and the first 1,000 days in particular, in its recent Childhood Obesity Manifesto (Irish Heart Foundation, 2019). The Faculty of Public Health of the Royal College of Physicians of Ireland (RCPI) has also stressed the benefit of early intervention and called for support, funding and provision of interventions to improve children's health, focusing on maternal nutrition, breastfeeding and infant/early years nutrition (Canny et al., 2018). They further recommended that health professionals undertake a number of actions including emphasising the benefits of breastfeeding for the weight of the child, highlighting healthy weaning practices with parents, and monitoring growth of all children aged 0-4 years (Royal College of Physicians Ireland, 2014).

Government leadership, regulation, and investment in programmes, monitoring, and research is key in addressing obesity (Swinburn et al., 2011). There is a gap between policy and practice however, with various barriers and facilitators around engagement in childhood obesity prevention activities noted. For example, an online survey of 187 policy-makers and stakeholders from different policy sectors conducted in 12 EU Member States identified physical activity-friendly environments and parental support as important facilitators for childhood obesity prevention, while the commercial marketing of foods and a lack of funding were identified as the most important barriers (Abu-Omar et al., 2018). Vallgårda (2018) argues that there is a discrepancy between how the issue of childhood obesity is presented as alarming by the WHO, the EU, Canada, England and New Zealand and the modest interventions proposed to address it. She further argues that while there are multiple, varied causes of obesity, interventions primarily address the information level of the population, placing responsibility on parents. State health promotion has also been criticised for focusing efforts on healthy lifestyles and encouraging people to 'take responsibility' for their health, which can translate into messages that people are agents that are morally responsible and therefore subject to moral criticism—for their (poor) health (Brown, Maslen, & Savulescu, 2019), rather than political responsibility along with society at large (Tulatz, 2019). Parents,

particularly those from lower socio-economic groups, can experience cognitive dissonance between being made responsible (responsibilisation), and taking 'ultimate responsibility' (by self-blaming) for their children's weight while lacking the material resources to provide optimal nutrition for them (Noonan-Gunning, 2019, p. 14). It is important to recognise and limit 'lifestyle drift' in this context, where policy starts off recognising the need for action on upstream social determinants of health but then drifts downstream and focuses primarily on individual lifestyle factors (Baum & Fisher, 2014; Popay, Whitehead, & Hunter, 2010; Williams & Fullagar, 2019). That said, individual behaviours must be recognised as key elements in a systems approach (Sniehotta et al., 2017) whilst also considering the impact of individual interventions on health inequalities. While it has been argued that such interventions could increase inequalities (Rutter et al., 2017), the evidence on this is mixed. Some reviews have concluded that interventions that aim to prevent, and/or prevent, reduce or manage, childhood obesity interventions do no increase inequalities (Bambra et al., 2015; Brown et al., 2019). Focus and features of interventions can be important factors in this regard. For example, complex interventions acting on multiple targets, settings, and risk factors appear to have a lower risk of increasing inequalities (Venturelli et al., 2019). Universal interventions and community-based obesity prevention strategies or policies aimed at structural changes to the environment can also be more effective in decreasing obesity among lower-socio-economic groups (Bambra et al., 2015; Beauchamp, Backholer, Magliano, & Peeters, 2014), while interventions targeting individual-level behaviour change (primarily based on information provision) may be less successful (Beauchamp et al., 2014). Caution is warranted, however, as a recent systematic review found that universal pediatric obesity interventions in high income countries had the potential to generate inequalities, regardless of the setting, target, and/or mechanism of action (Venturelli et al., 2019).

1.7 A role for health professionals in childhood obesity prevention efforts

Interventions to address childhood obesity that can be embedded into ongoing practice and existing systems are needed, rather than implementing interventions that are resource intensive and cannot be maintained in the long term (World Health Organisation, 2016a). It is also suggested that efforts may be best placed in integrating interventions into routine care given the challenges in recruiting

mothers of young children to obesity prevention intervention studies (Daniels et al., 2012; Ekambareshwar et al., 2018). For example, intervention studies such as NOURISH demonstrate that only a quarter of mothers with very young children will participate in an intervention study, and that even when recruitment rates are high, recruitment tends to be biased towards those who are more highly educated (Daniels et al., 2012). Health professionals have the potential to influence large numbers of parents during the early years, in part due to the large number of routine contacts that they have with parents (Daniels, Hassink, & Committee On Nutrition, 2015). For example, in Ireland, there are 25 routine contacts between a parent and their child and the health service between conception and the child's second birthday through the National Healthy Childhood Programme – specifically the Maternity and Infant Care Scheme (Health Service Executive, 2018e), the Child Immunisation Scheme (HSE National Immunisation Office, 2016) and the Child Health Surveillance Programme (Health Service Executive, 2018a) – and also the free GP care initiative for all children under the age of six which requires GPs to measure the height and weight of all children at age two and five (Health Service Executive, 2018b).

Nationally, there has been increased focus on early intervention within the health services in the last five years, with the launch of the Nurture Infant Health and Wellbeing Programme (Health Service Executive, 2019e). Nurture aims to improve the information and professional supports that the HSE provides to parents during pregnancy and the first three years of their baby's life, and is led by the HSE National Healthy Childhood Programme (Health Service Executive, 2019d). The latter works closely with the HSE's Healthy Eating Active Living Programme which is responsible for the implementation of the national obesity strategy, and also with those responsible for the implementation of the HSE's 'Making Every Contact Count' Framework (Health Service Executive, 2017). While policies and programmes advocate the involvement of health professionals in interventions to prevent childhood obesity and for them to 'make every contact count', how they might do this has not been fully explored. Indeed the American Academy of Pediatrics has highlighted the lack of feasible, scalable, and effective strategies in primary care (Daniels et al., 2015).

To date research on health professional views and practices around childhood obesity has primarily focused on its management/treatment (Johnson, Oyebode, Walker, Knowles, & Robertson, 2018; Kelleher, McHugh, Harrington, Perry, &

Shiely, 2019; McMeniman, Moore, Yelland, & McClure, 2011; Rhee, Kessl, Lindback, Littman, & El-Kareh, 2018), as well as what influences their intentions in this area (Frankfurter, Cunningham, Morrison, Rimas, & Bailey, 2017). Research in the area of childhood obesity prevention has generally focused on children of preschool age and older (Bourgeois, Brauer, Simpson, Kim, & Haines, 2016; Robinson, Denney-Wilson, Laws, & Harris, 2013; Tanda, Beverly, & Hughes, 2017). That said, there are now some studies which focus on health professionals views and practices concerning obesity prevention during early life (Bailey-Davis et al., 2018; Laws et al., 2015; Redsell et al., 2011; Spivack, Swietlik, Alessandrini, & Faith, 2010). It demonstrates scope to improve health professionals' knowledge and practices concerning obesity prevention. Laws et al. (2015) established that while Maternal and Child Health[2]/public health nurses are well positioned to address obesity prevention in early life, they need support to do so. This includes the use of service delivery prompts such as BMI chart/parent education materials to help nurses create a legitimate opportunity to raise sensitive issues such as weight, and increasing behaviour change counselling skills so they are more confident to approach parents about sensitive topics (Laws et al., 2015). In Ireland, and indeed internationally, there are varying levels of knowledge of infant feeding recommendations and practices amongst various types of health professionals including pediatricians, general practitioners, practice nurses, public health nurses and community dietitians (Allcutt & Sweeney, 2010; Brambilla et al., 2019; Chouraqui et al., 2019; National Nutrition Surveillance Centre, 2010; Redsell et al., 2011). The resultant conflicting messages that parents receive, and confusion it creates for them, is recognised by health professionals themselves (Bailey-Davis et al., 2018). Opportunities to reduce the conflicting messages parents receive, include care coordination across sectors with core educational messages, bi-directional data-sharing, and training (Bailey-Davis et al., 2019). Growth monitoring is also an area where issues have also been identified, particularly in relation to low use of growth charts in the evaluation of early childhood growth (Allcutt & Sweeney, 2010; Gies et al., 2017; Laws et al., 2015). This was often in spite of having access to, and confidence in using, such charts (Laws et al., 2015). Lack of knowledge or skills

[2]Registered nurses with qualifications in midwifery and child and family health in Australia. The Maternal and Child Health Service in Victoria is a universal, free service provided by Maternal and Child Health nurses to all families of children from birth to six years. The service comprises ten key age and stage consultations including a home visit shortly after birth, and then consultations at two, four and eight weeks; four, eight, twelve and 18 months; two and three and a half years of age.

amongst health professionals around relevant issues around pregnancy have also been highlighted, including maternal nutrition (National Nutrition Surveillance Centre, 2010), guidelines for physical activity (Hopkinson, Hill, Fellows, & Fryer, 2018), and preconception and gestational weight gain management (Fieldwick et al., 2014; Fieldwick, Smith, & Paterson, 2017, 2019; Wilkinson, Donaldson, Beckmann, & Stapleton, 2017). Lack of knowledge around breastfeeding is also an issue (Esselmont, Moreau, Aglipay, & Pound, 2018; Yang, Salamonson, Burns, & Schmied, 2018). In addition to identified gaps in knowledge, other barriers exist which hinder health professionals with regard to obesity prevention efforts.

Time constraints, coupled with many topics to cover and competing priorities, and lack of training are common barriers to maternal and infant nutrition education by health professionals (MacMillan Uribe, Woelky, & Olson, 2019; McCann et al., 2017; McLellan, O'Carroll, Cheyne, & Dombrowski, 2019). This can result in health professionals being reactive rather than proactive in their approach (MacMillan Uribe et al., 2019). Inadequate staffing levels and financial resources have also been cited as barriers to engaging in childhood obesity prevention activities by policymakers and stakeholders from different policy sectors in 12 countries within the EU (Abu-Omar et al., 2018). Health professionals can also find it difficult to raise the issue of children's weight with parents (King et al., 2007; Laws et al., 2015; Redsell et al., 2011; Regber, Mårild, & Johansson Hanse, 2013). Reasons include it being perceived as a sensitive issue because of its link to parenting behaviours, if a parent themselves has a weight issue, parental denial or defensiveness about their children's weight, and lack of services available for the family (King et al., 2007; Laws et al., 2015; Nordstrand, Fridlund, & Sollesnes, 2016). Health professionals, especially GPs, are fearful of adversely affecting relations with parents (Redsell et al., 2011; Rose et al., 2019). That said, parents often view the health professional's role in obesity prevention, or more generally, as one of reassurance (Appleton, Fowler, & Brown, 2017; Slomian et al., 2017).

Some authors have argued that there is a disparity between the public discourse of an 'obesity crisis' and the experiences of women in practice where health professionals show reluctance to engage in weight-related discussions (Keenan & Stapleton, 2010). Health professionals can hold stigmatised attitudes towards pregnant women with a higher weight, perceiving such women to be have poorer self-management behaviours (Hodgkinson, Smith, Hare, & Wittkowski,

2017; Mulherin, Miller, Barlow, Diedrichs, & Thompson, 2013) and interacting less with them in consultations (Washington Cole et al., 2017). While health professionals acknowledge the increasing levels of obesity and the associated risks (Knight-Agarwal, Kaur, Williams, Davey, & Davis, 2014; Schmied, Duff, Dahlen, Mills, & Kolt, 2011), they feel challenged by: the continuing stigma associated with obesity (Schmied et al., 2011), how to communicate effectively with women with a higher weight (Hart et al., 2018; Heslehurst et al., 2014; Holton, East, & Fisher, 2017; Knight-Agarwal et al., 2014; Schmied et al., 2011; Smith, Cooke, & Lavender, 2012) without being perceived as judgemental (Hodgkinson et al., 2017), a lack of knowledge (Heslehurst et al., 2014; Holton et al., 2017; Smith et al., 2012), and the lack of resources, equipment and facilities to adequately care for women with a higher weight (Holton et al., 2017; Schmied et al., 2011). Women report that, while gestational weight gain is important to them in terms of their health and the health of their babies (Nikolopoulos, Mayan, MacIsaac, Miller, & Bell, 2017), conversations with health care professionals do not occur (Nikolopoulos et al., 2017). Women can feel judged and discomfort during their communications with midwives and other health professionals (Cunningham, Endacott, & Gibbons, 2018; Dinsdale, Branch, Cook, & Shucksmith, 2016; Furber & McGowan, 2011; Holton et al., 2017; Keely, Cunningham-Burley, Elliott, Sandall, & Whittaker, 2017; Nyman, Prebensen, & Flensner, 2010). They can also feel that they miss out during pregnancy, because they are treated differently during healthcare conversations, yet want to be treated the same (Jones & Jomeen, 2017). Stigma can impact every aspect of routine pregnancy-related health care, from being weighed at prenatal visits, to having ultrasound-scans and blood tests, and in the delivery of medical interventions during labour and birth (Parker & Pausé, 2019). When healthcare professionals do raise the issue of increased risk because of maternal obesity, women can either blame themselves for potentially causing harm, or reject this notion (Jones & Jomeen, 2017). Atkinson and McNamara (2017) highlighted an 'unconscious collusion' between healthcare professionals and women with a BMI $\geq$30kg/m^2 during pregnancy around obesity-related conversations; in part due to professionals' reluctance to engage on the issue (e.g. recording weight without any discussion), or avoidance by pregnant women. Although women were generally unhappy with the communication skills of health professionals, they readily acknowledged the sensitive nature of obesity related communications (Atkinson & McNamara, 2017).

Women are not adverse to discussions about gestational weight gain/loss however (Criss, Oken, Guthrie, & Hivert, 2016; Dinsdale et al., 2016; Holton et al., 2017), and would welcome them as part of standard care (Nikolopoulos et al., 2017). That said, such discussions need to take place without judgement or blame (Jones & Jomeen, 2017), and with health care professionals initiating them by asking women how they feel about discussing weight (Nikolopoulos et al., 2017). There is also scope for health professionals to engage with fathers of young children around their growth and related behaviours. The role of pediatricians in engaging fathers in the care and development of their children has also been highlighted (Yogman, Garfield, & Committee on Psychosocial Aspects of Child and Family Health, 2016) and it has been reported that increasing efforts by pediatric clinicians to engage fathers may have impacts on both father and child health (Allport et al., 2018).

Nationally and internationally therefore there is increased policy and research focus on early life interventions to prevent childhood obesity, particularly those which can be integrated within routine care. While there are many opportunities for same, given the large number of contacts that parents have with health professionals during this time, health professionals report several barriers to engaging in such interventions with parents. Research finds that parents would value more engagement with health professionals in this area, however, and this should be explored further to identify how parents can be best supported.

1.8 The importance of engaging and supporting parents

Supporting parents is an important facilitator for childhood obesity prevention (Abu-Omar et al., 2018). Parents have a key role in the healthy growth and development of their children, especially during the early years when children are fully dependent on them for a range of needs including nutrition and care (Golan & Crow, 2004; Lindsay, Sussner, Kim, & Gortmaker, 2006). Negative parent/family/peer modelling, lack of knowledge, time constraints, using food as reward, affordability and concerns about child's health, can increase unhealthy dietary intakes (Mazarello Paes et al., 2015). Parental views and experiences of promoting healthy growth and/or obesity prevention in pregnancy and the first two years of life is limited however. Research to date has tended to focus on older children, and more recently on pre-school-aged children. The latter includes parental

perceptions of: childhood overweight and obesity (Eli, Howell, Fisher, & Nowicka, 2014; Jain et al., 2001; Pagnini, Wilkenfeld, King, Booth, & Booth, 2007); strategies to support the development of healthful weight-related behaviours (O'Kane et al., 2018), including via community playgroups (Fuller, Byrne, Golley, & Trost, 2019) and pediatricians (Bolling, Crosby, Boles, & Stark, 2009); weight management (Bradbury et al., 2019). Research has also tended to focus on discrete behaviours such as breastfeeding and/or the introduction of solid foods. As with health professionals, however, there is increasing research and interventions involving parents relating to early life obesity prevention efforts.

Many parents believe that they have a lot and/or total control over their child's weight gain (Butler et al., 2019) and a key role in modelling dietary behaviours (Goldthorpe, Ali, & Calam, 2018). Despite recognising the importance of establishing good habits early and providing children aged 0-2 years with good nutrition and opportunities to be active, and their role in doing this, however, it is difficult for parents to implement the necessary behaviours in practice (Appleton et al., 2017; Zehle, Wen, Orr, & Rissel, 2007). This can result in parents feeling distressed and/or blaming themselves when their child's weight becomes an issue (Appleton et al., 2017; Bentley, Swift, Cook, & Redsell, 2017). While parents of infants who have been identified as 'at risk' of developing obesity are receptive to preventive approaches, they highlight the need for better support in a range of areas, including infant feeding, including understanding the physiology of breastfeeding, how to differentiate between infant distress caused by hunger and other causes, and the timing of weaning (Redsell et al., 2010). Some also need guidance about how to recognize and prepare healthy foods, and facilitate physical activity, for their infants (Redsell et al., 2010). Research with parents to date, however, has not fully explored the full range of behaviours and issues during pregnancy and the first two years of life in relation to the promotion of healthy growth in children. This also applies to parental views and experiences of interventions involving health professionals.

Health professionals are key sources of advice and information for parents, however parents often express dissatisfaction in both the quality and quantity of information and support they provide. Developmental milestones such as weaning and offering finger food are key times for parents to seek food-related information, with advice on healthy eating given in these contexts and during statutory health visitor checks (Goldthorpe et al., 2018). Parents report a lack of information and

support around infant feeding (weaning onto solids) from health professionals, however, and can defer to information and reassurance provided on the internet or by peers (Bentley et al., 2017; Goldthorpe et al., 2018). Parents often report confusion and conflicting messaging around infant feeding from various sources (Lakshman et al., 2012; Tully et al., 2019).

Parents also consider health care providers to be an important source of information on infant weight status (Beck, Hoeft, Takayama, & Barker, 2018). There are several challenges to engaging parents around infant weight/growth, however, which need to be further explored to better support parents around this issue. While parents express concern about infants potentially becoming overweight (Beck et al., 2018), they are often more concerned about underweight or poor growth, with high levels of anxiety experienced when poor infant growth is highlighted (Bentley et al., 2017; Keenan & Stapleton, 2010). For many mothers, obesity only becomes a concern if excessive weight gain occurs (Zehle et al., 2007). While parents appreciate the issues surrounding childhood obesity, often they do not view overweight as a significant problem until infants can walk (Bentley et al., 2017). They report concerns that excess weight might hinder their child's ability to start walking, but also believe that a child can lose any excess weight when they become active (Bentley et al., 2017). While parents attribute infant overweight to overfeeding, they are reluctant to modify infant feeding practices prior to weaning (Bentley et al., 2017). Some mothers, however, believe that babies could not be overfed, the risks of formula milk feeding had been exaggerated, and infancy is too early to intervene to prevent obesity, (Lakshman et al., 2012). In relation to breastfeeding, mothers can lack confidence in their ability and become focused on infant weight as an objective measure of breastfeeding success (Hanafin, Creedon, O'Dywer, & Clune-Mulvaney, 2019); too frequent weighing, however, can be counter-productive and lead to unnecessary worry (Food Safety Authority of Ireland, 2011). While parents are aware of the growth charts and centiles used by health professionals, they often report being unable to understand them, as well as being sceptical overall about the growth standards (Bentley et al., 2017; Jarvie, 2016). Some mothers ignore growth charts, stating that growth is genetically determined (Lakshman et al., 2012).

That parents do not recognise excess weight in their children (toddlers and older), is a frequently cited barrier to addressing childhood obesity (Berggren et al.,

2018; Byrne, Magarey, & Daniels, 2016; Hager et al., 2012; Lundahl, Kidwell, & Nelson, 2014; Queally et al., 2018; Tompkins, Seablom, & Brock, 2015). Byrne et al. (2016) observed that leaner but healthy weight toddlers were perceived as underweight by their mothers, whereas only the heaviest children were recognized as overweight. A recent systematic review and meta-analysis found that 55% of (caregivers) and children underestimated their degree of overweight, and that this underestimation was positively associated with a number of factors such as: child's age, gender (male), current BMI and parental weight status, education and ethnicity (Alshahrani & Swift, 2019). Even when mothers appropriately classify their child as overweight at an earlier stage, this is not related to relatively lower child BMI a few years later however (Parkinson et al., 2017). Efforts to make parents aware of overweight may not be harmful but are unlikely to improve children's BMI status (Wake, Kerr, & Jansen, 2018). Studies around parents receptiveness towards communication of their child's obesity risk report mixed results. In a recent Australian study parents reported that they would be concerned if they thought their infant was gaining too much weight and were generally receptive to receiving information about their infant's risk of developing obesity, even though it would cause worry and upset (Butler et al., 2019). In a UK study, however, parents were hesitant about health professionals identifying infant overweight, believing that they would recognise this for themselves whilst also fearing being judged a bad parent by health professionals, other parents and the general public (Bentley et al., 2017). Similar to the Australian study, however, parents viewed the identification of future obesity risk during infancy positively, but stressed the need for a non-judgemental approach in doing so (Bentley et al., 2017). It is important therefore to bear such findings in mind when investigating parents views and experiences of interventions in relation to promoting healthy growth and related behaviours, and how they can be better supported.

There are various ways in which parents can shape children's weight-related behaviours, for example their knowledge, attitudes, practices and role modelling of behaviours. Most research examining these predictors has been undertaken with mothers (usually prima-parous) as the primary caregivers, however. Fathers have been neglected in childhood obesity-related research to-date (Davison et al., 2016; Davison et al., 2018; Fraser et al., 2011; Morgan & Young, 2017; Neshteruk, Nezami, Nino-Tapias, Davison, & Ward, 2017). For example, in their systematic

review, Davison et al. (2018) found that, of 85 eligible interventions, fathers only represented 6% of parent participants. Davison, Charles, Khandpur, and Nelson (2017) report that fathers are underrepresented in paediatric research because they have not been asked to participate. Study brevity, perceived benefits for fathers and their families, and the credibility of the lead organization are valued by fathers (Davison et al., 2017), as well as targeted rather than generic gender-neutral recruitment approaches (Leach, Bennetts, Giallo, & Cooklin, 2019). In recent years, increased attention has been paid to the role of fathers, as they may be important agents of change in intervention strategies to prevent childhood overweight and obesity (Smith et al., 2018). Fathers influence preschool children's weight gain, overweight and obesity status (Fraser et al., 2011; Weng et al., 2013; Wong et al., 2017).

While mothers are often the primary managers of infant/child feeding in the early years, fathers can be involved at different levels, starting in infancy, with involvement increasing over time, requiring an ongoing negotiation around co-parenting related to feeding (Thullen, Majee, & Davis, 2016). To date, research on parenting practices in the obesity domain has almost exclusively focused on a single parent or parenting figure (often the mother), with little consideration for how co-parenting and the relationship between the child and other parent figures may influence obesogenic behaviours and subsequent weight status (Patrick, Hennessy, McSpadden, & Oh, 2013). Several studies have found associations between dietary behaviours of fathers and their toddlers (Walsh, Cameron, Crawford, Hesketh, & Campbell, 2016) and school-aged children (Williams et al., 2018). Fathers/partners also have a strong influence on mothers' attitudes towards child feeding, physical activity and television viewing behaviours in their pre-school-aged children, with greater influence amongst more highly educated mothers (Cameron, Charlton, Walsh, Hesketh, & Campbell, 2019). Using data from the Melbourne Infant Feeding Activity and Nutrition Trial (InFANT) Program, a cluster randomised controlled trial (RCT) delivered to pre-existing first-time parent groups, Walsh, Crawford, Cameron, Campbell, and Hesketh (2017) found no clear associations between the physical activity levels of fathers and their children at child age 20 months, and 3.5 and 5 years. Indeed, few studies have examined the effect of fathers on child physical activity and this relationship remains unclear (Neshteruk et al., 2017). While the available data indicate that fathers' behaviours and parenting practices likely play an

important role in promoting healthy behaviours in children, the evidence base is limited by a reliance on observational designs and small, ungeneralizable samples (Morgan & Young, 2017). That said, there is increased interest in developing interventions specifically targeting fathers around a variety of issues, including prenatal health promotion (Mackert et al., 2017), perinatal mental health (e.g. SMS4dads (Fletcher et al., 2017; Fletcher, Knight, Macdonald, & StGeorge, 2019; Fletcher, May, Attia, Garfield, & Skinner, 2018; Fletcher et al., 2016), and breastfeeding (White et al., 2019).

Fathers often feel excluded – and sometimes patronised – by health professionals, despite wanting to take part in preparations for birth and parenthood, and in child health contacts (Baldwin, Malone, Sandall, & Bick, 2018; Cosson & Graham, 2012; Earle & Hadley, 2018; Hrybanova, Ekström, & Thorstensson; Huusko, Sjoberg, Ekstrom, Hertfelt Wahn, & Thorstensson, 2018; Kowlessar, Fox, & Wittkowski, 2015; Lau & Hutchinson, 2020; Lowenstein et al., 2013). Parents (mothers and fathers) also want fathers to be more involved and engaged by services during ante- and post-natally, however, many challenges are encountered, including work commitments (Entsieh & Hallström, 2016; Shorey, Ang, Goh, & Lopez, 2019; Widarsson, Engström, Tydén, Lundberg, & Hammar, 2015). While fathers have their own needs – e.g. fathers experience stress and worry during pregnancy, at birth and postnatally as they transition to their new role (Baldwin, Malone, Sandall, & Bick, 2019; Chin, Hall, & Daiches, 2011; Philpott & Corcoran, 2017; Philpott, Savage, FitzGerald, & Leahy-Warren, 2019) – they also play a key role in social support for mothers – including practical, financial and emotional (Anderson, Nicklas, Spence, & Kavanagh, 2010; deMontigny, Gervais, Larivière-Bastien, & St-Arneault, 2018; Slomian et al., 2017). It is important therefore, that the views and experiences of father are sought concerning the growth/development of their young children, and the associated behaviours.

1.9 The importance of language and framing in how we approach early life obesity prevention

As mentioned earlier in this chapter, children and young people with overweight and obesity experience greater weight bias and stigmatisation than those without overweight and obesity. Women with a higher weight also report feelings of

stigmatisation during pregnancy, e.g. during routine examinations (Johnson et al., 2013). The way in which obesity is portrayed in policies and interventions may contribute to weight bias in society (Gillborn, Rickett, Muskett, & Woolhouse, 2020; Ramos Salas, Forhan, Caulfield, Sharma, & Raine, 2018). A critical analysis of obesity prevention policies and strategies in Canada identified five prevailing narratives that may have implications for public health approaches and unintended consequences for people with obesity: 1) childhood obesity threatens the health of future generations and must be prevented; 2) obesity can be prevented through healthy eating and physical activity; 3) obesity is an individual behaviour problem; 4) achieving a healthy body weight should be a population health target; and 5) obesity is a risk factor for other chronic diseases, not a disease in itself (Ramos Salas et al., 2018). In addition, trying to enforce norms around 'healthy weight' or 'normal weight' in society can promote internalized weight stigma (Ramos Salas, Forhan, Caulfield, Sharma, & Raine, 2019). Researchers have highlighted the need to challenge 'the harmful apocalyptic discourse of fatness', which may do more harm than good when applied to 'childhood obesity' (Gillborn et al., 2020).

Lack of understanding of obesity, linked to public health narratives of 'eat less, move more', is a fundamental driver of weight bias (Ramos Salas et al., 2019). There is a growing field of research (critical weight/critical obesity/fat studies) which argues that public health policies and interventions that continue to individualise infant/child feeding practices, maternal eating habits and weight management are also problematic (Jarvie, 2016; Keenan & Stapleton, 2010). Research with mothers demonstrates that such policies and interventions can be a source of stigma, and judgement around parenting – mothering in particular, with the moralisation of larger bodies in pregnancy posing risks to both mothers and their foetus/infant (Jarvie, 2016; Keenan & Stapleton, 2010). Former First Lady Michelle Obama's speeches as part of the Let's Move! campaign were also criticised for evoking anti-immigrant rhetoric and characterizing Latinas as "bad" mothers if their child did not conform to an acceptable body size (Dame-Griff, 2016). Media framing of larger babies clearly asserts maternal responsibility (Jarvie, 2016). Some mothers themselves believe that infant weight is the best marker of child health and successful parenting, and that it is therefore better to have a heavy infant (Baughcum et al., 1998). Indeed 'big babies' are often viewed in a positive light rather than as a 'problem' (Jarvie, 2016; Keenan & Stapleton, 2010; Rachmi, Hunter, Li, & Baur,

2017). Mothers can often be more upset and anxious about babies who were underweight, premature, or have problems feeding and gaining weight, than those who have a baby identified as big, growing rapidly, or 'overweight/obese' by health visitors (Keenan & Stapleton, 2010). Other women, however, can view a large baby as a potential source of stigma – rather than pride, and can reject maternal responsibility for having a big baby (e.g. citing hereditary), protecting their identity as 'good mothers' (Jarvie, 2016), or what Foucault (1980, p. 104) termed 'biologico-moral responsibility'. Some women feel that there has been a shift in societal views of big babies, from bonny babies traditionally to disapproval (Jarvie, 2016). Mothers refer to big babies and/or their unborn child in pejorative terms such as: porker; bloater; massive beast; monster; heifer; and whale (Jarvie, 2016). Women from lower socio-economic status groups may be more likely to experience the stigma associated with having a bigger baby and result in the layering of stigma, and further marginalisation (Jarvie, 2016). Thus, it is important to recognise the meaning attributed to higher weight in babies, and the potential stigma, and judgement associated with this when conducting research and interventions in this area. Similar applies to maternal weight, which is also a source of stigma during the first 1,000 days.

During pregnancy and the postpartum period, women experience weight stigma from multiple sources, with increasing frequency the higher their weight category (Incollingo Rodriguez, Dunkel Schetter, & Tomiyama, 2019). In particular, pregnant women with a higher weight can feel humiliation, and the stigma associated with carrying excess weight during pregnancy (Furber & McGowan, 2011; Holton et al., 2017; Jones & Jomeen, 2017; Keenan & Stapleton, 2010; Mulherin et al., 2013), as discussed earlier in this chapter. Such stigma is not without harm, and can have negative impacts on physical and mental health outcomes for pregnant and postpartum women. This includes greater: gestational weight gain and weight gain in excess of recommendations; emotional eating; postpartum depressive symptoms; weight retention at 1 year postpartum (Incollingo Rodriguez, Tomiyama, Guardino, & Dunkel Schetter, 2019). Women experiencing weight stigma from more sources report more depressive symptoms, maladaptive dieting behavior and perceived stress (Incollingo Rodriguez, Tomiyama, et al., 2019). In addition to impacting on physical and mental health, such stigma can negatively influence how women experience their pregnancies and motherhood (Parker & Pausé, 2019).

There is also stigma and moral judgement around infant feeding: women can feel judgement, stigma and guilt whether they breastfeed or not (Appleton, Laws, et al., 2018; Barimani, Vikström, Rosander, Forslund Frykedal, & Berlin, 2017; Bresnahan et al., 2020; Fallon, Komninou, Bennett, Halford, & Harrold, 2017; Gallagher & James, 2015; Guell, Whittle, Ong, & Lakshman, 2018; Komninou, Fallon, Halford, & Harrold, 2017; McGorrigan, Shortt, Doyle, Kilroe, & Kelleher, 2010). Breastfeeding in public is also a particularly stigmatised activity and a barrier for some women (Shortt, McGorrian, & Kelleher, 2013), especially those with a higher weight (Claesson, Larsson, Steen, & Alehagen, 2018; McKenzie, Rasmussen, & Garner, 2018). Having to justify reasons for breastfeeding can create divisions between formula feeding mothers and breastfeeding mothers, which has negative ramifications for all mothers, regardless of how they feed their babies as it can impact on social support (Woollard, 2019). Breastfeeding is also seen as an act of 'good mothering' (Marshall, Godfrey, & Renfrew, 2007; Pallotti, 2015). While women may have a moral motive to breastfeed, they do not have a moral duty to do so; thus, while it is vital to support women to breastfeed, this should not create feelings of shame, guilt, blame or failure amongst those who do not breastfeed, for whatever reason (Woollard & Porter, 2017). Approaches and language used around breastfeeding can make some women feel pressured to breastfeed (Hoddinott & Pill, 2000; Lagan, Symon, Dalzell, & Whitford, 2014) and reinforce the moral context around infant feeding where women who do not breastfeed can be judged for not doing so (Darwent & McInnes, 2015). Women themselves believe that changes needed to be made to current messaging around breastfeeding, suggesting a move away from the perception that breastfeeding is best (rather than normal), emphasis on wider values other than the health benefits of breastfeeding, and a message that every feed matters (Brown, 2016). Thorley (2019) argues that culture influences the perception of what is 'normal' and where a culture has abandoned breastfeeding, or where it is in decline, women are unlikely to view it as the normal way to feed a baby. She suggests that describing breastfeeding as 'biologically normal' or 'physiologically normal' is more appropriate, and that breastfeeding initiatives in this context can be termed 'interventions'. Again, it is important to be cognisant of the stigma and moral judgement surrounding infant feeding when conducting research and developing interventions in this area, and to engage with parents in a supportive, non-judgemental manner.

Accepting nutrition information and advice can further compromise a good mothering identity (e.g. sufficient instinctive knowledge) for some mothers (O'Key & Hugh-Jones, 2010). Women can feel they are being surveilled through institutionalized encounters with professionals and also through more informal everyday interactions with fellow mothers, whether or not this is the case (Foucault termed this the Panopticon-like society) (Henderson, Harmon, & Houser, 2010; Taylor, Teijlingen, Ryan, & Alexander, 2019). They can also experience intrusive policing of their behaviours and infant feeding practices from family, friends and strangers, and must negotiate this 'moral maze of surveyed motherhood' (Grant, Mannay, & Marzella, 2018, p. 431). Mothers constantly surveil one another through interpersonal communication and observation (e.g. through conversations about children's appropriate developmental milestones), and use such interactions to surveil themselves and their own decisions about parenting. This fuels 'New Momism' - mothering and the pressure to be perfect (Henderson et al., 2010). Pregnancy is increasingly experienced in the public domain owing to advances in gender equality, maternity benefits, technological innovation and mass media; this has coincided with new types of surveillance in the form of scientific 'advice', medical technologies and media dissemination of cultural norms regarding appropriate dress, lifestyle and behaviour during pregnancy (Fox, Heffernan, & Nicolson, 2009). Online forums can also create their own regulatory and disciplinary effects, and reinforce norms of 'good mothering'; this can create conflict within mothers between what they feel/believe and what is expected within the group (Tugwell, 2019).

There is a need to ensure that research and interventions to address childhood obesity use appropriate language and supportive approaches, and do not contribute to stigma and weight bias. This consideration of language also applies to parents and families, and others involved in a child's life. In 2017, the American Academy of Pediatrics issued a policy statement on stigma experienced by children and adolescents with obesity (Pont et al., 2017). It outlines several recommendations including: improving the clinical setting by modelling best practices for non-biased behaviours and language; using empathetic and empowering counselling techniques, such as motivational interviewing, and addressing weight stigma and bullying in the clinic visit; advocating for inclusion of training and education about weight stigma in medical schools, residency programs, and continuing medical education programs;

empowering families to be advocates to address weight stigma in the home environment and school setting. Despite agreement on a number of guiding principles, evidence-based best practices for how healthcare professionals can best communicate with children (0-18 years) and their families about obesity and weight-related topics are lacking (McPherson et al., 2017). In their scoping review, McPherson et al. (2017) identified the following guiding principles: (i) include all stakeholders in discussions; (ii) raise the topic of weight and health early and regularly; (iii) use strengths-based language emphasizing health over weight; (iv) use collaborative goal-setting to engage children and parents and (v) augment discussions with appropriate tools and resources. There is a gap in knowledge concerning what language to use and how best to frame messaging about healthy weight and related behaviours to avoid stigma and promote healthy behaviours (British Psychological Society, 2019). Some work has been undertaken in this regard around language and framing. For example, pregnant women consider use of the term 'obese' unacceptable, and instead prefer the term 'raised BMI' (Cunningham et al., 2018). A recent media analysis found an increased focus on societal solutions to childhood obesity, however, this coincided with a reduction in the issue's salience (Nimegeer, Patterson, & Hilton, 2019). The challenge is balancing non-stigmatising messaging with advocacy efforts. It is important therefore to examine parents views around language and framing in how we approach early life obesity prevention.

1.10 The effectiveness of behavioural interventions in preventing childhood obesity

To date, research concerning childhood obesity has tended to focus on children aged five years and over (Ash, Agaronov, Young, Aftosmes-Tobio, & Davison, 2017; Blake-Lamb et al., 2016; Campbell & Hesketh, 2007; Ciampa et al., 2010; Haynos & O'Donohue, 2012; Hesketh & Campbell, 2010; Laws et al., 2014; Monasta et al., 2011; Seburg, Olson-Bullis, Bredeson, Hayes, & Sherwood, 2015; Summerbell et al., 2005; Yavuz, van Ijzendoorn, Mesman, & van der Veek, 2015). In a 2011 Cochrane review of childhood obesity prevention interventions, only one intervention targeting children under the age of two was identified (Waters et al., 2011); since then, however, the number of interventions reported has increased substantially (Blake-Lamb et al., 2016; Koplin et al., 2019; Laws et al., 2014; Monasta et al., 2011; Redsell et al., 2016; Seburg et al., 2015; Yavuz et al., 2015).

The most recent update of the Cochrane review of interventions for preventing obesity in children included 153 RCTs: most targeted children aged 6-12 years, and had modest impacts in reducing the risk of obesity in children aged 0-5 years and 6-12 years (Brown et al., 2019). Thirty-nine studies focused on children aged 0-5 years: interventions that combined diet with physical activity targets were more effective (Brown et al., 2019). There was less evidence in this review for adolescents and young people aged 13 to 18, and the strategies given to them did not reduce their zBMI score, highlighting the need for intervention among younger children (Brown et al., 2019).

The results of early life interventions to date in terms of their impact on child weight are mixed. In general, they demonstrate limited impact on child weight and/or anthropometric outcomes but positive impacts on weight-related outcomes, e.g., infant feeding, activity levels, and sleep (Blake-Lamb et al., 2016; Redsell et al., 2016). Askie et al. (2020) synthesised the findings of four RCTs of childhood obesity prevention interventions [Healthy Beginnings, NOURISH, INFANT, POI NZ] into an individual participant data prospective meta-analysis. They observed that, overall, the interventions achieved a modest, but statistically significant, reduction in BMI *z*-scores at 18-24 months to a moderate degree, as well as prolonging breastfeeding duration, and reducing TV viewing time (Askie et al., 2020). There was some evidence that the BMI z score reduction was greater in settings with limited well-child health care programmes (Askie et al., 2020). While two of the most recent reviews have focused on interventions delivered during the first 1,000 days (Blake-Lamb et al., 2016; Redsell et al., 2016), they did not focus on intervention delivery agents; therefore, we cannot tell who is best placed to deliver such interventions. A review of the role and impact of community health workers in childhood obesity interventions only found one intervention that targeted children under the age of 2; overall, meta-analysis demonstrated small but significant impacts on weight-related measures (Schroeder, McCormick, Perez, & Lipman, 2018). While a recent review of early life feeding interventions did focus on health care professional-delivered interventions, it only included interventions delivered between birth until the age of two years—the prenatal period was not included—and only looked at interventions including infant feeding practices, not the wider range of weight-related behaviours such as physical activity and sleep. It also found inconsistent effects on feeding practices, dietary intake, and weight outcomes within

the 10 trials identified (Matvienko-Sikar et al., 2018). Recent reviews have highlighted the potential of interventions that aim to improve parental feeding practices, responsive feeding interventions in particular (Koplin et al., 2019; Matvienko-Sikar et al., 2018; Redsell et al., 2016; Spill et al., 2019). There has been limited focus on prenatal interventions, however, a recent overview of systematic reviews found limited evidence of the impact of pregnancy-related diet or lifestyle interventions on childhood obesity; 5 of 11 dietary interventions, alone or in combination with exercise, showed beneficial effects on the risk factors for childhood obesity (Grobler, Visser, & Siegfried, 2019).

Completed and ongoing early life obesity prevention trials have: had fairly modest effects; been limited largely to high-income countries; used relatively short-term interventions and outcomes (few have used body composition measures); neglected key life stages (i.e. pre-conception and toddlerhood) and behavioural risk factors (maternal smoking during pregnancy, infant and child sleep) (Reilly, Martin, & Hughes, 2017). Interventions are increasingly being developed that span the antenatal and postnatal periods, including pre-conception, and with child follow-up (Timmermans et al., 2019). Interventions generally tend to target individual-level diet and activity behaviours, rather than the broader social and ecological factors that give rise to them (Blake-Lamb et al., 2016), which may account for the limited impacts on adiposity/weight outcomes. Lack of attention to-date has been paid to long-term intervention effects (St George et al., 2020). The dearth of evidence of economic effectiveness has been noted by other authors (Bambra et al., 2015; Summerbell et al., 2005). Intervention effectiveness trials in general are also often hampered by poor reporting (Baron et al., 2018) and issues noted concerning the reporting of fidelity in behavioural childhood obesity intervention trials, in general (JaKa et al., 2016) and those specific to infant feeding (Toomey et al., 2019). There has also been little consideration to external validity and /or scalability of interventions (Haynos & O'Donohue, 2012) and reviews of external validity reporting in childhood obesity interventions identify insufficient reporting of elements necessary to make decisions about generalisability (Klesges, Dzewaltowski, & Glasgow, 2008; Laws et al., 2014).

Multitarget interventions (i.e., addressing nutrition, physical activity, sedentary behaviour, behaviour change, and parenting) are recommended to prevent obesity in children and young people (NICE, 2015b), and interventions are complex,

involving multiple components. We do not know, however, what the most important target behaviours are, or the most important intervention components to determine effectiveness. Such information could assist in the testing and scale-up of interventions.

1.11 The role of behavioural science in childhood obesity prevention

Early life obesity prevention interventions target several risk and protective factors for childhood obesity during the first 1,000 days. As mentioned in the previous section, the evidence of their effectiveness is mixed, however. The use of theory is not well-developed, and it is not known what the active ingredients of interventions are. There has been a large increase in the number of interventions delivered during this period; it is timely therefore to take a more in-depth look into what works, and why, in order to enhance the evidence base in this area.

Many models and frameworks exist for the development, implementation and evaluation of complex interventions (Araújo-Soares, Hankonen, Presseau, Rodrigues, & Sniehotta, 2019). These include Intervention Mapping (Bartholomew Eldredge et al., 2016; Bartholomew, Parcel, & Kok, 1998), the RE-AIM (Reach Effectiveness-Adoption Implementation Maintenance) Framework (Glasgow, Vogt, & Boles, 1999), and the Precede-Proceed Model, and, more recently, the Medical Research Council (MRC) Framework for Developing and Evaluating Complex Interventions (Craig et al., 2008) and the Behaviour Change Wheel (Michie, van Stralen, & West, 2011). Best practice in intervention development is to engage in systematic development, drawing on appropriate evidence and theory, then move on to pilot, exploratory and then definitive evaluation (Craig et al., 2008). A recent realist synthesis of the processes that researchers use to develop complex interventions to improve health, found that almost half took a pragmatic self-selected approach, one-quarter took a theory- and evidence-based approach (e.g. Intervention Mapping; Behaviour Change Wheel, while one-tenth took a partnership approach (e.g. community-based participatory research; co-design) (Croot et al., 2019). Regardless of the approach taken, ten common actions of intervention development were identified, including: identifying a need for an intervention, selecting the intervention development approach to follow, considering the needs of the target

population, reviewing published evidence, involving stakeholders, drawing or generating theory, and designing and refining the intervention (Croot et al., 2019).

A theory "presents a systematic way of understanding events or situations. It is a set of concepts, definitions, and propositions that explain or predict these events or situations by illustrating the relationships between variables"(Glanz & Rimer, 2005, p. 4). Interventions which are based on theory are more likely to be effective (Taylor, Conner, & Lawton, 2012). It should be noted, however, that recent studies have concluded that this is not the case, due to methodological and reporting issues (Dalgetty, Miller, & Dombrowski, 2019; Lock, Post, Dollman, & Parfitt, 2020; Prestwich et al., 2014). Such debates outstanding, a theoretical understanding of how an intervention causes change enables the identification of key components of interventions that can be maximised nonetheless (Craig et al., 2008). The type of theory is also likely to be important. In their review of interventions, Redsell et al. (2016) found that the majority were not underpinned by a theory of change, and where a theory was applied, it tended to be social-cognitive in nature. Use of theory enables the identification of key constructs which impact on behaviours and thus key intervention targets; it also facilitates the identification of key intervention components – active ingredients or "behaviour change techniques" (Michie & Prestwich, 2010; Moore et al., 2019).

A behaviour change technique (BCT) is "an observable, replicable, and irreducible component of an intervention designed to alter or redirect causal processes that regulate behavior; that is, a technique is proposed to be an "active ingredient" (e.g., feedback, self-monitoring, and reinforcement)/the active ingredients of an intervention (Michie et al., 2013, p. 82). Understanding the active ingredients and mechanisms of change of theory-based interventions can lead to theory refinement and/or development (Michie & Prestwich, 2010). It can also assist in the testing and scale-up of interventions (Moore et al., 2019). Theory, however, is often lacking in the development of health behaviour interventions (Arnott et al., 2014; Farmer et al., 2016; French, Cameron, Benton, Deaton, & Harvie, 2017; Michie, Jochelson, Markham, & Bridle, 2009; Prestwich et al., 2014). Better reporting of interventions and theory is needed (Moore et al., 2019).

Behavioural science can also play a role in understanding how to understand and target key behaviours that need to change. For example, Olander, Smith, and Darwin (2018) argue that much of antenatal health promotion assumes increased

motivation for behaviour change (i.e. the 'teachable moment' (Atkinson, Shaw, & French, 2016; Phelan, 2010)), without considering women's capability and opportunity to engage in the relevant behaviours. They further highlight that it is necessary to better understand behaviour change related to pregnancy; using psychological theory and exploring health behaviours from the perspective of the woman, midwives and other healthcare professionals can aid in this regard. This also applies to obesity prevention-related behaviours across the first 1,000 days, and the need to explore parents' views and experiences to inform intervention development.

1.12 Knowledge translation: Reducing the gap between research, policy, and practice

The Canadian Institutes of Health Research defines knowledge translation as "a dynamic and iterative process that includes the synthesis, dissemination, exchange and ethically sound application of knowledge to improve health, provide more effective health services and products, and strengthen the health care system" (Canadian Institutes of Health Research, 2017). It can take 17 years for research evidence to reach practice (Morris, Wooding, & Grant, 2011). There is increased focus on bridging this gap between research and practice, and many groups across the world, such as Fuse: the Centre for Translational Research in Public Health, are doing pioneering work in this area (Van der Graaf et al., 2018). Research aligned with national/international priorities is more likely to be used (Kok, Gyapong, Wolffers, Ofori-Adjei, & Ruitenberg, 2016). Chalmers et al. (2014) have also called for improved transparency in the processes by which funders prioritise research. Adopting a systematic and transparent approach to the identification of health research priorities helps ensure that funded research is policy-relevant and has the greatest potential public health benefit, ensuring efficient and equitable use of limited resources (Bryant, Sanson-Fisher, Walsh, & Stewart, 2014). To date, work has been undertaken to gain consensus on research priorities in areas relevant to childhood obesity including: paediatric preventive care (Lavigne, Birken, Maguire, Straus, & Laupacis, 2017), obesity prevention in early care and education settings (Ward, Vaughn, & Story, 2013), the effective management of childhood obesity (Taylor et al., 2013), childhood obesity treatment (Wilfley et al., 2017), and longitudinal studies (Byrne, Wake, Blumberg, & Dibley, 2008). No previous prioritization exercise has identified research priorities for childhood obesity

prevention in 0- to 18-year-olds, however. In Ireland, the national obesity strategy emphasizes prevention and adopting a life-course approach. Research-related actions include the development of an obesity knowledge translation programme, research capacity to facilitate knowledge translation, and a multiannual research plan (Department of Health, 2016b). As there is good evidence to support the beneficial effects of childhood obesity prevention programmes, focus should now be placed on translating effective intervention components into practice and scaling up interventions (Waters et al., 2011).

While research prioritization has been identified as one method to reduce the gap between research, policy, and practice, it is just one stage in the research cycle. There are several other stages before the end-point, including the implementation phase. Many different theories and frameworks for implementation exist, for example the Consolidated Framework for Implementation Research (Damschroder et al., 2009) and The Stages of Implementation Completion (Chamberlain, Brown, & Saldana, 2011), and the Framework for the Successful Scale-Up of Global Health Interventions (Yamey, 2011). Inherent to these are barriers and facilitators to knowledge translation. There are several barriers to the use of research evidence by public health decision makers. These include the lack of relevant research, decision makers' perceptions of evidence and their skills and opportunity to use it, the culture and competing demands surrounding decision making, as well as practical constraints such as time and cost (Oliver, Innvar, Lorenc, Woodman, & Thomas, 2014; Orton, Lloyd-Williams, Taylor-Robinson, O'Flaherty, & Capewell, 2011). Facilitators to the use of evidence by public health policymakers include access to and improved dissemination of relevant research, as well as promoting collaboration between policymakers and research staff (Oliver et al., 2014). Understanding the specific barriers and facilitators to the use of research evidence in obesity prevention may help in improving the uptake of research into policy/practice.

Engaging with those who are likely to benefit from the intervention is also important. If relevant perspectives are used to shape an intervention, then it is more likely to be relevant, culturally appropriate, credible, and acceptable to those delivering or receiving the intervention, leading to implementation and engagement in the real world if found to be effective (Croot et al., 2019).

1.13 Research gaps which this thesis will aim to address

Firstly, while research priorities have been established in a range of areas related to childhood obesity, research priorities for childhood obesity prevention in 0- to 18-year-olds have not been investigated. Furthermore, research has not yet examined the specific barriers and facilitators to the use of research evidence in obesity prevention. This may help to improve the uptake of research into policy/practice.

Secondly, while the numbers of interventions targeting children under the age of two are increasing, the results of these in terms of their impact on child weight are mixed, with limited impact on primary, weight-related, outcomes measures (Blake-Lamb et al., 2016; Redsell et al., 2016). There appears to be some potential with certain types of interventions (Blake-Lamb et al., 2016; Redsell et al., 2016). There is a lack of research on interventions to prevent childhood obesity, delivered during the antenatal period and beyond. While multi-component interventions (i.e. addressing nutrition, physical activity, sedentary behavior, behavior change and parenting) are recommended to prevent obesity in children and young people, it is not known which components of these (BCTs) determine effectiveness (NICE, 2015a). No studies to date have focused on the discrete BCTs that may distinguish more effective from less effective multi-component obesity prevention interventions delivered during the first 1,000 days. It is therefore difficult for practitioners, researchers and/or intervention developers to understand the most important and effective, transferable, intervention components. By better understanding what works (or not), extant interventions can be optimised or new ones developed. Furthermore, despite the increasing numbers of trials to assess the impact of early life obesity prevention interventions, there is relatively little reporting on the potential for these interventions to be translated into routine practice. Given that it can take up to 17 years to translate evidence into practice (Morris et al., 2011), it is important to assess the extent to which trials report on factors which can provide additional explanation for variability in intervention outcomes, insights into successful adaptations of interventions, inform generalizability to or across settings and populations (i.e. external validity), and help guide policy decisions.

Thirdly, it is vital to include and support parents in obesity prevention interventions. The focus to date has been on their perspectives towards the treatment and/or management of obesity, and obesity prevention in children of preschool age

and older. There is a lack of published research on the views of parents towards obesity prevention, specifically how programmes for children under the age of two should be developed, or their experiences of engaging in such interventions.

1.14 Overall aim and research questions

Considering the research gaps outlined above, the overall aim of this thesis was to examine opportunities for, and the effectiveness of, interventions delivered by health professionals during the first 1,000 days which aim to prevent childhood obesity. To address this overall aim, three separate studies were conducted. The research question for each study, and the corresponding papers, are outlined below.

- **Study 1**
    - Research Aim: To work with key stakeholders to:
        - Identify and prioritise policy- and practice-relevant knowledge gaps for research in childhood obesity prevention using the Nominal Group Technique (NGT);
        - Identify barriers and facilitators to knowledge translation in childhood obesity prevention.
    - Research question 1: What are the policy- and practice-relevant research priorities, and barriers and facilitators to knowledge translation, in childhood obesity prevention? [Paper 1]

    Hennessy, M., Byrne, M., Laws, R., Mc Sharry, J., O'Malley, G., & Heary, C. (2019). Childhood obesity prevention: priority areas for future research and barriers and facilitators to knowledge translation, coproduced using the nominal group technique. *Translational Behavioral Medicine*, *9*(4), 759-767. Retrieved from https://doi.org/10.1093/tbm/iby074. doi:10.1093/tbm/iby074 [Paper 1]

- **Study 2**
    - Research Aim: To synthesise the evidence for the effectiveness of health professional-delivered interventions which aim to reduce the

risk of overweight and obesity, directly or indirectly, in children under the age of two.

- Research Question 2: What is the evidence for the effectiveness of health professional-delivered interventions to reduce the risk of overweight and obesity in children under the age of two, and what behaviour change theories and/or techniques are associated with intervention outcomes? [Study 2a: Paper 2]
- Research Question 3: To what extent do childhood obesity interventions delivered by health professionals during the first 1,000 days report on factors that can be used inform generalizability across settings and populations? [Study 2b: Paper 3]

Hennessy, M., Heary, C., Laws, R., van Rhoon, L., Toomey, E., Wolstenholme, H., & Byrne, M. (2019a). The effectiveness of health professional-delivered interventions during the first 1,000 days to prevent overweight/obesity in children: A systematic review. *Obesity Reviews*, *20*(12), 1691-1707. Retrieved from https://doi.org/10.1111/obr.12924. doi: 10.1111/obr.12924 [Paper 2]

Hennessy, M., Heary, C., Laws, R., Van Rhoon, L., Toomey, E., Wolstenholme, H., & Byrne, M. (2019b). Health professional-delivered obesity prevention interventions during the first 1,000 days: A systematic review of external validity reporting. *HRB Open Research*, *2*, 14. Retrieved from https://hrbopenresearch.org/articles/2-14/v1files/39675/2-14.html. doi:10.12688/hrbopenres.12924.1 [Paper 3]

- **Study 3**
  - Research Aim: To elicit parents' views and experiences of interventions to prevent childhood obesity / promote healthy growth during the first 1,000 days, and interventions delivered by health professionals in particular.
  - Research Question 4: What are parents' views and experiences of interventions to prevent childhood obesity / promote healthy growth

during the first 1,000 days, and interventions delivered by health professionals in particular.

Hennessy, M., Byrne, M., Laws, R., & Heary, C. (2020) "They just need to come down a little bit to your level": A qualitative study of parents' views and experiences of early life interventions to promote healthy growth and associated behaviours. [Paper 4; submitted to the International Journal of Behavioural Nutrition and Physical Activity in February 2020]

1.15 Thesis outline

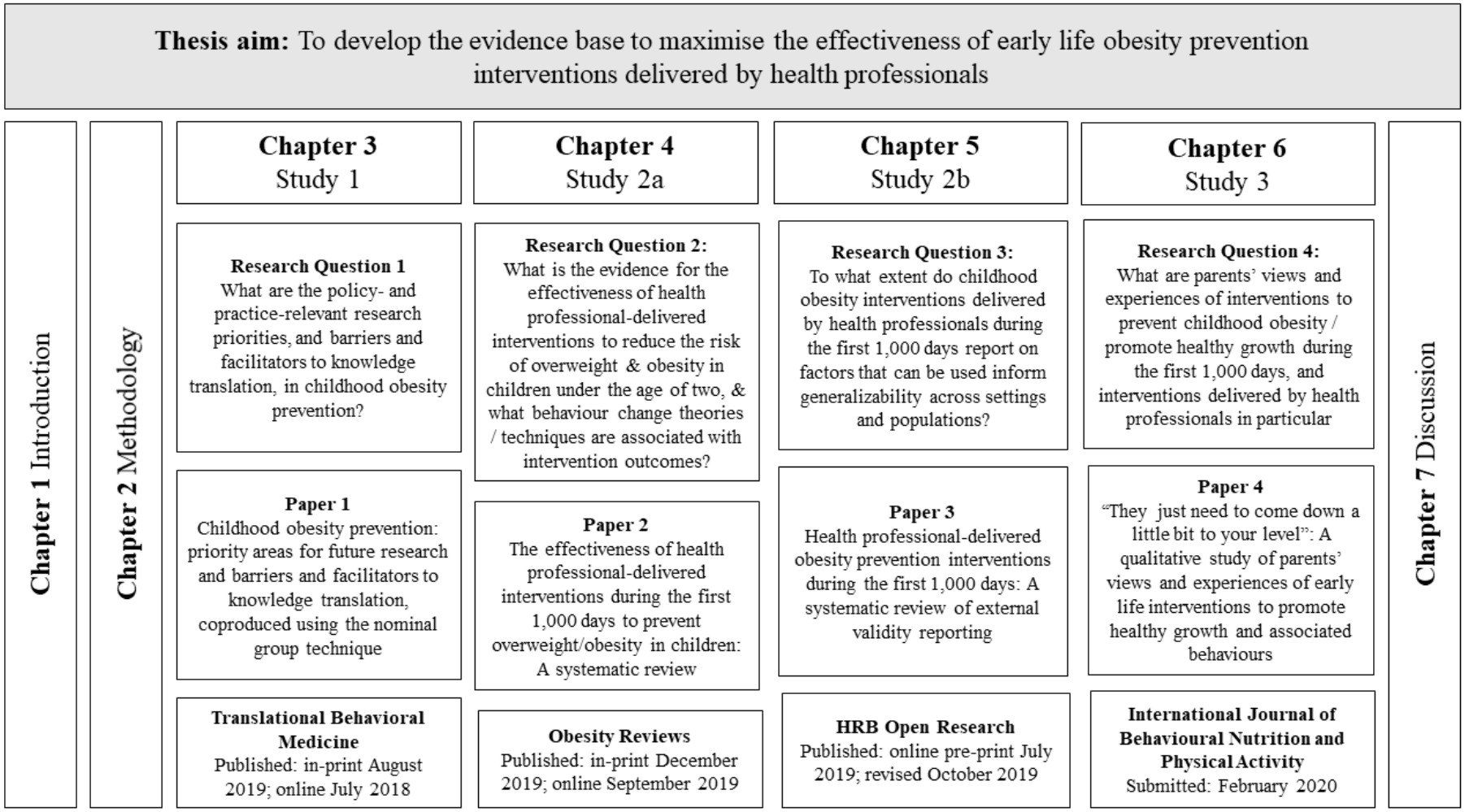
The thesis is organised into the following chapters (Figure 1.2):

Chapter 2 outlines the methodological basis of the overall PhD thesis and the three studies underpinning it. The methodological decisions relating to each study, in terms of design, implementation and analysis, are discussed in relation to the study research questions.

Chapters 3-6 contain copies of the three published papers, and one which is under submission, in peer-reviewed journals.

Chapter 7 contains a general discussion of the findings of the three studies in the context of the extant literature and outlines the strengths and limitations of the overall body of research. The implications of this research for future research, policy and practice are discussed and conclusions drawn.

Figure 1.2 Thesis outline



Chapter 2 Methodology

2.1 Chapter overview

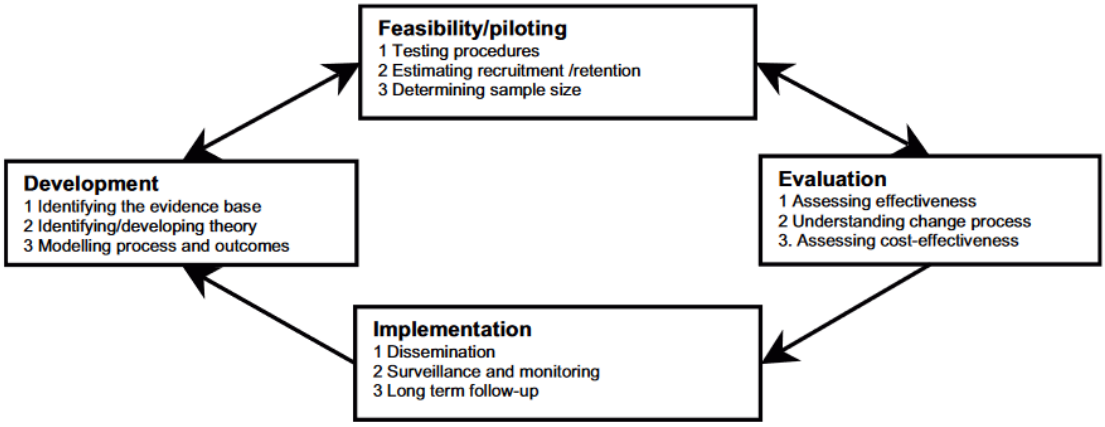
The aim of this chapter is to describe the overall methodological approach to this thesis and the three individual studies. While the peer-reviewed articles associated with each study outline the methodology and methods used, this chapter provides a richer description of the methodology (where necessary) alongside a rationale and critique of the chosen methods. Cross-cutting issues relating to ethics, patient and public and involvement, and reflexivity are also considered.

2.2 Overview of study design and philosophical approach

As outlined in the previous chapter, the overall aim of this thesis is to build the evidence base for interventions to promote healthy growth in children during the first 1,000 days; those delivered by health professionals in particular.

The UK Medical Research Council (MRC) Framework for Developing and Evaluating Complex Interventions (Craig et al., 2008) (Figure 2.1) aims to assist researchers in choosing and implementing appropriate methods in the development and evaluation of complex interventions. The first study in this thesis sets the context for the research by identifying and prioritising research questions to be addressed in childhood obesity prevention. Subsequent studies are situated within the development phase of the MRC Framework; specifically, they involve identifying the evidence base, and appropriate theory. The use of behaviour change theory in the design, implementation and evaluation of health-related interventions is advocated and it is generally recognised that interventions developed in this manner are more likely to be effective (Craig et al., 2008). It should be noted, however, that recent studies have concluded that this is not the case, due to methodological and reporting issues (Dalgetty et al., 2019; Prestwich et al., 2014). Such debates outstanding, a theoretical understanding of how an intervention causes change enables the identification of key components of interventions that can be maximised nonetheless (Craig et al., 2008).

Figure 2.1 MRC Framework for Developing and Evaluating Complex Interventions



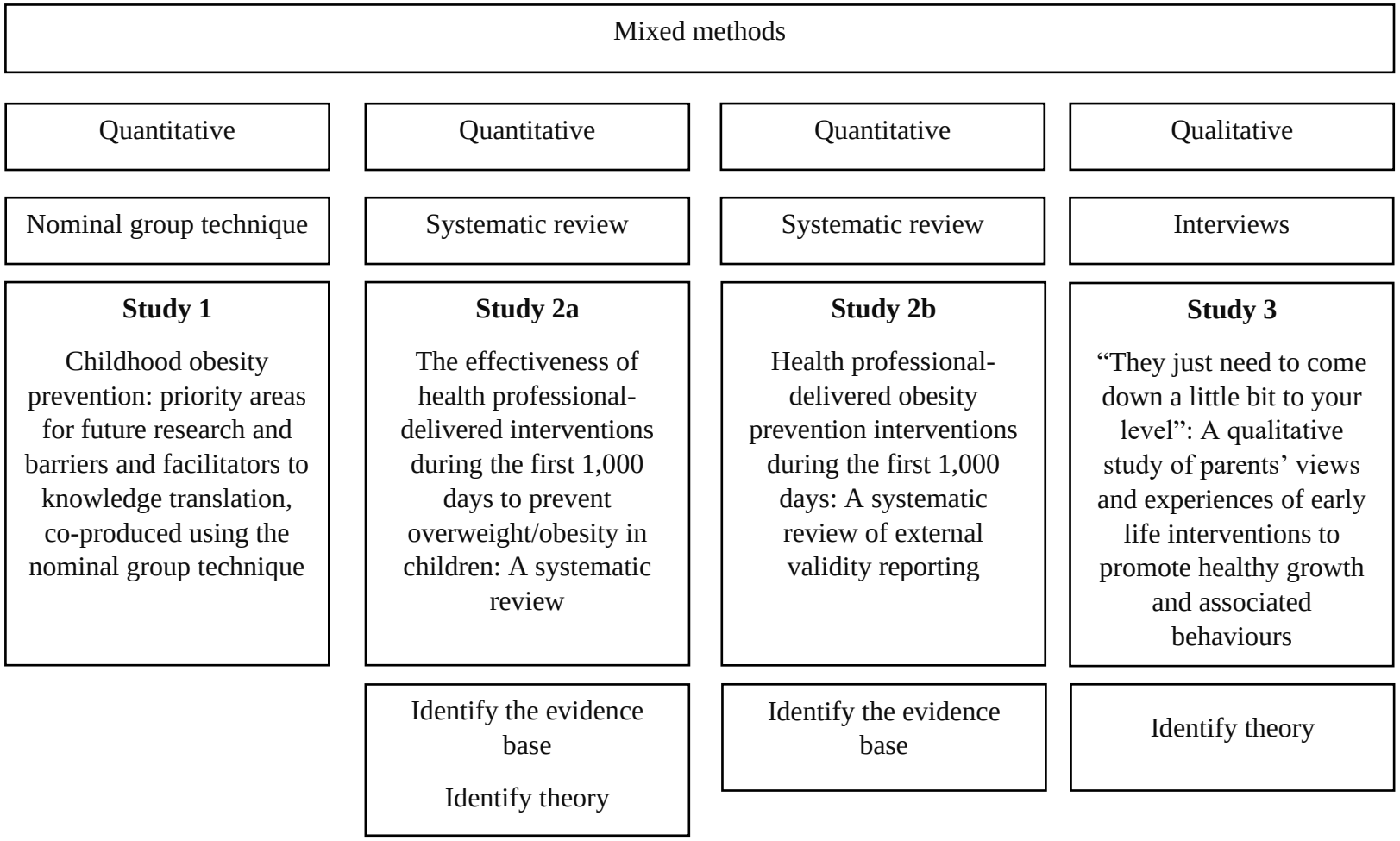
An overview of the thesis study design is presented in Figure 2.2. A mixed methods approach was required to achieve the overall study aim and objectives, for several reasons. Firstly, neither quantitative not qualitative approaches on their own are a panacea for investigating multi-level public health issues (Headley & Plano Clark, 2020). Mixed methods research brings qualitative and quantitative data together to transcend the conclusions warranted by either approach on its own (Creswell & Plano Clark, 2011). Furthermore, mixed methods approaches can meaningfully bridge the gap between siloed research and everyday practice (Headley & Plano Clark, 2020; Mertens, 2012), an important area of focus for this thesis. Finally, the three studies within this thesis are quite distinctive in their focus – from setting research priorities, to assessing the effectiveness, active ingredients, and external validity reporting of interventions, to understanding parents' views and experience of interventions – thus a variety of methodological approaches were required to address the specific research questions.

An exploratory, pragmatic, mixed methods design was adopted: the findings of Study 1 informed the focus of Studies 2 and 3 (i.e. sequential mixed methods design). Studies 2 and 3 were conducted simultaneously (i.e. concurrent mixed methods design) as they were stand-alone investigations. A pragmatic design was chosen as each method used was chosen to address the specific research question rather than being tied to a

particular epistemology. The first study sets the context for the thesis by using the nominal group technique to identify research priorities for childhood obesity prevention and barriers and facilitators to knowledge translation. The second study – a systematic review – then identifies the evidence base by synthesising the evidence for the effectiveness of health professional-delivered interventions during the first 1,000 days which aim to prevent overweight or obesity in children. The latter includes identifying theory and behaviour change techniques, as well as examining the external validity reporting of the included intervention studies. The third and final study elicits parents' views on interventions to promote healthy growth during the first 1,000 days, particularly those delivered by health professionals, via qualitative interviews. This contributed to identifying theory as to how to best engage parents in interventions. The value of qualitative research in understanding complex interventions (Moore et al., 2015; Muller et al., 2019; Thirsk & Clark, 2017) and within trials (O'Cathain, 2018) is increasingly recognised. Qualitative methods can provide rich insights into intervention design, enhancing its acceptability to users and relevance to the context in which it will be used (Muller et al., 2019).

On completion, the findings from each study phase were triangulated to further our understanding of the effectiveness of health professional-delivered obesity prevention interventions in children under the age of two and how we can progress work in this area. This information—which includes a description of the evidence base and theory in line with the first phase of the MRC Framework, as well as parents views of interventions—is presented in the final chapter. Initially the objective was to use the findings from the thesis to inform the development of an intervention to promote healthy growth during the first 1,000 days; however, over the course of the work, it became apparent that the next phase might better focus on the adaptation of an existing intervention, rather than the development of a completely new one.

Figure 2.2 Overview of thesis design



2.3 Study 1: Identifying research priorities for childhood obesity prevention and barriers and facilitators to knowledge translation

2.3.1 Background and rationale

Despite the public health significance of childhood obesity, research priorities for childhood obesity prevention have not yet been established. Co-production of priorities leads to research which may be more translatable to the domains of policy and practice. The aim of Study 1 was to work with key stakeholders to:

- Identify and prioritise policy- and practice-relevant knowledge gaps for research in childhood obesity prevention using the Nominal Group Technique (NGT);
- Identify barriers and facilitators to knowledge translation in childhood obesity prevention.

To address these aims, we used the NGT during multi-stakeholder workshops over a two-day national obesity conference in Ireland, hosted by the Association for the Study of Obesity on the Island of Ireland (ASOI) in May 2017. During Day 1 workshops, ten nominal groups identified and prioritised research priorities and barriers and facilitators to knowledge translation in childhood obesity prevention. On Day 2, a smaller workshop was held with key stakeholders to reach consensus on the research priorities identified the previous day. The study [POCKETS:Prevention Of Childhood obesity-Knowledge Exchange and TranSlation], embedded within a national conference, provided an ideal opportunity to engage in research prioritisation with a broad range of stakeholders. It facilitated researchers, policymakers, and practitioners to reflect on and discuss current and future directions for research on childhood obesity prevention in Ireland. It also enabled us to locate the identified priorities within an international context as six international experts in childhood obesity also presented at the conference and participated in the research prioritisation exercise on Day 2. An advisory group, comprising members of the Health Behaviour Change Research Group (HBCRG) and School of Psychology at NUI Galway and ASOI, oversaw the priority setting process, including determining which stakeholders should be consulted, and synthesising, refining and/or translating

priority areas generated by participants during day one workshops which employed the NGT.

While a variety of approaches to generating research priorities are available (e.g. Delphi methods and NGT), there is no gold standard approach (Viergever, Olifson, Ghaffar, & Terry, 2010). We opted to use the NGT, a consensus method designed by Delbecq and Van de Ven which aims to generate potential answers to a question which can then be agreed upon and/or prioritized (Delbecq & Van de Ven, 1971; Delbecq, van de Ven, & Gustafson, 1975). A key strength of a consensus method like NGT is that participation from group members is balanced due to the structured, individual nature of idea generation and ranking (McMillan et al., 2016). Other benefits of the NGT method are: results can be obtained quickly as it only involves participants for a few hours; it is convenient for participants who are likely to only want to attend a single session compared to answering multiple questionnaires several weeks apart (e.g. Delphi method) (McMillan et al., 2016). The NGT has a number of potential weaknesses also however, which were considered and addressed in the research protocol. These include: time-wasting if questions are not posed with clarity; evaluation of individual's ideas by other group members or dominance of certain individuals in discussions, which requires skilled facilitators (Scott & Deadrick, 1982).

2.3.2 Participants

Priority setting exercises should incorporate the views of a wide range of stakeholders (Bryant et al., 2014). Conference delegates were invited to participate in Day 1 workshops using ASOI and HBCRG membership lists and online platforms (organisational websites- www.asoi.info, www.nuigalway.ie/hbcrg; Twitter; LinkedIn; Facebook). The inclusion criteria were broad – anyone with an interest in obesity prevention, including (but not limited to) researchers, clinicians, practitioners, policymakers, health service managers, advocacy groups, members of the public. To ensure a wide variety of stakeholders were represented, and therefore to maximise the generation of research priorities that were meaningful to policymakers, practitioners, and researchers, we issued direct invitations also to key groups, and/or their representative bodies. They included researchers (including: childhood obesity, nutrition, physical activity/sedentary behaviour); clinicians (GPs, practice nurses, paediatricians, medical officers, endocrinologists, neonatologists,

midwives, public health nurses, practice nurses, physiotherapists, nutritionists, dietitians, speech and language therapists); parents; community organisations (community groups, family support organisations, early years' providers); educators; policymakers; health and social service managers/planners; advocates (e.g. Irish Heart Foundation; Irish Cancer Society; Diabetes Ireland). We also circulated details of the conference and study to national and European stakeholders in childhood obesity prevention, and representative organisations with a specific focus on obesity - in Ireland, the UK, Europe and beyond, i.e. Association for the Study of Obesity in the UK (ASO UK); European Association for the Study of Obesity (EASO); World Obesity. In addition, researchers at all career stages involved in obesity prevention-related research in Ireland were identified through the existing literature in this area and invited to participate. The conference was also promoted extensively on social media. Following a similar procedure for Day 2, we selected participants for the consensus meeting based on their expertise in obesity prevention, aiming for a mix of disciplines/sectors, gender, and national/international participants. Direct invitations were issued to individuals and/or representative bodies agreed by the research team. All those that completed a consent form were eligible to participate in the study.

We aimed to get 100 people to register to attend day one in order that 70 people would attend on the day and participate in the roundtable workshops. We sought to involve 20 participants (max.) in the smaller workshop on Day 2 to reach consensus on the research priorities identified during Day 1. The study was focused on identifying knowledge gaps in obesity prevention for research and also facilitators/barriers to knowledge translation; as such, participant age was not a primary concern (experience/expertise in the area was), efforts however were made to attract participants from a variety of age groups, and genders also. Participants in Day 2 were selected based on their expertise in the area of obesity prevention (e.g. researchers, policymakers, health service managers, clinicians). Initially we had planned to involve parents in the workshop on Day 2, however, it was decided that it would be best not to include them in this grouping due to potential inequalities. This was of particular concern as the meeting was a once-off, with no opportunity to build rapport and address potential power imbalances within the group (Green & Johns, 2019). No additional exclusion criteria were applied. Participants on Day 2 were given the opportunity to excuse themselves from roundtable discussions conducted

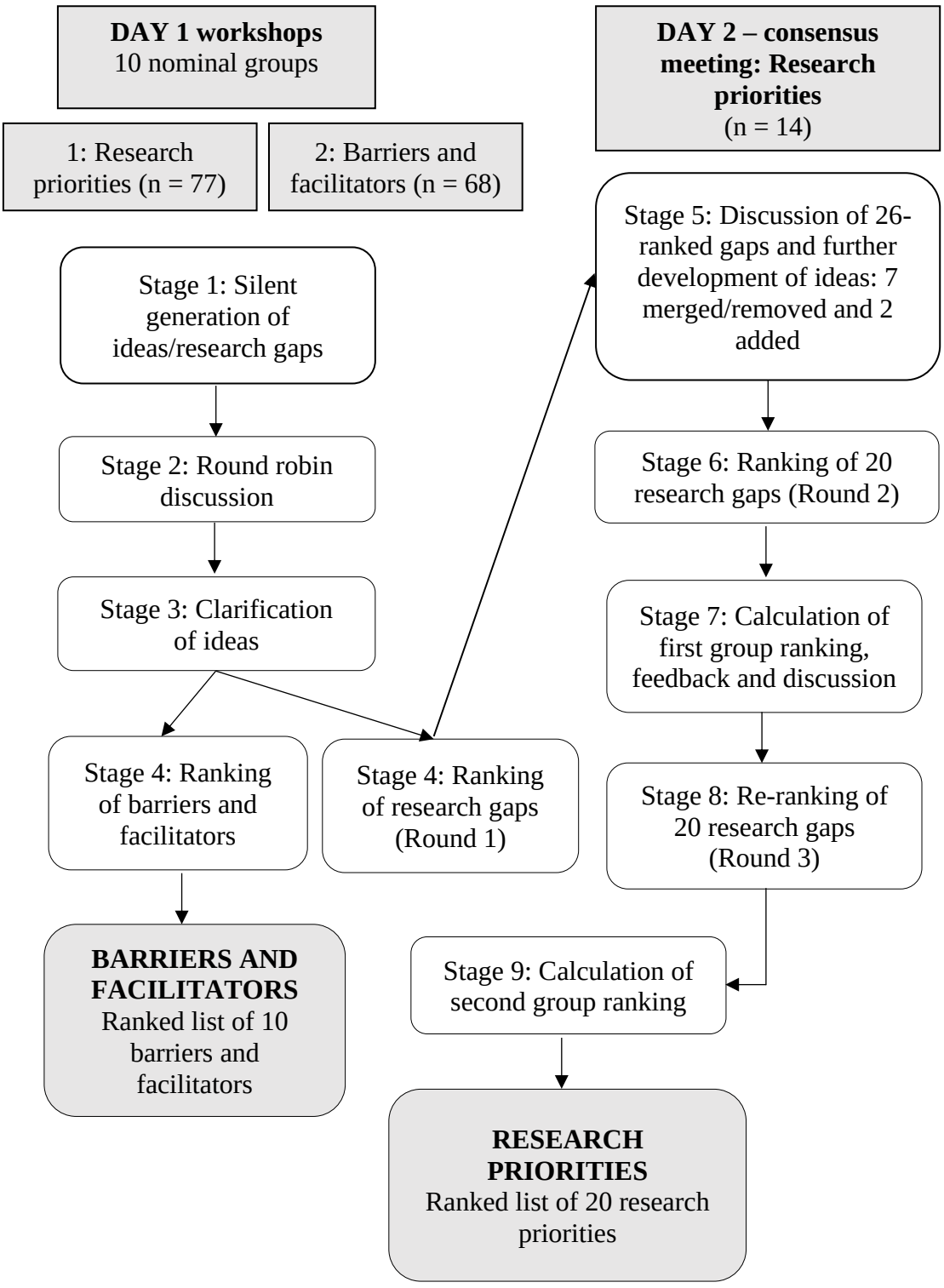
as part of the research study during Day 1 if they preferred, as many were presenting that day and we did not wish to over-burden them.

2.3.3 Procedures

The NGT has four core phases: silent generation, round robin, clarification and ranking (McMillan et al., 2014). We conducted each of these phases/stages during two separate workshops on Day 1, the first to identify and prioritise research gaps childhood obesity prevention, and the second to identify and prioritise barriers and facilitators to knowledge translation in childhood obesity prevention. We conducted a further five stages during Day 2 to gain consensus on the top 10 priorities for childhood obesity prevention research. See Figure 2.3 for an overview of the study methodology.

Experienced facilitators led each group during the workshops. They were briefed on the study and their roles in advance, and had the opportunity to ask questions. Day 1 facilitators were given a copy of the research study protocol, facilitators' notes, a detailed agenda for each of the workshops, and participant and/or group worksheets for each of the workshops (Appendix 3). In addition to the research study protocol, Day 2 facilitators were also given an agenda for the meeting, and individual ranking sheets for participants (Appendix 3). Further details on the methods are provided in Chapter 3.

Figure 2.3 Flow chart of the methodology for Study 1



Note: Stages 1-4 conducted during both workshops on Day 1

2.4 Study 2a: The effectiveness of health professional-delivered interventions during the first 1,000 days to prevent overweight/obesity in children: A systematic review

2.4.1 Background and rationale

Best practice in intervention development is to develop interventions systematically, using the best available evidence and appropriate theory (Craig et al., 2008). With that in mind, the aim of Study 2 was to synthesise the evidence for the effectiveness of health professional-delivered interventions during the first 1,000 days to prevent overweight/obesity, and to identify appropriate theory. The specific objectives were to:

- Synthesise the evidence for the effectiveness of health professional-delivered interventions to reduce the risk of overweight and obesity in children under the age of two;
- Establish what behaviour change theories and/or techniques are associated with more effective interventions.

2.4.2 Procedures

A systematic review was conducted based on a pre-registered protocol, available on the International Prospective Register for Systematic Reviews (PROSPERO) CRD42016050793.

Bramer, Rethlefsen, Kleijnen, and Franco (2017) suggest that optimal searches in systematic reviews should search at least Embase® (Elsevier; 1980), MEDLINE (Ovid®; 1966) (including electronic publications ahead of print), Web of Science™ (Thomson Reuters; Core Collection), and Google Scholar (the 200 first relevant references) as a minimum requirement to guarantee adequate and efficient coverage with topic/systematic review-specific databases (e.g. PsycINFO/Cochrane CENTRAL) added where relevant. Using a comprehensive list of key word search terms, from inception to April 2019 (updated in April 2019), the above databases were searched to identify eligible trials. We did not search Google Scholar as Cochrane currently suggest using at least two electronic databases, usually MEDLINE (using PubMed) and Embase®, plus the Cochrane Central Register of Controlled Trials (CENTRAL) (Higgins & Green, 2011). We also searched:

CINAHL Complete (EBSCOhost; 1994); PsycINFO (Ovid®; 1978); PubMed (1996); The Cochrane library databases: The Central Register of Controlled Trials; Database of Systematic Reviews; Database of Abstracts of Reviews of Effect (Wiley; 1996). Conference proceedings and other grey literature were searched on: Open Grey (INIST-CNRS; 2011) and Web of Science. ProQuest Dissertations & Theses Global, and ProQuest Dissertations & Theses – UK and Ireland, were used to identify eligible dissertation and thesis studies internationally. I also searched the following databases for the registration of clinical trials to identify any ongoing or unpublished research trials: International Clinical Trials Registry Platform Search Portal; ClinicalTrials.gov; ISRCTN registry. In addition, reference lists of previous systematic reviews on this topic were manually searched (Blake-Lamb et al., 2016; Campbell & Hesketh, 2007; Ciampa et al., 2010; Hesketh & Campbell, 2010; Redsell et al., 2016; Summerbell et al., 2005; Waters et al., 2011; Yavuz et al., 2015).

We included studies - as per Cochrane systematic review criteria - if they were randomised controlled trials (RCTs), including cluster-randomised controlled trials, or quasi-randomised trials comparing any behavioural intervention, led by or involving health professionals, with 'usual care' which aimed to prevent childhood overweight/obesity (either directly or indirectly) in children under the age of two that were born at term (37 to 42 weeks' gestation). Included studies reported at least one weight-related outcome measure (either as a primary or secondary outcome in their study). The primary outcome of interest in this review was any type of child adiposity/weight-related outcome measure. Trials must have had at least one follow-up weight-related measure to compare against baseline data (follow-up could be immediately post-intervention); trials only reporting infant birth weight were excluded.

Titles and abstracts of references were independently screened by two reviewers (MH and LT). Following the retrieval of full-texts, two reviewers (MH and LVR) independently reviewed them for inclusion. Disagreements were resolved through discussion, with a third author where necessary. Data from included full texts were extracted using a pre-piloted data extraction tool. Intervention descriptions were extracted following the criteria outlined in the TIDieR reporting guidelines (Hoffmann et al., 2014). Extraction fields included author, year, intervention title/brief name, country, design, population, intervention details, and

outcomes of interest. There is some overlap between the criteria outlined in the Template for Intervention Description and Replication (TIDiER) guidelines and therefore sometimes the same information was coded under more than one category for comprehensiveness. For example, materials were coded under 'What (materials)?' and 'How well (planned) [Strategies to improve or maintain intervention fidelity]'. Data were extracted by the lead author (MH) and 20% were checked for accuracy by a second reviewer (HCW). Any discrepancies were resolved through discussion.

A study was classified as supporting 'intervention effectiveness' where there was (i) a statistically significant difference between intervention and comparator in an objective measure of adiposity/weight (e.g. weight, body mass index (BMI), BMI z score, or percent overweight) AND (ii) at least one statistically significant difference between groups in a measure of any behavioural determinant of obesity (i.e. the secondary outcome(s) of interest of the review, e.g. nutrition, physical activity, and sleep behaviours) at intervention end or alternative follow-up point. We adopted this approach as we were interested in a more in-depth assessment of effectiveness, combining both adiposity/weight and behavioural outcomes; we also examined intervention effectiveness on adiposity/weight and behavioural outcomes separately. A similar definition of effectiveness was used previously by Golley, Hendrie, Slater, and Corsini (2011). Although we did not place a limit on the length of follow-up of outcomes in this review, we did apply a cut-off for effectiveness. This cut-off was pragmatically defined as within 12 months of follow-up of the intervention endpoint for this review (i.e., child aged 2 years, plus a maximum of 12 months follow-up) given the variable duration of interventions and timing of follow-up assessments. The frequency of 'intervention effectiveness' by behaviour change technique (BCT)s and use of theory was assessed. Risk of bias was assessed independently by two reviewers (MH and LVR) using the Cochrane Collaboration's risk of bias assessment tool (Higgins & Green, 2011).

Two coders (MH and LVR) independently coded all trials to determine the extent to which interventions were theory-based using the Theory Coding Scheme (Michie & Prestwich, 2010). We included 11 of the 19 items of the Theory Coding Scheme as these are the items which measure whether interventions are based on theory (Redsell et al., 2016). Disagreements were resolved through discussion, with a third author where necessary, until 100% agreement was achieved. Intervention

descriptions as reported (and control arms) were independently coded by two coders (MH and LVR) using the BCT Taxonomy V1 (Michie et al., 2013). The reliability of the method was assessed and improved in iterative rounds of coding. In the first step, a sample of five trials were independently coded. Coding differences were resolved through discussion, until 100% agreement was achieved. If agreement could not be reached, the views of a third party experienced in BCT coding (ET) were sought.

Due to the heterogeneity of participant characteristics and program features including length, outcomes measured and time of assessment, meta-analysis was not possible. Findings are presented descriptively in data summary tables and synthesized qualitatively in text. Further details on the methods are provided in Chapter 4. Supplementary tables and figures were also made available on Open Science Framework as they are useful to readers, peer reviewers and authors, as well as supporting open science (Price, Schroter, Clarke, & McAneney, 2018).

2.5 Study 2b: Health professional-delivered obesity prevention interventions during the first 1,000 days: A systematic review of external validity reporting

2.5.1 Background and rationale

While the number of interventions to prevent childhood obesity during the first 1,000 days is growing rapidly, greater consideration of the external validity of such interventions (i.e. how generalisable the intervention is to populations and/or settings beyond those in the original study) is needed to inform decisions about whether interventions should be adopted elsewhere and/or scaled-up (Glasgow et al., 2006). This systematic review aimed to determine the extent to which childhood obesity interventions delivered by health professionals during the first 1,000 days report on elements that can be used to inform generalizability across settings and populations.

2.5.2 Procedures

An external validity assessment tool previously developed by Dr Rachel Laws (Laws et al., 2014; Laws, St. George, Rychetnik, & Bauman, 2012) was used to assess the extent to which studies/trials identified in Study 2a reported on external

validity elements. The tool, based on the quality rating criteria proposed by Green and Glasgow (Green & Glasgow, 2006), included five main dimensions: 1) reach and representativeness (individuals); 2) reach and representativeness (settings); 3) implementation and adaptation (of intervention); 4) outcomes for decision makers; 5) maintenance and institutionalisation (i.e. the potential for implementation of the intervention in routine service delivery). We made three minor adaptations to the 'implementation and adaptation' dimension of this tool to ensure consistency with the approach taken to extracting and reporting fidelity in the overall review. Data concerning fidelity in the overall review was extracted according to three of the five criteria within the National Institutes of Health Behaviour Change Consortium (NIHBCC) fidelity checklist, namely: (i) training, (ii) treatment delivery, (iii) treatment receipt (Borrelli, 2011). We therefore amended the criterion 'Delivery agents described' in the original external validity tool to 'Delivery agents described: characteristics and training'; 'Intervention exposure' to 'Intervention delivery and exposure', and 'Fidelity assessment' to 'Fidelity assessment: treatment receipt'. Included studies were coded according to whether they met each criterion (yes, no, or not applicable). Initially, two authors (MH and RL) independently assessed the external validity of 20% of included studies. Any discrepancies were resolved through discussion, and then one author (MH) completed assessments of the remaining studies. Further details on the methods are provided in Chapter 4.Supplementary tables and figures were also made available on Open Science Framework.

2.6 Study 3: A qualitative study of parents' and experiences of early life interventions to promote healthy growth and associated behaviours

2.6.1 Aim of study 3

Given the dearth of research concerning parental perceptions of obesity prevention in very young children, Study 3 aimed to elicit parents' views on obesity prevention interventions and specifically health professional-delivered obesity prevention interventions during the first 1,000 days. This study formed part of a larger study, which also sought to explore parents perceptions of healthy growth and

associated behaviours during the first 1,000 days. The findings of the broader study will be reported elsewhere.

2.6.2 Procedures

Study design

A qualitative research design was employed to meet the overall aim and objectives. The value of qualitative research in understanding complex interventions and in trial/intervention development is increasingly recognised. Semi-structured, one-to-one interviews were conducted with parents / primary caregivers of young children. The philosophical underpinnings of this research combined constructivist ontology with interpretivist epistemology. My aim was to provide insight into constructions of reality and the ways in which such constructions are socially and culturally situated. During the interviews knowledge was created and negotiated (co-constructed): the meanings of the participant's stories were developed as we interpreted them (Kvale, 1996). I conducted this particular study within a qualitative paradigm as I believe that there are multiple versions of reality and that these are closely linked to the context in which they occur. The interviews were exploratory, and targeted a wide range of questions, and behaviours relating to promoting healthy growth in very young children. Various factors influence child weight, at individual, family and community/societal levels (Davison & Birch, 2001; Pocock, Trivedi, Wills, Bunn, & Magnusson, 2010); it is a very complex issue. While I appreciate positivist approaches and quantitative research, a qualitative paradigm was more suited to my research question in this study. I wanted to elicit people's views and experiences around promoting healthy growth, and interventions, from conception up until the age of two. I was interested in observing, describing, interpreting, and analysing the way people's views of themselves and the world around them (Bazeley, 2013). Using a semi-structured approach, I facilitated participants to share their views, experiences and stories so to make sense of how the world is seen from their perspective - 'experiential qualitative research' (Braun & Clarke, 2013), which fits with phenomenology. Interviews were the most appropriate method for this study as we were interested in individual experiences rather than group dynamic.

Lack of theory in qualitative research undermines its quality (Bradbury-Jones, Taylor, & Herber, 2014). Bronfenbrenner's (1979) ecological systems theory

is one framework that qualitative researchers use to investigate multilevel research problems (Headley & Plano Clark, 2020). The study was underpinned, from the outset, by social ecological theory which is often used to describe or investigate influences on child weight and related behaviours (Davison & Birch, 2001; Pocock et al., 2010). The interview guide was developed to tap into the various layers of influence within social ecological theory, namely individual/intrapersonal, interpersonal, organisational, community, and policy/enabling environment factors.

Sampling – inclusion and exclusion criteria, sampling approach, recruitment

Inclusion and exclusion criteria

Participants were parents and/or primary caregivers of children aged under 30 months. This cut-off was chosen because we were interested in their views and experiences of the child's first 1,000 days of life and therefore felt that those with a child aged up to 30 months would be best able to reflect on this period. Parents also had to have a good command of the English language and be aged 18 years and over. Parents / primary caregivers of pre-term infants and those with morbidities and other conditions affecting growth, and primiparous pregnant women and expectant fathers were ineligible. The full list of inclusion and exclusion criteria is outlined in Table 2.1.

Table 2.1 Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
1) Parents (mothers and fathers) / primary caregivers who have at least one child aged up to two years at the time of recruitment. 2) Participants must have a good command of the English – they must be able to read English and engage in conversation in English – but English does not have to be their first language. 3) Participants must be aged 18 years and over.	1) Parents / primary caregivers of pre-term infants and those with morbidities and other conditions affecting growth. 2) Pregnant women and expectant fathers.

Sampling approach

Parents were purposively recruited to ensure variety in several criteria, with the aim of achieving maximum variation:

- Mothers and fathers
- Socio-economic backgrounds
- Prima/multi-parous mothers/fathers. To date, much of the research - including intervention studies – have focused on prima-parous mothers, however, there is evidence that parents may use different strategies with their second, and subsequent children. For example, Ruggiero, Birch, Paul, and Savage (2019) found that second born children may be exposed to more unhealthy foods and have less consistent meal routines.
- Parents who breastfed/formula fed their babies
- Location – urban/rural
- Ethnic/cultural backgrounds
- BMI.

A brief demographic questionnaire was administered to study participants before each interview commenced to monitor sampling variation (Appendix 3). Participants were asked to self-report their height (feet and inches/metres) and weight (stone and lbs/kg), and BMI was calculated.

There are no computations that can be done to determine a priori the minimum number of sampling units required in a qualitative study (Sandelowski, 1995). Rather than relying on sample size community norms, methodological knowledge was used to critically consider sample size sufficiency for this study (Vasileiou, Barnett, Thorpe, & Young, 2018). We focused on achieving a high level of 'information power' (i.e. the more information the sample holds, relevant for the actual study, the lower amount of participants is needed) within our sample to adequately address the research questions, as opposed to the analysis aiming to achieve 'saturation' (Malterud, Siersma, & Guassora, 2016), a contested concept within qualitative research (Malterud et al., 2016; Nelson, 2017). The criterion of 'data saturation'– "when no new categories or relevant themes are emerging" (Corbin & Strauss, 2008, p. 148) – is often used by researchers to guide the decision on when sufficient interviews are conducted. Originally stemming from grounded theory, Corbin and Strauss (2008, p. 149) argue that while "total saturation

(complete development) is probably never achieved, if a researcher determines that a category offers considerable depth and breadth of understanding about a phenomenon, and relationships to other categories have been made clear, then he or she can say sufficient sampling has occurred, at least for the purposes of this study". Saturation is often conceptualised as theoretical-, data-, code- or thematic-saturation, though some simply refer to 'saturation'. Low (2019, p. 131) contends that it is a 'logical fallacy', as new theoretic insights will be garnered as data continues to be collected and analysed. Furthermore, Virginia Braun and Victoria Clarke (2019b) argue that such concepts are not consistent with the values and assumptions or reflexive thematic analysis, but rather are aligned with coding reliability types of thematic analysis. Sandelowski (1995) argues that the main goal should be to ensure that the sample size is small enough to manage the material and large enough to provide 'a new and richly textured understanding of experience' (p. 183) and this is always a matter of subjective judgment, i.e. guided by researcher experience and assessing the data as it is analysed in relation to the goals of the research. In reflexive thematic analysis "the researcher makes a situated, interpretative judgement about when to stop coding and move to theme generation, and when to stop theme generation and mapping thematic relationships to finalise the written report. They can also move back and forth recursively between coding and theme development" (Virginia Braun & Victoria Clarke, 2019b, p. 10). In this study, we deemed that sufficient sampling occurred when the major categories showed depth and variation in terms of their development.

Recruitment

Potential participants were recruited in two ways. Parents were recruited through existing community groups and social media (Facebook and Twitter). Copies of the study advertisement for parents and fathers are available in Appendix 3.

Participants were recruited through community groups (e.g. Mother and Toddler Groups) in Cork, Dublin, and Galway initially. These counties were chosen due to the high percentage of births amongst mothers living in them (Healthcare Pricing Office, 2016). We also engaged with groups that target fathers/men to identify relevant participants; other strategies to engage fathers in the study were employed such as directly requesting their involvement, and outlining the benefits of

the study to them and their families (Davison et al., 2016a). A primary contact point/gatekeeper was identified in each community group and their permission sought to recruit participants from their organization. Following their agreement to support the recruitment process, the most appropriate mechanism of identifying and recruiting potential participants was agreed. Gatekeepers provided a copy of the information sheet and consent form to potential participants. Parents were then asked to make contact with the research team if interested in participating, or if more information was required. Upon contacting the lead researcher (MH), the purpose of the study was outlined and the parent had the opportunity to ask any questions before they decided to participate or not. Recruitment was enhanced through the placing of study advertisement notices in the meeting place and/or Facebook group of each community group. Participants were also recruited through social media using the Facebook, Twitter and LinkedIn accounts of the lead researcher (MH). Upon agreeing to take part, participants completed a consent form, and a suitable date, time and location for the interview agreed with MH. prior to participating in the interviews.

Conduct of interviews

All interviews were conducted by the same experienced qualitative interviewer: the lead researcher, a then 38-year-old female, who was not a parent. An interview guide was used to semi-structure discussions (Appendix 3). It was developed based on findings of a literature review and guides used previously, e.g. Redsell et al. (2010) and two ongoing studies at NUI Galway, in collaboration with University College Cork, which are investigating infant feeding and are focusing in particular on parental perspectives and behaviours. Questions focused on parents': views of childhood obesity and perceived importance of the issue and healthy infant growth; understanding of behaviours associated with healthy growth; personal experiences around infant growth and associated behaviours; views about interventions to prevent childhood obesity / promote healthy growth – those delivered by health professionals in particular. The interview guide (and other materials) was reviewed by a Parent Advisory Group convened for the study, and a pilot interview was conducted with one of the parents (a mother), to determine the appropriateness and suitability of the interview guide and interview process. Minor revisions to wording to make it more suitable for a lay audience, and question

ordering in the interview schedule were suggested and incorporated. It was then further piloted with a mother and father. No amendments were deemed necessary following the pilot and therefore both pilot interviews were included in the analysis. Interviews took place from 5th March to 30th April 2018. The interviewer remained flexible with respect to participants' agendas whilst still covering the main topics outlined in the guide. An iterative approach was adopted; however no new topics were added to the interview guide as the interviews progressed. Data collection and analysis proceeded concurrently to enable follow-up of emergent lines of enquiry and to inform decision-making surrounding data sufficiency.

Interviews lasted between 45 minutes and 2.5 hours (average = 86 minutes) and were held in a location convenient to the participant, usually their home, or a public place (e.g. coffee shop, hotel). They were recorded using an Olympus WS-650 digital recorder. In addition, the interviewer made detailed field notes after each interview. Field notes and memos are an important aspect of qualitative research (Miles & Huberman, 1984). After each interview, I wrote up a summary of (i) what happened (observational notes), (ii) my thoughts and reflections on what happened (theoretical notes), (iii) critique of the process/things I might do differently again (methodological notes), and (iv) summary/progress review (analytical memo).

Analysis

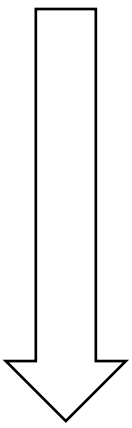
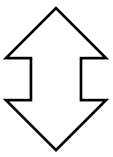
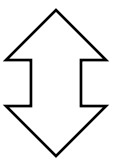
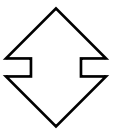
Interview audio recordings were transcribed verbatim by an independent transcriber. The lead researcher (MH) listened to the recordings and checked all transcripts for accuracy before importing them into NVivo (NVivo qualitative data analysis Software; QSR International Pty Ltd. Version 11, 2015) for data management and analysis. The main advantages of using qualitative data analysis software include: speed at handling large volumes of data, and increasing rigour and transparency (Silverman, 2017). Excerpts from the analysis process in NVivo are available in Appendix 3 to provide support for rigour and transparency. This includes illustrations of changes in the process of analysis, i.e. early and later thematic maps, and examples of coding and the process of change that took place. This will enable readers to make judgements about the trustworthiness and plausibility of the study.

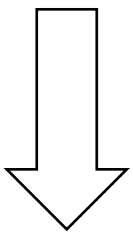
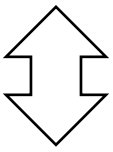
Data were analysed using *reflexive* thematic analysis (Braun & Clarke, 2006, 2013; Virginia Braun & Victoria Clarke, 2019a). This is a flexible method for 'systematically identifying, organising, and offering insight into patterns of meaning (themes)' in qualitative data (Braun & Clarke, 2012, p. 57). Researcher subjectivity and reflexivity is central to this method which applies a rigorous and systematic approach to coding and theme development but one which is also fluid and recursive (Virginia Braun & Victoria Clarke, 2019a). This approach, along with the theoretical framework underpinning the study (constructivism), was congruent with what I wanted to know (Braun & Clarke, 2006). A theme captures something important about the data in relation to the research question, and represents some level of patterned response or meaning within the data set (Braun & Clarke, 2006, p. 82). These patterns of shared meaning are underpinned by a central organising concept (Virginia Braun & Victoria Clarke, 2019a, p. 1). I took an inductive (data-driven) approach to the analysis - the themes identified were strongly linked to the data themselves (Patton, 1990) and bear little relation to the specific questions that participants were asked. I did not try to fit the data into a pre-existing coding frame, or my analytic preconceptions; but remained cognisant that data would not be not be coded in an epistemological vacuum as we cannot free ourselves of our theoretical and epistemological views. Coding and theme development was both latent (reported concepts and assumptions underpinning the data) and semantic (reflected the explicit content of the data). Recording and tracking analytical insights during data collection are part of fieldwork and the beginning of qualitative analysis (Patton, 2002, p. 436). I used the field notes/memos that I generated during data collection to aid data analysis and my interpretation of the data. I also generated memos and annotations as I analysed the data within NVivo. I employed the 15-point checklist of criteria for good thematic analysis (Braun & Clarke, 2006) when writing up the report. This checklist comprises 13 questions to aid the evaluation of the methods and methodology used (e.g. Question 6: Is the specified type of thematic analysis consistently enacted throughout the paper?), and a further seven to evaluate the analysis (e.g. Question 15: Are themes reported domain summaries rather than fully realised themes?), to ensure that they fit the requirements of reflexive thematic analysis. I also followed the Standards for Reporting Qualitative Research (SRQR) (O'Brien, Harris, Beckman, Reed, & Cook, 2014) when writing the journal article. I chose the SRQR over the 'Consolidated criteria for reporting qualitative research' (COREQ) checklist for interviews and focus groups (Tong, Sainsbury, & Craig,

2007) because it is more suited to reporting studies conducted using reflexive thematic analysis. COREQ has an orientation toward grounded theory (Peditto, 2018). For example, it asks about data saturation, and number of data coders, which are not features of this approach (Braun & Clarke, 2013; Virginia Braun & Victoria Clarke, 2019b).

I followed the six phases to thematic analysis, following Braun and Clarke (2006, 2013). There were eight discrete phases of analyses in NVivo spread across these six phases. Analysis is not a linear process; it is a more recursive/iterative process, where movement is back and forth as needed, throughout the phases. Table 2.1 links the guidelines for thematic analysis set out by Braun & Clarke (2006, 2013) with the practical application of phases and processes in NVivo.

Table 2.2 Phases and processes involved in the analysis

Analytical process (Braun & Clarke, 2006)	**Practical application in NVivo 11**	**Strategic objective**	**Iterative process throughout analysis**
Phase 1 Familiarising yourself with the data	*Phase 1* Transcribed data, read and re-read the data, noting down initial ideas	**Data management***(Open and hierarchical coding through NVivo)* 	Assigned data to refined concepts to portray meaning 
Phase 2 Generating initial codes	*Phase 2* Open coding: Coded interesting data (i.e. data relevant to the research question) in a systematic fashion across the entire data set, collating data relevant to each code		Refined and distilled more abstract concepts 
Phase 3 Searching for themes	*Phase 3* Categorisation of codes: Collated codes into potential themes, gathering all data relevant to each potential theme		Assigned data to themes/concepts to portray meaning 
Phase 4 Reviewing themes	*Phase 4* Coding on: Checked if the themes work in relation to the coded extracts (Level 1) and the entire data set (Level 2),	**Descriptive accounts** (Re-ordering, coding-on and annotating through NVivo)	

	generated a thematic 'map' of the analysis	 **Interpretive accounts** (Extrapolating deeper meaning, drafting summary statements, and analytical memos through NVivo)	Assigned meaning  Further refined themes and concepts
Phase 5 Defining and naming themes	*Phase 5* Data reduction: Ongoing analysis refined the specifics of each theme, and the overall story the analysis told, generating clear definitions and names for each theme		
Phase 6 Producing the report	*Phase 6*-Generating analytical memos *Phase 7*-Testing and validating *Phase 8*-Synthesising analytical memos The final opportunity for analysis. Selected vivid, compelling extract examples; completed final analysis of selected extracts; related analysis back to the research question and literature; produced a scholarly report of the analysis		

Phase 1: Familiarising yourself with the data

Phase 1 in NVivo: This phase involved fully transcribing the interviews (by JD Audio Transcription) and checking transcripts for 'accuracy' (by MH), reading and re-reading the interview data, noting down initial ideas. Anonymised transcripts and related field notes and observations were subsequently imported into NVivo 11 (NVivo qualitative data analysis Software; QSR International Pty Ltd. Version 11, 2015).

Phase 2: Generating initial codes

Phase 2 in NVivo: Open Coding: This phase involved data-driven open coding of the interview transcripts. Open codes were generated within NVivo to deconstruct the data from its original chronology into initial non-hierarchical codes. These codes were allocated clear labels and definitions to serve as rules for inclusion during the coding process. Five transcripts were coded by MH and then these were discussed within the research team. V. Braun and V. Clarke (2019) do not advocate the use of multiple-coders and inter-rater reliability for thematic analysis. Their approach sees coding as flexible and organic, and as an active and reflexive process that inevitably and inescapably bears the mark of the researcher(s).

Phase 3: Searching for themes

Phase 3 in NVivo: Categorisation of codes: This phase involved re-ordering initial codes identified and coded in phase 1 into categories of codes (Note: categories could be described as half-way between initial codes and themes). This also included distilling, re-labelling & merging similar codes generated in phase 1 to ensure that labels and rules for inclusion accurately reflected coded content.

Phase 4: Coding on

Phase 4 in NVivo: 'Coding on': The restructured categories were broken down into sub-categories to offer more in-depth understanding of the data, including divergent views and negative cases.

Phase 5: Developing a theoretical framework

Phase 5 in NVivo: Data Reduction: Codes from all three cycles (stages 2-4) were collated into more abstract, philosophical and literature-based themes to create a final framework of themes and to explore their inter-relatedness.

Phase 6: Write-up

The sixth and final phase comprised three phases in NVivo: generating analytical memos, testing and validating, and synthesising analytical memos.

Phase 6 in NVivo: Generating analytical memos: I wrote *analytical memos* against the higher-level themes to accurately summarise the content of each category and its codes, noting patterns in the data and participant characteristics, and proposed empirical findings against such categories.

Phase 7 in NVivo-Testing and validating: During this phase, I tested, validated and revised analytical memos to self-audit the proposed findings by seeking evidence in the data beyond simply the textual quotes/interview transcript to support the stated findings, and to expand on deeper meanings embedded in the data. This involved interrogation of the data and the consideration of elements beyond the theme itself. I drew on relationships across and between themes and cross-tabulation with demographics, observations and literature.

Phase 8 in NVivo-Synthesising analytical memos: This eight and final phase involved synthesising analytical memos into a coherent, cohesive and well-supported report of findings.

Over 100 critical appraisal tools exist for qualitative research (Munthe-Kaas, Glenton, Booth, Noyes, & Lewin, 2019). I adopted a range of strategies to enhance the rigour and credibility of the findings of this qualitative research study (Houghton, Casey, Shaw, & Murphy, 2013; Lincoln & Guba, 1985; Noble & Smith, 2015). To enhance the *credibility* of the findings, I sought to ensure completeness of data by interviewing mothers and fathers purposively to get as complete a picture as possible of views and experiences of parents. I also engaged in peer debriefing with members of the study team. To evidence *dependability* and *credibility*, I maintained an audit trail through comprehensive notes, including field notes and memos within NVivo

audit trail, which provide context to the data and justification for methodological decisions made. I also maintained a reflective diary. Finally, to demonstrate *transferability*, I provide thick description of the original context of the research and methods, as well as the study findings. Data from the qualitative study such as anonymised transcripts and field notes (Tsai et al., 2016) were not made publicly available as I did not seek permission from participants to do so at the outset. In addition, I feel it would have been difficult to anonymise the records sufficiently to eliminate the risk of deductive disclosure.

2.7 Positionality and reflexivity

I recognise I brought my own subjectivity into the research process, at all stages - developing the research question; sourcing participants; collecting the data; analysing the data; presenting and disseminating the results. I was reflexive around this, as it is vital during all of these stages (Berger, 2015). Researcher positionality is often referred to as the 'perspective shaped by the researcher's unique mix of race, class, gender, nationality, sexuality and other identities' (Mullings, 1999, p. 337). Some argue, however, that this is too individual-focused and that researchers should also actively reflect on how personal, interpersonal, institutional, pragmatic, emotional, theoretical, epistemological, and ontological influence their research practices (Doucet & Mauthner, 2007). Personality and appearance are also important to consider when reflecting on positionality (Wilkinson, 2016).

2.7.1 My background

I am a 40-year-old, heterosexual, white Irish, cis female from a middle-class background. I am married 15 years and am not a parent/primary caregiver, nor have I ever been pregnant. I grew up on a large dairy and tillage farm in the 'Golden Vale', an area of rolling pastureland in the South of Ireland. I am the second youngest of three siblings, each of whom is married with children – I have four nieces (1, 4, 6 and 8 years of age) and two nephews (twins, 17 years old), at the time of writing.

On a more personal level, I have alopecia areata – an autoimmune disorder that results in hair loss – with 30 years, and have been wearing a hair piece since 2005. I don't really talk about this for many reasons, but feel it is important in my personal context, and also my positionality as a researcher. Living with alopecia is

something that I have struggled with down through the years, primarily in terms of my appearance, and what other people think about this. It has taken until recently for me to go out, on occasion, without wearing my hairpiece (wearing only a scarf). While I feel more like myself without wearing it, I do feel like 'a bit of a fraud/imposter' even though I know I shouldn't. I think people look at me with expressions of sadness, and often mis-perceive me as a person living with cancer. I hate the thoughts of this and it is something that I struggle with – how to be the true me. I always wear my hairpiece when conducting fieldwork as I don't want to divert the focus of discussions or to appear to be someone in a position that I am not. I know that this is only my perception and it may be an unfair assumption. I think a lot about being an 'imposter' on many levels – my alopecia, being a PhD student/researcher, researching with parents as person without children. All of the above shapes who I am, and my world views.

I completed an undergraduate degree in nutritional sciences in 2001 and subsequently worked in the food industry for four years, as a shift manager/assistant production manager in a processed cheese plant and then as a technical manager for a speciality food distributor. Over the next 11 years I held contract research posts working on diverse projects including: men's health help seeking (Hennessy & Mannix-McNamara, 2014), men's experiences of prostate cancer care (Hennessy, Comber, Drummond, & Sharp, 2013a, 2013b; Hennessy, O' Leary, Comber, Drummond, & Sharp, 2013; Hennessy, O'Leary, Comber, Drummond, & Sharp, 2014), teachers' attitudes and experiences of nutrition interventions (Hennessy & Deasy, 2016), food poverty (safefood, 2011), early school leavers and nutrition (Davison, Share, Hennessy, Bunting, et al., 2015; Davison, Share, Hennessy, & Knox, 2015; Share, Hennessy, Stewart-Knox, & Robinson, 2012), food access and nutritional health among families in emergency homeless accommodation (Share & Hennessy, 2017). I have employed qualitative (including interviews and focus groups), quantitative, and mixed-methods approaches. I conducted my first qualitative study in 2008 for my Masters in Health Promotion. Over the years I have volunteered with various organisations locally that have a child and family focus, e.g. Society of St Vincent de Paul, Citizens Information Centre, and a Youth Café. I am passionate about lifelong education and completed several part-time courses while working: Masters in Health Education and Health Promotion (2008); Specialist Diploma in Youth and Community Work (2011); Specialist Diploma in

Teaching, Learning and Scholarship (2015). In 2015 I commenced a full-time, fully-funded PhD in Psychology, focusing on behavioural interventions delivered during the first 1,000 days to promote healthy growth. Broad in scope, it covers areas such as healthy eating, physical activity and weight gain during pregnancy, infant feeding (breastfeeding, formula feeding, combination feeding, introduction to solid foods), active play, and sleep.

My personal experiences were not an influencing factor in my decision to conduct a PhD research in this area. My background is in public health nutrition and I worked in childhood obesity for several years – designing resources, interventions and mass media campaigns, commissioning research/programmes, and influencing policy. My interest in the area was re-ignited when I approached a potential PhD supervisor; they were collaborating on a project that was about to commence on healthy infant feeding practices, specifically focusing on the introduction of solid foods. I began to re-familiarise myself with the literature and after doing so widened the scope of my proposed project to include pregnancy (thereby focusing on the first 1,000 days) and other healthy growth-related factors including breastfeeding, physical activity, and sleep. I was driven by the gap in the literature, as well as the current policy focus in Ireland on this area, as part of the national obesity policy. I was also driven by my interests in addressing health inequalities – investigating early life interventions to prevent childhood obesity that could be delivered as part of routine care and scaled up within existing national structures would potentially be one way of doing so, and to give children 'the best start in life'. Throughout the PhD, I have been collaborating on another infant feeding-related project which aims to develop a core outcome set for infant feeding interventions during the first year of life (Matvienko-Sikar et al., 2017), as well as a multi-disciplinary project which aims to develop, pilot and evaluate an intervention to promote healthy infant feeding practices (www.cherishstudy.com). My primary supervisor and two co-supervisors are all female, and mothers to young children.

2.7.2 My approach to research

My research, and indeed my way of living, is influenced by two key people that I encountered during my Masters in Health Promotion – Carl Rogers and Paolo Freire. I use aspects of Client-Centred Therapy (Rogers, 1951) when conducting research – unconditional positive regard, genuineness, and empathetic

understanding; I also use active listening skills. I am also influenced by the work of Paolo Freire and his work on education and social justice; specifically his thoughts on problem-posing education for critical consciousness (Freire & Ramos, 1970). I evidence this in my work by seeing the interview as a two-way process, where I am not the expert, but rather am a learner also, albeit in a position of power (whether I like it or not!). While I do not identify as a feminist researcher, I adopt many of the characteristics of feminist research in my work, for example, concern for issues of social justice and social change, and for/with rather than on women (people) (Doucet & Mauthner, 2007).

I sit somewhere between the middle (critical realism) and left (relativism) of the ontology continuum. While I believe that there are multiple constructed realities (relativism), I also think that a researcher's approach depends on the research question and therefore am more of a pragmatist in my general ontological approach.

In Study 3, reality was created through the process of the research (constructivism). My epistemological perspective is in keeping with the philosophical stance of social constructionism. Like Kvale (1996)'s 'traveller metaphor', I was a traveller who was going on the journey with the interview participant. I played quite a big role in this process – and by process I include decisions/actions I took even before the interviews began, and after they were completed. During the coding and analysis process I used my own personal and professional knowledge (including knowledge of the extant research), and experiences, to make sense of the information co-constructed with participants during the interviews.

2.7.3 Positionality - Past experience

Since the outset of my foray into research, qualitative research specifically, I have been pre-occupied with identity and positionality. This began while I was conducting my Masters in Health Promotion. For my dissertation, I investigated men's heath help-seeking experiences using semi-structured interviews. I found the whole area of men's health fascinating, yet as a novice researcher, was concerned as to whether my gender would impact on the research process, specifically in terms of whether men would 'open up' to conversations with me and how masculinity would be constructed during our interactions. I did a lot of reading and reflection around

this. Some studies reported that males talk more easily and engage in more self-disclosure with female investigators (McKee & O' Brien, 1983), that a researcher's gender also dictated the presence or absence of less traditional male sexualities (Allen, 2005) and that this should be seen as data providing first hand insights into the way masculinity is constructed rather than inhibiting the quality of data collected (Allen, 2005). I observed this in my own research.

2.7.4 Positionality – This thesis

I am a trained nutritional scientist and health promoter. I am committed to, and have been involved (to varying degrees) down through the years in, addressing the social and commercial determinants of health, and issues of social justice. Some would argue that overweight is 'a lifestyle choice' or that whether you breastfeed or not is a choice. I don't believe that people have real choices when it comes to these matters, due to the multiple influences on them – i.e. the aforementioned social and commercial determinants of health, therefore some people make constrained choices (consciously / unconsciously) because of the circumstances they find themselves in. For example, women may want to breastfeed but they may not be able to fully exercise this choice because of lack of supports available to them to support this decision (e.g. lack of lactation consultant support in hospital when they experience feeding difficulty in the first few days; being given 'top-up' infant formula in hospital because health professionals feel that that their infant is not gaining enough weight or their 'mother needs some rest'; pressure from their own mothers/partners to not start/discontinue; or lack of support for breastfeeding in public). I was keen to reflect this in the interview schedule for study 3 and incorporated questions based on the social-ecological model.

I have personal experience of weight issues - I was overweight as a child, so was one of my sisters (as toddler up to 15); we were both bullied. I am therefore aware of the impact of excess weight on young children and strongly believe in early life interventions to prevent childhood obesity – ones that are holistic and family-centered, and that don't blame or stigmatise parents. I am passionate about the topic in general – obesity prevention during the early years. I'm also passionate about involving people in research and facilitating having 'their voices' heard. I am heavily invested in this area and I do have views about it that I bring into the research. As mentioned above, when deciding on a research topic for my PhD I initially focused

on infant feeding regarding obesity prevention (specifically the introduction of solids foods). The more I read into the area, however, the more interested I became in breastfeeding (which surprised me!) and in other behaviours/topics that are risk factors for childhood obesity in the early years – including gestational weight gain, and infant birth weight. I began to think that early life obesity prevention interventions should begin antenatally and that we need to intervene more around lots of different behaviours, especially breastfeeding. In that sense, I bring this strong belief on the importance of the antenatal period into the qualitative work. I mentioned my surprise at my strong engagement with the breastfeeding literature. In the past, I think I shut myself off from this area as I felt that the public health messages were very polarised and that they were too simplistic. Messages like 'breast is best' and 'it's easy' drove me crazy, as well as certain groups with 'militant' views in this area – I felt that it excluded, stigmatised and shamed so many women. This is starting to change and we now hear things like 'breastfeeding is normal', 'every drop counts' and 'it is hard!'. While I don't have direct experience of what it's like to be a parent, or of parents' interactions with health professionals, friends and family members have related their experiences to me so I have pre-formed opinions about the state of these interactions. These would be backed up by my reading also. Many of my friends have spoken about the difficulties they have encountered with their babies, particularly in relation to feeding them. Interactions with health professionals are a common discussion point and how they (parents) receive conflicting advice, and how there is such little support available to parents, particularly when it comes to breastfeeding. Many of my friends have spoken about their desire to breastfeed their babies, but the lack of support within hospitals from midwives and how they are often 'forced' to bottle feed their babies when any difficulties with breastfeeding are encountered. I appreciate the context also in which health services are currently delivered in Ireland and the huge strain on resources – particularly within primary care. I am also cognisant of the statistics around several of the early life risk factors for childhood obesity in Ireland and the socio-cultural influences on these. For example, 1 in 4 children aged 3 years has an 'unhealthy' weight; 48% of women report exclusive breastfeeding on discharge from hospital; 18% of women smoke during pregnancy; 14% of infants are introduced to solid foods outside of the recommended period.

I have struggled from the outset with the focus on obesity prevention in the study. I am keen to promote healthy growth. I would rather focus on the positives than the negatives - a salutogenic approach (Antonovsky, 1979). I was keen to hear parents' views on this. While I was trying to establish how we can better support/deliver/develop early life interventions delivered by health professionals to prevent childhood obesity, I didn't have any pre-conceptions about what the end product would be, or look like. I was very much open to what parents (and health professionals) had to say about this and to see what would work from their perspectives and in their contexts. I firmly believe that interventions should not be developed as stand-alone measures; I wanted to contribute towards the development of something that could be integrated into routine care – hence my focus on the routine contacts between parents and health professionals during the first 1,000 days. This is also a key focus of the Health Service Executive at present, so I was keen to capitalise on this 'policy window' in my research.

2.7.5 Insider or outsider?

I primarily had outsider status in the qualitative study, though I was the same gender and within a similar age range to many of the participants that I interviewed. My positionality changed during the research process. From the outset of my doctoral studies, I was conscious that I wasn't a parent and therefore had no direct personal experience of the topic. I was also concerned that potential research participants and the research/practice community might be reluctant to engage with me and my work. I was very open, almost apologetic, about the fact that I wasn't a mother/parent, always feeling the need to 'put it out there'. When relaying my PhD topic to many, I was often asked, "And do you have children yourself?"; I received many puzzled looks when I said that I didn't. I discussed this with one of my friends (a mother of three children, all aged under seven) and following the conversation she automatically added me to several closed Facebook groups, including breastfeeding/infant feeding groups, to give me an insight into issues raised and how parents interact with each other. While I feel like an outsider, and even a fraud, on such forums, I have benefitted greatly from engaging with them. I subsequently joined some public groups. I was also worried about the language I was using. I remember one particular interaction on Twitter over a year ago. Several researchers were criticising a recent book published in relation to child rearing and one of the

particular criticisms was that the author 'wasn't even a parent'. This made me think even more about my status. I also began to discuss my concerns with other researchers. I spoke with one more senior researcher, who also works in child feeding, about her thoughts on not being a parent and strategies she used to overcome this, if she felt she needed to. She said that she presents it as a strength rather than a limitation: she feels that she brings a more objective (or perhaps different) perspective to the research, but also draws on her vast experience in working/researching with parents over the last number of years, thereby legitimising perhaps her work in this area. Similar to Holt – she draws on *'authoritative knowledge' rather than 'experiential knowledge'* (Frost & Holt, 2014). I also convened the parent advisory group at the outset of my third PhD study, the interview study with parents about their views and experiences of healthy infant growth. While it is 'fashionable' in Ireland now to have 'patient and public involvement (PPI)' in research, I was keen to involve a group of parents in the study, to advise and input on the questions I was asking parents, and how I was asking them. Initially, this was to allay my concerns about being 'an outsider' and I recall inviting people to participate in the group on that basis. On reflection, I think that because I was so forthright about this that they reinforced my thinking around this. This changed however the more that time went on and I interacted with parents and became more comfortable with the subject matter, in terms of my grasp of the literature but also through my observations of parent interactions on online forums. I also think it improved as I progressed in my PhD journey and became more confident in general, about everything.

Having insider status is often assumed to be advantageous in terms of access, rapport and impact (Bridges, 2001; Hayfield & Huxley, 2015). Others see merit in having outsider status, associating it with researchers potentially making different observations, and exploring topics in more depth than an insider might overlook (LaSala, 2003; Merriam et al., 2001; Perry, Thurston, & Green, 2004; Shang Tang, 2006). It has also been argued however that everyone's perspectives are unique, and commonality between the researcher and the researched does not guarantee that an insider's data and analysis will be any more or less meaningful than that of an outsider (Bridges, 2001). Thus, it is often argued that characterizations of insider/outsider are far too simple (Merriam et al., 2001). I had much in common with many of the participants within my study - similar age, white, Irish, etc. To

consider 'insider' and 'outsider' within a dichotomous framework oversimplifies the position of the researcher in relation to their participants, because researchers are rarely one or the other (Gair, 2012; Griffith, 1998; Hayfield & Huxley, 2015).

Limited attention to date has been given to how a researcher's maternal status impacts on the research process. I have knowledge of the various issues pertaining to healthy infant growth/childhood obesity prevention through my education, reading the literature, friends and family. I lack tacit knowledge, however, in mother-/father-/parent-hood; I therefore bring an outside/etic perspective to this. I am not quite sure how to best describe my status of not being a mother/parent, other than those words. I don't particularly feel comfortable with the terms 'childless by choice', 'childless by circumstance' (outlined by Cannold (2004)) or indeed any derivation of 'childless'. Letherby (2002) points out that the very status of 'childlessness' is defined by lack – women are childless, 'barren', non-mothers. I don't feel that I am lacking – but rather perhaps that I bring something different to the research process. It cannot be assumed that because I am not a mother/parent/primary-caregiver that I cannot empathise with mothers/fathers/parents. Specifically, in terms of motherhood research, having, or appearing to have, 'insider status' may hold limitations. Frost and Holt (2014) argue that it may be more beneficial to not self-identify with mother-participants when researching mothering issues that are particularly morally-loaded, e.g. infant feeding/breastfeeding. Some researchers have drawn on experiences of family members who are mothers so that their participants feel that they are more likely to understand their experiences (Budds, 2013). Frost and Holt (2014) also posit that 'insider status' may be more important to the researcher than participants themselves; they cite a study where a researcher attempted to draw parallels between her own and her participants' experiences as 'teenage mums', her participants continued to draw distinctions between them (Ellis-Sloan, 2012).

When I began conducting the interviews, and throughout, I was neither overt nor covert about my motherhood status. I did not tell people out-right that I was not a mother, neither did I pretend to be a mother, however, if the conversation arose, I addressed the issue. I usually automatically followed this up with 'but I do have nieces and nephews', trying to somehow legitimise my position. Some interviewees said, 'that's okay', others said, 'ah sure, plenty of time for that'. I did not feel the need to discuss it any further, so I didn't, and it wasn't an issue. It should be stated that while I am 40 years of age, many people attribute a younger age to me, often

perceiving me to be in my mid-twenties. They do not realise that my biological clock is ticking - whether I want to have children or not, an area that I am still grappling with. I reflected on this a lot during the interviews. I had to acknowledge my own 'unknowing' around my status and why I didn't want to have children. In truth, I was slightly in awe of many of the parents I interviewed and their ability 'to become' parents. I often reflected on what was 'lacking' in me that I 'didn't want' to have children. This was quite a difficult process for me, often raising negative emotions on a personal level.

I also experienced negative emotions at an interpersonal level during interviews when parents' accounts of certain issues left me feeling angry, upset, distressed, demoralised and disillusioned. This was often the case when parents spoke about not meeting their feeding goals (e.g. feeling forced to introduce breast milk substitutes when they wished to continue exclusively breastfeeding) or being subjected, consciously or unconsciously, to social norms around 'good parenting'. While Widdowfield (2000) argues that emotions may influence the researcher's interpretation of a situation, this does not prevent rigorous analysis (Wilkinson, 2016). I believe that my social and emotional qualities enabled me to develop a close relationship with participants during interviews, while critical reflection on my positionality and the research process facilitated rigor.

Because of my vicarious experiences through online fora, the input of the parent advisory group, and my grasp of the literature, I felt that I was able to address topics easily enough during interviews and was more aware about following particular lines of inquiry. I neither felt like an insider, nor an outsider during the interviews. Reflecting on the earlier discussion with another researcher about drawing on 'authoritative knowledge' rather than 'experiential knowledge', I feel that I cannot commit to this either. I believe that there are different types of knowledge and ways of knowing, and that my knowledge is neither authoritative nor experiential. These feelings may change as my work in this area develops, however, I have always felt that my role is to co-create knowledge with research participants to better understand issues and/or to develop interventions. It is in my nature to reject aligning to 'authoritative knowledge' as I am quite critical of my own capacity as an authoritative source of knowledge, as well as embracing a more wide-ranging definition of 'authority' when it comes to knowledge.

2.7.6 Power dynamics of the interviews

I was very much aware of power dynamics in the interviews in Study 3. While I endeavoured to strike a balance between interviewer and interviewee balance, I was conscious that this was difficult to achieve during the interviews, for many reasons. I set the research questions for the interviews with parents. While I had the input of the Parent Advisory Group members on the refinement of the interview guides and procedures– and did my best to take everyone's views into consideration and make their involvement meaningful - I ultimately decided the final versions. I documented the feedback provided by parents on the study materials and noted the changes made to keep it transparent. Parents may have viewed me as holding all the power within the interviews (particularly perhaps with those from lower socio-economic backgrounds, or cultures). I tried to establish a rapport with the interviewees, in trying to make them feel comfortable - through how I dressed (e.g. I wore plain clothes, didn't wear much jewellery – just my wedding band), how I engaged with them, and where/how I conducted the interviews (e.g. in their homes, workplaces, public places). I wanted them all to feel like they could be as open as possible in what they told me and be safe in the knowledge that I would interpret and represent their views as accurately and sensitively as possible. Throughout the interviews I sought to clarify participants' narratives rather than assuming that we had a shared understanding, e.g. I often found myself asking participants 'who are people?', 'what do you define as extended breastfeeding?'. I encouraged participants to bring their children with them if it was more convenient for them. For most interviews, young children were present with their mothers. I made a point at the outset of interviews to let participants know that they would 'go with the flow' during the interview, and if at any stage they needed to take a break or do anything they needed to (e.g. attend to their child, feed their child, change a nappy, etc) that they could. I was not used to being in the company of woman who breastfed, however, I didn't make this known during the interviews. During my childhood and within my family, I had very little exposure to breastfeeding, being more familiar with seeing infants being fed breastmilk substitutes.

While some researchers who identify as mothers may need to "resist performing 'good motherhood'" during interviews to maintain the researcher/mother divide, I found myself attending to children during interviews, purely as an act of kindness and reciprocity (Frost & Holt, 2014). In some instances, children wanted to

play with me, or sit on my lap, so I let them do so, as long as their parent was comfortable with this. I wanted the parents to feel that they were welcome in the interview. This wasn't to 'get good data'; it is just my personality and caring nature. I was also very clear at the outset, and during interviews that there were no right or wrong answers and that I wanted to hear their views and that there would be no judgement. The latter came up a lot during the interviews – judgement about feeding methods, and parenting in general. I was conscious of my own biases too during interviews, e.g. use of breast milk substitutes, baby food, adoption of a vegan diet for an infant. Interviews lasted from 45 minutes to 2.5 hours. I did not want to 'stop' participants from relaying their stories just because it might have been more convenient for me for them to be shorter. At the end of interviews, participants almost always reflected on what a positive experience it had been to look back and talk about their experiences, as they said they didn't ever really got the opportunity to do so. I usually spent some time chatting with participants afterwards, talking about issues raised and/or how the research was going. Despite my best efforts, I felt a power imbalance during some of the interviews, particularly with participants who were foreign nationals. I felt with the latter that they were most likely to portray a 'good parenting' persona, though this was evidenced in most interviews.

2.7.7 Reflexivity in data analysis

I was reflexive around data analysis in Study 3, being careful during the analysis to look critically at the data and not simply relay participants' stories; issues relating to personal feelings and a sense of responsibility towards participants can affect both insider and outsider researchers (Bridges, 2001). I used the field notes that I generated during data collection to aid data analysis and my interpretation of the data. I also generated memos and annotations as I analysed the data within NVivo. Analysis was discussed within my supervisory team – whom I mentioned earlier are all female, and mothers to young children.

2.8 Ethical considerations

Each of the four studies were conducted in line with the Singapore Statement on Research Integrity (World Conference on Research Integrity, 2010) and the "The European Code of Conduct for Research Integrity" (ALLEA - All European

Academies, 2017). Studies 1 and 3 adhered to principles outlined in the Declaration of Helsinki for research involving humans (World Medical Association, 2013). The investigators had no conflicts of interest. Ethical considerations to each of the four studies within this thesis are outlined below.

2.8.1 Study 1

Ethical approval for study 1 was granted by the NUI Galway Research Ethics Committee (Reference no. 17-Jan-06). The Patient and Public Involvement (PPI) in Research and Research Ethics Committee Review Statement provided by the UK Health Research Authority and INVOLVE, a national advisory group on public involvement in research, however states that "You do not need to apply for ethical approval to involve the public in the planning or the design stage of research" (Health Research Authority & Involve, 2016, p. 2). Precaution was taken nonetheless as other guidelines go further and state that if you use formal research methods and intend to publish the findings as research, then ethical approval is required (University of Oxford's Nuffield Department of Primary Care Health Sciences, 2017).

Participants were informed, via information sheet (Appendix 3) and consent form (Appendix 3), of their right to refuse to participate and their right to withdraw from this research study. Given the nature of the study, it was unlikely to result in any risks, discomfort or distress to the research team or the participants. There were no known risks to participants' well-being or safety as a result of taking part. Participants were taking part in the research during roundtable discussions that formed part of a two-day national conference. Details of the study, and what it involved, were explained to participants in online communications concerning the event, e.g. in promotional materials, on the event registration page, and in conference materials provided to registrants/participants in reminders about the event, and on the day of the event. Potential participants/registrants had as much time as they wished to review the materials, and could decide to register, and to take part in the study, when they felt ready. It was made clear to them that they did not have to take part in the study, but could still attend the conference and absent themselves from the roundtable discussion groups that formed part of the study. That participants may have been involved in any other research investigations was not known; however, it should not have impacted on this study, or vice versa. The burden on participants

was minimal; they were informed about the study, and what it entailed, before consent was sought. Participants were informed that they may take a break or withdraw their participation entirely at any point. There were no known risks to researchers' well-being or safety as a result of taking part in this study. The data was collected as part of facilitated roundtable discussions: the groups were facilitated by experienced researchers/facilitators. Similar research prioritisation exercises were conducted by Professor Byrne and colleagues within the Health Behaviour Change Research Group previously.

Participants were advised on the study information sheet that their contributions on the day would not be confidential or anonymous (except for the private ranking of knowledge/research gaps), but that in the final write-up their contributions would be confidential and anonymous. They were also asked to consent to: (i) the inclusion of their personal details (name, role, organisation, email address) on the workshop delegate list, and (ii) the publication of their relevant background details (i.e. role, organisation), if required, in research reports and papers to contextualise the findings. If they did not provide such consent, they were still be eligible for inclusion in the study. In addition, participants taking part on Day 2 were asked to complete a declaration of potential conflicts of interest, including disclosure of relationships with for-profit organisations, to contextualise the data generated, where necessary. To ensure confidentiality thereafter, personal information was stored electronically and was encrypted. Hard copy information was secured in a locked filing cabinet: identifying information was stored separately from anonymised data. All such data will be destroyed five years from the conclusion of the study.

2.8.2 Studies 2a and 2b

Studies 2a and 2b were systematic reviews therefore ethical approval was not required. Good practice in conducting and publishing the reviews were followed, such as avoiding plagiarism, and ensuring accuracy and transparency (Wager & Wiffen, 2011).

2.8.3 Study 3

Ethical approval for Study 3 was granted by the NUI Galway Research Ethics Committee. We did not anticipate any risks to participants in taking part in this study. Some topics under discussion, e.g. perception of their child's weight, may have been a sensitive issue for parents, however. While it was unlikely that any issues would arise, we informed parents in all communications concerning the study (verbal and written) that their participation in the study was completely voluntary, that they could withdraw at any stage and/or not answer any questions that they do not wish to, and that it would not affect or influence their current or future healthcare in any way. We also provided a list of information sources and supports to all participants at the end of each interview, in case they wished to talk to someone about some of the issues that arose during the interview (Appendix 3). We advised parents that there were no direct benefits to them, or their children, by taking part in the study, however, the findings may help to inform the development of interventions to prevent childhood obesity and therefore help other families in the future. Interviewer safety was a prime consideration as interviews were conducted in a variety of settings, including community facilities and participants' homes. An interviewer safety protocol was developed and followed throughout the study to minimise the risk to the researcher when conducting fieldwork.

Informed consent was obtained verbally and in writing before interviews were conducted. We provided all participants with a detailed information leaflet (Appendix 3) prior to them agreeing to participate in the proposed study; they had time to read it, consider the information, and ask any questions of the study team before they decided to participate or not. If they agreed to take part, then they were asked to read and complete a consent form (Appendix 3), and return it to the researcher. Participants were given a copy of the signed consent form, and the information sheet, for their records.

Interviews were audio-recorded to enable transcription and analysis. Transcription was conducted by a professional transcription company used by the university who are obliged to abide by data confidentiality agreements. Transcripts were assigned a study ID number to maintain anonymity, and any information linking participants to the data removed from transcripts and pseudonyms inserted. Audio-recordings were permanently deleted upon completion of analysis. A password protected file stored separately from the interview transcripts contains the

participant's study ID number, the participants' age, gender, name and contact details to ensure that interview transcripts are identifiable only to the research team and can made available to the interviewee on request. Data is being stored securely, and separately from the identification code key, on the NUI Galway OneDrive, a file hosting service and synchronization service operated by Microsoft as part of its web version of Office. Hard copies of transcripts, background questionnaires and consent forms are being stored in a separate locked filing cabinet in the School of Psychology, NUI Galway. In accordance with the Data Protection Act 2018, the data will be retained for no longer than is necessary for the purpose of this project.

2.9 Patient and public involvement in research

It is increasingly recognised that research conducted 'with' or 'by' members of the public rather than 'to', 'about' or 'for' them leads to research that is more relevant, better designed, has clearer outcomes, and is more readily translated into practice and policy (Hayes, Buckland, & Tarpey, 2012). Furthermore, engaging parents as research partners in family-based research studies, including those focused on obesity prevention, may be an effective way to increase participant engagement and study retention (Walton et al., 2018). Meaningfully engaging parents in research is important. For example, parents involved with the Guelph Family Health Study Family Advisory Council, a longitudinal family-based study, a family-based obesity prevention intervention felt that the topics discussed were appropriate, their opinions were valued and their suggestions had an impact and direct benefit on the study (Walton et al., 2018).

Patients and/or members of the public were not involved in the design of Study 1, a research prioritisation exercise. The proposal to host POCKETS: Prevention Of Childhood obesity-Knowledge Exchange and TranSlation was subject to peer-review by the Irish Research Council. The full research proposal was reviewed by the international speakers involved in POCKETS and also members of the Health Service Executive, namely the National Lead for Healthy Eating and Active Living (responsible for the implementation of the Obesity Policy and Action Plan) and the National Lead for Child Health.

Patients and/or members of the public were not involved in the conception, design, conduct, interpretation or reporting of Studies 2a and 2b, the systematic reviews.

I convened a Parent Advisory Group (three mothers, one father) at the outset of Study 3 to incorporate PPI in this particular study. Members were identified through the Galway City Early Years Sub-Committee, a sub-group of Galway Children and Young Peoples Services Committee, and also through recruitment at a Parent and Toddler Group in Galway. The Parent Advisory Group reviewed and refined the study protocol, participant information sheet and consent form, and interview schedule to ensure that they were appropriate and relevant. An initial meeting was convened to explain the purpose of the study, the extent of the collaboration, respective roles and responsibilities, what members could expect to gain from the research, and anticipated contributions. During subsequent meetings, the group reviewed and discussed various documents and procedures. The initial meeting was held in a community venue at NUI Galway. Subsequent meetings were held in a community facility suggested by members. Refreshments were provided, and participants were welcome to bring their children with them. Meetings were facilitated by MH, with the assistance of a second researcher (LT / KF / CH). Detailed notes were taken at each meeting, documenting views garnered, and decisions taken. The Parent Advisory Group provided valuable insights into the lived experience of parents during the first 1,000 days of their child's life. This added depth to the extant research in the area that the study was built upon, and the knowledge of the researcher as someone that did not have first-hand experience of pregnancy and/or parenting. It also enhanced the conduct and relevance of the study. Due to time constraints, the extent of PPI within the study was minimal, restricted to input and feedback into documents and procedures. This will be further discussed in Chapter 7.

2.10 Chapter summary

In this chapter, I have presented the overall study design and the methodological approach taken to the studies therein, as well as key issues relating to reflexivity, ethics and participation. The aim of the four studies was to build the evidence base to maximise the effectiveness of health professional-delivered interventions to promote healthy growth during the first 1,000 days. A research

prioritisation exercise (Study 1), systematic review (Studies 2a and 2b), and qualitative interview study (Study 3) were conducted to address the study aims. A mixed methods, pragmatic approach was adopted. Study 1 influenced the conduct of the subsequent studies, which were conducted concurrently. The papers from each of the studies are presented in the following chapters.

Chapter 3 Study 1: Childhood obesity prevention: priority areas for future research and barriers and facilitators to knowledge translation, co-produced using the nominal group technique

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Note: Supporting information for this chapter (i.e. Tables S1-S6) is available online at https://tinyurl.com/iby074SM

Abstract

Childhood obesity is a significant public health challenge, yet research priorities for childhood obesity prevention are not established. Co-production of priorities leads to research which may be more translatable to the domains of policy and practice. The aim of the present study was to identify knowledge gaps and research priorities in addition to facilitators and barriers to knowledge translation in childhood obesity prevention. The nominal group technique involving consensus-building with researchers, policymakers and practitioners was employed during workshops at a national obesity conference held over two days in May 2017. Seventy-seven people participated in the first round of research prioritisation during Day 1, while fourteen stakeholders participated on Day 2. The top five research priorities identified were: (i) Evaluate (including economic evaluation) current programmes to inform practice and policy; (ii) How to change culture towards addressing the determinants of health; (iii) Implementation science: process; (iv) How to integrate obesity prevention into existing service structures; (v) How to enhance opportunities for habitual physical activity, including free play and active travel. Key themes emerging from this research prioritization exercise were the importance of funding and resources, co-production of research, and a focus on both implementation research and social determinants within the field of childhood obesity prevention. The co-produced research priorities may help to shape the research agendas of funders and researchers, and aid in the conduct of policy-relevant research and the translation of research into practice in childhood obesity prevention.

Keywords: childhood obesity; implementation science; knowledge translation; nominal group technique; prevention; research priorities

3.1 Introduction

Worldwide, childhood obesity is a significant public health challenge with myriad health, social and economic consequences. In 2014, an estimated 41 million children under the age of five years were overweight or obese (World Health Organisation, 2018). Similar to rates in other developed countries, one in four three-year olds in Ireland is overweight/obese, with comparable levels observed amongst nine-year olds (Layte & McCrory, 2011; Williams et al., 2013).

Actions are being taken at European and international levels to address childhood obesity. These include the implementation of several policies and actions plans such as the: five-year Pan-American Health Organization Plan of Action for the Prevention of Obesity in Children and Adolescents (Pan American Health Organization World Health Organisation Regional Office for the Americas, 2014), Report of the Commission on Ending Childhood Obesity (World Health Organisation, 2016b), and European Union Action Plan on Childhood Obesity 2014-2020 (European Commission, 2014). The latter states that gaps in research should be identified and eliminated through the funding of new projects and by improving alignment of national research agendas. In Ireland, the national obesity strategy emphasises prevention and adopting a life-course approach. Research-related actions include the development of: an obesity knowledge translation programme, research capacity to facilitate knowledge translation, and a multi-annual research plan (Department of Health, 2016b). As there is strong evidence to support beneficial effects of child obesity prevention programmes, focus should now be placed on translating effective intervention components into practice and scaling up interventions (Waters et al., 2011).

The Canadian Institutes of Health Research define knowledge translation as "a dynamic and iterative process that includes the synthesis, dissemination, exchange and ethically sound application of knowledge to improve health, provide more effective health services and products, and strengthen the health care system" (Canadian Institutes of Health Research, 2017). Morris and colleagues reported that it can take 17 years for research evidence to reach practice (Morris et al., 2011), there are unique challenges in translating social and behavioral interventions into practice and policy (Riley, 2017), and research aligned with national/international priorities is more likely to be used (Kok et al., 2016). Furthermore, Chalmers and colleagues have called for improved transparency in the processes by which funders prioritise research to reduce research waste (Chalmers et al., 2014). Bryant and colleagues concluded that adopting a systematic and transparent approach to the identification of health research priorities can help to ensure that funded research is policy-relevant, has public health benefit, and makes efficient and equitable use of limited resources (Bryant et al., 2014). There is no gold standard approach to health research prioritisation, however (Viergever et al., 2010).

To date, research priorities have been established in areas including: paediatric preventive care (Lavigne et al., 2017), obesity prevention in early care and education settings (Ward et al., 2013), the effective management of childhood obesity (Taylor et al., 2013), childhood obesity treatment (Wilfley et al., 2017), and longitudinal studies (Byrne et al., 2008). However, no previous prioritisation exercise has identified research priorities for childhood obesity prevention in 0-18-year olds.

While research prioritisation has been identified as one method to reduce the gap between research, policy and practice, it is just one stage in the research cycle. There are several other stages before the end-point, including the implementation phase. Many different theories and frameworks for implementation exist, e.g. the Consolidated Framework for Implementation Research (Damschroder et al., 2009), The Stages of Implementation Completion (Chamberlain et al., 2011), and the Framework for the Successful Scale-Up of Global Health Interventions (Yamey, 2011). Inherent to these are barriers and facilitators to knowledge translation. There are several barriers to the use of research evidence by public health decision-makers. These include the lack of relevant research, decisions-makers' perceptions of evidence and their skills and opportunity to use it, the culture and competing demands surrounding decision-making, as well as practical constraints such as time and cost (Oliver et al., 2014; Orton et al., 2011). Facilitators to the use of evidence by public health policymakers include access to and improved dissemination of relevant research, as well as promoting collaboration between policymakers and research staff (Orton et al., 2011). Understanding the specific barriers and facilitators to the use of research evidence in obesity prevention may help in improving the uptake of research into policy/practice.

Thus, it is necessary to identify priorities for obesity prevention research and investigate improved mechanisms for knowledge translation. The aims of this study were to work with a range of stakeholders to identify the following:

(1) prioritized knowledge gaps for research in childhood obesity prevention, and

(2) barriers and facilitators to knowledge translation in childhood obesity prevention.

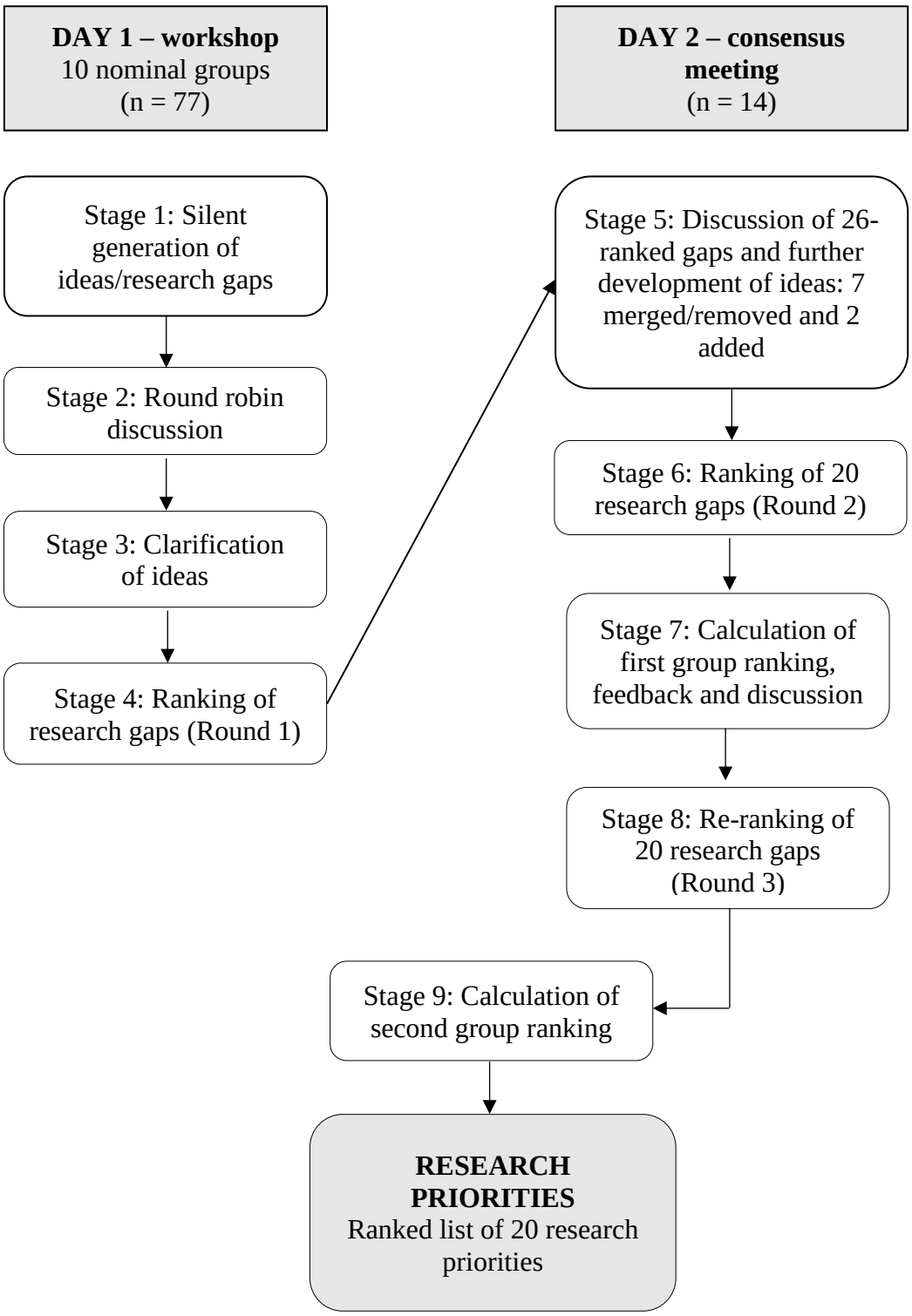
3.2 Methods

3.2.1 Overview

We used the Nominal Group Technique during multi-stakeholder workshops over a two-day national obesity conference in Ireland, hosted by the Association for the Study of Obesity on the Island of Ireland in May 2017, to address the study aims. The theme of the 2017 conference was the prevention and management of childhood obesity.

The Nominal Group Technique is a consensus method designed by Delbecq and Van de Ven (1971) used to generate potential answers to a question which can then be agreed upon and/or prioritised (McMillan et al., 2014; McMillan, King, & Tully, 2016). Despite diversity in its application, there is general consensus on four core phases: silent generation, round robin, clarification, and voting (ranking/rating) (McMillan et al., 2014). It has previously been used to identify research priorities in other health-related areas (Mc Sharry, Fredrix, Hynes, & Byrne, 2016). Figure 3.1 outlines the study methodology.

Figure 3.1 Flow chart of the Nominal Group Technique process utilised, study participants, and numbers of research gaps generated/ranked



3.2.2 Participants

We invited conference delegates to participate in Day 1 workshops. Direct invitations were issued to key stakeholders, identified and agreed by the research and conference organising teams (organisations and networks outlined in Supplementary Table S1). These included those involved in policymaking and health service management, and professional bodies and practitioners/researchers in the fields of early childhood care and education, general practice, health promotion, nutrition/dietetics, public health (nursing and medicine), physical activity, psychology, paediatrics, and knowledge translation. We also circulated details of the conference through representative organisations with a specific focus on obesity - in Ireland, the UK, Europe and beyond. In addition, the conference was promoted extensively on social media.

Following a similar procedure for Day 2, we selected participants for the consensus meeting based on their expertise in obesity prevention, aiming for a mix of disciplines/sectors, gender, and national/international participants. Direct invitations were issued to individuals and/or representative bodies agreed by the research team.

All those that completed a consent form were eligible to participate in the study. The NUI Galway Research Ethics Committee granted ethical approval for the study (reference no. 17-Jan-06).

3.2.3 Procedures – Identification of research priorities

Nominal Group Technique Procedure-Day 1

We conducted stages 1-4 of the Nominal Group Technique (see below, and Figure 3.1) during a one-hour workshop on the morning of Day 1. Previously groups of 2-14 participants have been used in Nominal Group Technique research (McMillan et al., 2016), however, a maximum of 7 is recommended (McMillan et al., 2014). We assigned participants to groups of 7-8 people using simple randomization and each group completed stages 1-4 of the process. We assigned an experienced facilitator to each group to moderate discussions.

Stage 1: Silent generation of ideas

Participants silently reflected and recorded their individual ideas in response to the question: *What topics/questions are important to focus on in future research on the prevention of childhood obesity?"*. Facilitators maintained silence (except to clarify the purpose/format of the exercise) and did not partake in the exercise themselves (McMillan et al., 2014).

Stage 2: Round-robin discussion

The facilitator then asked one participant at a time to present one idea from their list to the group in a 'round-robin' fashion, writing each idea on a flipchart. Participants generated new ideas during this process but had to wait their turn before they could share their idea with the group. Participants were advised to not discuss/evaluate ideas at this stage, other than to clarify ideas presented.

Stage 3: Clarification

Participants engaged in discussion to clarify the ideas, ensuring that they understood the meaning of each; they were also permitted to exclude, include or alter ideas.

Stage 4: Ranking of research gaps (Round 1)

Facilitators asked participants to independently rank their top-three preferences from the generated ideas, allocating a score of three for their top-ranked priority, two for second-highest, and one for third-highest. The ranking of five ideas is common in the literature (McMillan et al., 2016); we only ranked the top-three priorities on Day 1 due to time constraints. Facilitators noted and summed scores for each idea on a Group Worksheet and quality-checked the data before they finished the workshop. Members of the study team (MH, MB and CH) re-checked the data and collated the top-three-ranked priorities across all ten nominal groups.

Nominal Group Technique Procedure-Day 2

On Day 2, a group of targeted participants (n=14) attended a half-day meeting to complete stages 5-8 of the Nominal Group Technique (see Figure 3.1). Four study team members (MH, MB, CH, JMS) facilitated the meeting and did not take part in discussions.

Stage 5: Further development of lists of research gaps

The list of research priorities identified on Day 1 was presented to participants who were then asked to discuss these, refine where necessary, and identify any additional gaps.

Stage 6: Ranking of research gaps (Round 2)

The final list of agreed research gaps was presented to participants, who then privately ranked their top-five research priorities, assigning five to their top-ranked priority, four to their second highest, and so on.

Stage 7: Calculation of first group ranking, feedback and discussion

Members of the research team (MH and CH) entered the results of the first ranking on a spreadsheet and calculated total scores for each research gap. Results were subsequently presented to the group, with the five most highly ranked research gaps highlighted. Participants were asked to comment on the results, particularly focusing on research gaps whose rankings they found surprising or interesting.

Stages 8-9: Final ranking of research gaps (Round 3) and calculation of research priorities

Participants privately re-ranked their top-five research gaps. A research priority score was then generated for each research gap by summing individual priority scores.

3.2.4 Procedures – Identification of barriers and facilitators to knowledge translation

On the afternoon of Day 1, in the same small groups as the Nominal Group Technique research prioritisation exercise, participants were asked to answer the following questions: *"What are the facilitators of knowledge translation in childhood obesity prevention?" and "What are the barriers to knowledge translation in childhood obesity prevention?"*. The same four stages were followed: (i) silent generation of ideas, (ii) round-robin discussion, (iii) clarification, and (iv) ranking. Facilitators presented the Canadian Institutes of Health Research definition of knowledge translation to participants verbally, and in writing, at the outset of the workshop to aid understanding of the task; it was repeated where necessary. Participants individually noted facilitators and barriers. Facilitators noted each idea on a flipchart and participants were asked to rank their top-three preferences from the generated ideas by placing numbered stickers (scored three to one, with three ranked as top priority) beside the relevant barriers and facilitators. Facilitators quality-checked the information on the flipcharts before concluding the workshop. That evening, members of the research team (CH, MB and MH) re-checked the data and collated the top-three-ranked priorities across all ten nominal groups.

3.2.5 Analysis

The scores and ranked priorities for each group on Days 1 and 2 were recorded. We calculated the sum of the scores for each topic/idea and noted its ranked priority. This allowed for immediate reporting back of results to participants. Because a priority that has a high score may not necessarily reflect its popularity within the group, the voting frequency was also recorded and analysed (McMillan et al., 2014). Following the workshops and consensus meeting, data were checked for accuracy by a second researcher (MH).

3.3 Results

3.3.1 Participants

One hundred and six people attended Day 1 of the conference; of these, 85 were available to participate in the workshops, the remainder (n=21) facilitated the

workshops (n=10), were involved in conference organisation (n=6), were solely chairing a session at the conference (n=1), or arrived after the morning workshop had finished (n=4). Seventy-seven people (70 female, 7 male) participated in the research prioritisation workshop on Day 1, while sixty-eight people (61 female, 7 male) participated in the barriers and facilitators workshop. This resulted in a participation rate of 91% for workshop 1 and 80% for workshop 2. On average, 7 people participated in each group during workshop 1 (range: 7-8) and 6 in workshop 2 (range: 5-9). See Table 3.1 for background characteristics of those who participated in workshop 1. Participants were classified as: academics (40%), healthcare professionals (38%), health service managers (16%) and other (6%); 88% were based in Ireland.

Table 3.1 Background characteristics of workshop 1 participants, N=77

	Category	n	%
Organisation	Academic institution	27	35
	Child and family service	1	1
	Community sector	1	1
	Government department	1	1
	Health service	34	44
	NGO	2	3
	Other / public body	5	6
	Private sector	6	8
Current work area	Academic	31	40
	Research and/or education/teaching	24	
	Student	7	
	Clinical	29	38
	Dietitian	4	
	Education/teaching	1	
	Nurse	3	
	Nutritionist	2	
	Other	2	
	Physician/GP/community medical officer	8	
	Physiotherapist	6	
	Psychologist	3	
	Health services management	12	16
	Other	5	6
	Community / early years' sector	4	
	Other	1	
Country	Australia	1	1
	Ireland	68	88
	Israel	1	1
	UK	6	8
	Sweden	1	1

Twenty-one individuals/organisational representatives were invited to participate in the meeting on Day 2. Fourteen agreed, or could send a representative, giving a participation rate of 67%. Participants (13 female, 1 male) were academics/researchers (n=6; all international), health professionals (n=3), early years/community-based practitioners (n=2), policymakers (n=2) and a health service manager (n=1). Together they had 289 years of professional experience, ranging from 5-42 years (mean=21). The academics/researchers were also trained health professionals: dietitian, dietitian/ nutritionist (public health), paediatrician, psychologist/health visitor, health psychologist, nutritionist/psychologist. The three health professionals were a nurse, consultant physician, and nutritionist – all with public health remits. All but three of the Day 2 participants took part in the Day 1 workshops also.

3.3.2 Research priorities

Twenty-six research gaps (Supplementary Table S2) were identified in the Day 1 workshop. The top-ranked research gap was *implementation science*: two groups assigned it a score of 3 (1st rank) and two groups assigned it a score of 2 (2nd rank).

During discussions on Day 2, seven research gaps were removed and merged into others. One research gap was removed (*Database of interventions*) as it was not perceived to be a research area. Two research gaps were added: *How to enhance opportunities for habitual physical activity, including free play and active travel* and *How to change sedentary behaviours–screen-time*. This resulted in a revised list of 20 research gaps (Supplementary Table S3).

During Round 2 of ranking, participants identified their top-five priorities; these were then discussed and re-ranked (Supplementary Table S4). An overview of the top-five identified priorities, across all three ranking rounds, is provided in Table 3.2. Participants discussed a range of research gaps during the various rounds. These included: translating evidence into practice and evaluation; physical activity; how to change the culture in obesity prevention work, recognising the importance of the social determinants of health and garnering a multi-sectoral approach; how to best support parents; interventions to address the socio-economic gradient in childhood obesity rates; early life nutrition, including the impact of the foetal environment on

food preferences, and breastfeeding; cost-effectiveness of early intervention/prevention; influence of social media and digital tools.

Table 3.2 Top-five priorities for childhood obesity prevention research across the three rounds

Overall ranking	Round 3 (final round), 14 individuals	Round 2, 14 individuals	Round 1[1], 10 groups (77 individuals)
1	Evaluate *(including economic evaluation)* current programmes to inform practice and policy	Evaluate current programmes to inform practice and policy	Implementation science
2	How to change culture towards addressing the determinants of health (Health in All Policies)	Implementation science: process	2(i): Supporting health professionals to support parents 2(ii): Evaluate current programmes and policy to upscale 2(iii): Whole system approach using co-creation for intervention development 2(iv): Support for parents - correct message 2(v): Cost benefit analysis of increased support for 0-5 years 2(vi): Telling the foetal environment story 2(vii): Increasing parental awareness of childhood obesity 2(viii): Interventions to reduce the gap between children (social backgrounds) 2(ix): How to change behaviours especially in lower socio-economic groups 2(x): Breastfeeding-understanding poor rates
3	Implementation science: process	How to change culture towards addressing the determinants of health (Health in All Policies)	
4	How to integrate obesity prevention into existing service structures	Interventions to reduce the gap between children (social backgrounds)	
5	How to enhance opportunities for habitual physical activity, including free play and active travel[2]	How to support and engage parents	

[1]Ten knowledge gaps were ranked in 2nd position therefore results of Round 1 cannot be separated into a discrete top-five ranking; [2]New knowledge gap introduced on Day 2

3.3.3 Barriers and facilitators to knowledge translation

Thirty barriers (Supplementary Table S5) were identified; no high priority barriers were common across groups. Twenty-nine facilitators were identified (Supplementary Table S6); only one facilitator was common across three groups: *Involving key stakeholders from the start*. The top 10 barriers and facilitators are outlined in Table 3.3. Barriers discussed were multi-level, and included factors at policy (e.g. lack of priority; limited funding and resources for prevention; mis-match between policy and practice; politics-competing agendas; short funding cycles; lack of joined-up thinking across Government departments; poor public planning; lack of understanding of the importance of research by decision makers), community (e.g. industry/vested interests; obesogenic environment), organisational (e.g. lack of training for health professionals and teachers; pitching communications at the right level-cognisant of health literacy, stigma, complexity of the issue, clarity around a complex issue; poor planning of research and potential impact, including conduct of research that is incompatible with scalability), and individual levels (e.g. parental awareness, knowledge, education and skills; socio-economic status). Similarly, facilitators discussed during the Day 1 workshop focused on policy (e.g. political will; national policy frameworks; legislation around fast food near schools, obesity prevention prioritised in funding), community (e.g. the media, local champions, implementation in schools), and organisational levels (e.g. training for health professionals; motivated staff). In addition, participants also discussed practical process-related facilitators such as having a process to implement research into practice/established infrastructure for dissemination, using existing resources, co-production of knowledge with all stakeholders including children, and communicating messages clearly, appropriately, using the right channel, and avoiding stigma.

Table 3.3 Top 10 barriers and facilitators to knowledge translation (10 groups, 77 individuals)

Rank	Barrier	Rank	Facilitator
1	Limited funding & resources for prevention	**1**	Involving key stakeholders from the start
1	Pitching to the right level - all stakeholders (*Targeting communications/messages at the right level, depending on the audience)*	**2**	Engagement with your target group. For socially isolated groups, someone to interpret the message *[Active engagement with target of your message from the outset; may require someone else to deliver the message to socially excluded groups]*
1	Parental knowledge, education, skills	**2**	Process to translate research into practice *(Lack of support from decision makers to identify a function/process within their organisation to use research or translate research into practice)*
1	The food industry	**2**	Existing resources, e.g. information leaflets
1	Priority *(Lack of a priority at policy/service level)*	**2**	Obesity prevention prioritised in funding
1	Family and societal issues *(Other family and health-related issues impacting on behaviours)*	**2**	Co-production of knowledge
1	Mismatch between policy & practice. Health promotion being eroded *(Policy focus on prevention but this is not the reality in practice)*	**2**	Implementing in schools
1	Lack of resources to implement (health care professional resources)	**2**	Money, funding, incentivisation
1	Lack of shared realistic goals	**2**	Education and training for healthcare professionals
1	Research which is incompatible with scalability	**2**	Political will

3.4 Discussion

This study aimed to work with a range of stakeholders to identify research priorities, and barriers and facilitators to knowledge translation, in childhood obesity prevention.

Three of the top-five identified research priorities concern knowledge translation and implementation science: *the evaluation of ongoing programmes to inform policy and practice*, *using implementation science to improve the uptake of effective interventions into routine practice*, and *how to integrate obesity prevention into existing structures*. Previous research however has highlighted the poor reporting of external validity elements in prevention interventions for childhood obesity, limiting information available for decision-makers on translation of interventions into practice (Klesges et al., 2008; Laws et al., 2014). Increasing research knowledge and skills in implementation science and strong research and practice/policy partnerships is essential to addressing this gap.

The second ranked priority–*how to change the culture towards addressing the determinants of health*–was perceived crucial: participants stressed the need for all actors/sectors to work together to prevent childhood obesity, reinforcing the complex structural drivers outlined in the Foresight model of obesity (Butland et al., 2007). *Enhancing opportunity for physical activity* was ranked fifth and echoes other recent research prioritization work (Lavigne et al., 2017).

Our research prioritisation differed in focus to other such exercises in the obesity domain as it focused on childhood obesity prevention in 0-18-year olds. That said, engaging parents was identified in previous childhood obesity priority-setting exercises (McPherson et al., 2016; Ward et al., 2013). This ranked seventh in our study, though clearly many evaluation efforts (identified as the most important priority) may involve parents as they are often key targets/supporters of prevention interventions (Bleich et al., 2018; Redsell et al., 2016). For example, interventions to enhance the implementation of healthy eating and physical activity policies and practices in the early childhood education and care have been limited in their use of strategies to engage parents and overall impact (Wolfenden et al., 2015). The importance of involving parents was highlighted in our study, as they also featured as barriers to knowledge translation. Teasing this perceived barrier out further is important to enhance the perception of parents as facilitators in prevention research to translate effective interventions into standard practice for maximum impact.

A wide range of barriers and facilitators to knowledge translation were determined in this study. This is perhaps reflective of the broad definition of knowledge translation used and the variety of perspectives incorporated. The top-ranked barriers included: *limited funding & resources for prevention*, *pitching to the*

right level–all stakeholders, and *parental knowledge, education, skills*. These barriers differ somewhat to the barriers identified in previous public health research, such as the lack of availability of research or relevant research, or having no time or opportunity to use research evidence (Oliver et al., 2014). This may reflect the diverse perspectives of decision-makers, researchers and practitioners in this study, unlike other studies which primarily described the views of decision-makers. The barrier, *limited funding & resources for prevention*, however highlights the perceived lack of priority afforded to childhood obesity prevention work in the form of funding and resources for translating evidence into practice. Lack of resources has previously been identified as a barrier to work on childhood obesity prevention policies by policy-makers, NGO representatives, and academics (Rutkow, Walters, O'Hara, Bleich, & Jones-Smith, 2016). Importantly, the barriers identified can guide future research on how to implement practical solutions.

Three of the top-ranked facilitators to knowledge translation identified were: *involving key stakeholders from the start, engagement with your target group; for socially isolated groups, someone to interpret the message*, and *process to translate research into practice*. The top-ranked facilitator, *involving key stakeholders from the start*, aligns somewhat with previous facilitators identified in the literature including research targeted at the needs of decision-makers (Orton et al., 2011) and promoting collaboration and relationships between policymakers and research staff (Oliver et al., 2014), although it is broader in that it concerns all stakeholders, from policymakers to parents and children (which also encompasses *engagement with your target group*). *Process to translate research into practice* also aligns with previously identified facilitators including capacity-building (Orton et al., 2011) and access to and improved dissemination of research, and existence of and access to relevant research (Oliver et al., 2014).

The strengths of this study are the use of a well-established systematic and transparent process to co-produce research priorities. The workshop, embedded within a national conference, provided an ideal opportunity to engage with a broad range of stakeholders, in contrast to previous studies which solely engaged researchers (Byrne et al., 2008; Taylor et al., 2013) or leaders in childcare and education (Ward et al., 2013). Care was taken to minimise any potential limitations of the Nominal Group Technique, e.g. time-wasting, evaluation of individual's ideas by other group members, or dominance of certain individuals in discussions

(Viergever et al., 2010). There were several limitations. Firstly, participants from a variety of backgrounds and sectors generated and prioritised topics/questions; the resultant research priorities are thus quite broad/thematic. Future work should be undertaken to turn these into actionable research questions. Furthermore, we focused on childhood obesity prevention in 0-18-year olds. This broad age range was chosen as a starting point, future studies could further develop the findings for specific sub-groups.

While we successfully involved a wide range of stakeholders, despite our attempts to engage parents and/or representatives of parent organizations, no *lay* people participated. Future work should include the voices of parents, and children; it may be more beneficial to convene ongoing advisory committees rather than once-off events (McPherson et al., 2016). Involving children in research prioritisation exercises may also provide a channel to build youth advocacy for childhood obesity prevention and enhance interaction with policymakers (Millstein & Sallis, 2011). Our findings are also limited by the number of males that participated in the study (7/77 on day one and 1/14 on day two), despite targeted efforts to recruit them. Fathers in particular have not been engaged in childhood obesity interventions that target parents (Morgan et al., 2017), and therefore more innovative strategies are needed to engage them in research priority setting exercises and programmes. While a multi-sectoral approach is required to address obesity (Butland et al., 2007), participants in our study were largely from the health sector, again despite attempts to target individuals and groups from other sectors. Additional efforts are needed to engage such additional stakeholders and elicit their views on these issues, particularly given their role in the implementation process.

We ranked the top-three priorities on Day 1 due to time constraints, however, the ranking of five ideas is common in the literature (McMillan et al., 2016). We cannot estimate what the impact of ranking three versus five priority areas was due to lack of evidence in this area. Future research should examine outcomes associated with different ranking levels.

We did not specify a numerical level to indicate consensus within the Nominal Group Technique process; this is common in using the Nominal Group Technique, unlike with the Delphi method (McMillan et al., 2016). Instead, we conducted three ranking rounds over two days. Challenges were encountered in achieving consensus within and across rounds of the research prioritisation. Only evaluation and

implementation science appeared in the top-five priorities identified during all three rounds, and three of the five research gaps appeared in the second and third rounds. It is notable however that consensus increased between rounds two and three (Supplementary Table S4).

Finally, while we cannot claim that the results of our study are generalisable internationally, they are influenced by the international researchers and practitioners who participated in the study. They should be replicated in other countries to investigate generalisability.

3.5 Conclusion

In summary, research priorities for childhood obesity prevention were co-created using a standardized method, and facilitators and barriers were identified. Key themes were the importance of funding and resources, co-production of research with all stakeholders and a focus on both implementation research and social determinants within childhood obesity prevention. Our findings will be of interest to researchers, funding bodies, policymakers and health service commissioners/managers, and may facilitate the development of research funding applications and stimulate multidisciplinary collaboration.

3.6 Conflict of interest

Marita Hennessy, Molly Byrne, Rachel Laws, Jenny Mc Sharry, Grace O'Malley, and Caroline Heary declare that they have no conflicts of interest.

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3.8 Authors' contributions

MH led the conceptualisation and design of the study and wrote the initial draft of the manuscript. MH, MB, JMcS and CH collected and analysed the data. All authors had full access to all the data in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis. All authors–MH, MB, RL, JMcS, GOM and CH–made substantial contributions to the interpretation of data, revised the manuscript critically for important intellectual content, and approved the final version to be published.

Chapter 4 Study 2a: The effectiveness of health professional-delivered interventions during the first 1,000 days to prevent overweight/obesity in children: A systematic review

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Note: Supporting information for this chapter (i.e. Tables S1-S11) is available online at https://onlinelibrary.wiley.com/doi/full/10.1111/obr.12924. Table S5 is also available in Appendix 4, for ease of reference.

Abstract

Childhood obesity is a global public health challenge. Early prevention, particularly during the first 1,000 days, is advocated. Health professionals have a role to play in obesity prevention efforts, in part due to the multiple routine contacts they have with parents. We synthesised the evidence for the effectiveness of obesity prevention interventions delivered by health professionals during this time period, as reviews to date have not examined effectiveness by intervention provider. We also explored what behaviour change theories and/or techniques were associated with more effective intervention outcomes. Eleven electronic databases and three trial registers were searched from inception to 04 April 2019. A total of 180 studies, describing 39 trials involving 46 intervention arms were included. While the number of interventions has grown considerably, we found some evidence for the effectiveness of health professional-delivered interventions during the first 1,000 days. Only four interventions were effective on a primary (adiposity/weight) and secondary (behavioural) outcome measure. Twenty-two were effective on a behavioural outcome only. Several methodological limitations were noted, impacting on efforts to establish the active ingredients of interventions. Future work should focus on the conduct and reporting of interventions.

Keywords: childhood obesity, prevention, intervention, health professional, systematic review

4.1 Introduction

Childhood obesity is a significant societal challenge with health, social, and economic consequences. Several risk factors, identifiable during the first 1,000 days – the period from conception to a child's second birthday – are associated with the development of childhood overweight and obesity. These include maternal pre-pregnancy overweight, smoking during pregnancy, high infant birth weight and rapid weight gain (Weng et al., 2013). On the other hand, breastfeeding and the appropriate timing of introduction of solid foods (usually between 4-6 months, definitions vary by study) are moderately protective factors (Weng et al., 2012). There are therefore modifiable behaviours that are amenable to intervention during this period.

Effective, scalable, and affordable strategies that do not widen health inequities are needed to reduce childhood obesity (Blake-Lamb et al., 2016; Wake, 2018). Indeed the World Health Organisation has argued that interventions that can be embedded into ongoing practice and existing systems are needed, rather than implementing interventions that are resource-intensive and cannot be maintained in the long-term (World Health Organisation, 2016a). Evidence for the effectiveness of health professional-delivered obesity prevention interventions is required to inform policy and service provision. Health professionals have the potential to influence large numbers of parents during this time period; in part due to the large number of routine contacts that they have with parents (Daniels et al., 2015). The American Academy of Pediatrics however has highlighted the lack of feasible and effective strategies in primary care, implementable at scale (Daniels et al., 2015). No review to date has specifically looked at the effectiveness of intervention delivered by health professionals during the first 1,000 days to prevent childhood obesity.

In a 2011 review of childhood obesity prevention interventions, only one intervention targeting children under the age of two was identified (Waters et al., 2011); since then, however, the number of interventions reported has increased substantially (Blake-Lamb et al., 2016; Ciampa et al., 2010; Laws et al., 2014; Matvienko-Sikar et al., 2018; Redsell et al., 2016; Seburg et al., 2015; Yavuz et al., 2015). The results of these interventions to date in terms of their impact on child weight are mixed: in general, they demonstrate limited impact on child weight and/or anthropometric outcomes, but positive impacts on weight-related outcomes, e.g. infant feeding, activity levels, and sleep (Blake-Lamb et al., 2016; Redsell et al., 2016). While two of the most recent reviews have focused on interventions delivered during the first 1,000 days (Blake-Lamb et al., 2016; Redsell et al., 2016), they did not focus on intervention delivery agents; therefore we cannot tell who is best placed to deliver such interventions. A review of the role and impact of community health workers in childhood obesity interventions only found one intervention that targeted children under the age of two; overall, meta-analysis demonstrated small but significant impacts on weight-related measures (Schroeder et al., 2018). While a recent review of early life feeding interventions, did focus on healthcare professional-delivered interventions, it only included interventions delivered between birth until the age of two years – the prenatal period was not included – and only looked at interventions including infant feeding practices, not the wider range

of weight-related behaviours such as physical activity and sleep. It also found inconsistent effects on feeding practices, dietary intake and weight outcomes within the ten trials identified (Matvienko-Sikar et al., 2018). Two recent reviews have highlighted the potential of interventions that aim to improve parental feeding practices, responsive feeding interventions in particular (Matvienko-Sikar et al., 2018; Redsell et al., 2016). Interventions generally tend to target individual-level diet and activity behaviours, rather than the broader social and ecological factors that give rise to them (Blake-Lamb et al., 2016), which may account for the limited impacts on adiposity/weight outcomes.

Multi-target interventions (i.e. addressing nutrition, physical activity, sedentary behaviour, behaviour change and parenting) are recommended to prevent obesity in children and young people (Waters et al., 2011) and interventions are complex, involving multiple components. We do not know, however, what the most important target behaviours are, or the most important intervention components to determine effectiveness. Such information could assist in the testing and scale-up of interventions. Interventions based on theory are more likely to be effective (Craig et al., 2008; Taylor et al., 2012; Webb, Joseph, Yardley, & Michie, 2010), however, some studies have found that this is not the case (Borek, Abraham, Greaves, & Tarrant, 2018; Dalgetty et al., 2019; Prestwich et al., 2014) due to methodological and reporting issues (Borek et al., 2018; Dalgetty et al., 2019). Importantly also, use of theory enables us to hypothesise and test how our interventions actually work, specifying the proposed causal mechanisms and the key intervention components or "behaviour change techniques" (BCTs) (Michie & Prestwich, 2010). BCTs are considered the "active ingredients" of behaviour change interventions—that is, they are observable, replicable, and irreducible components of an intervention designed to modify the processes that regulate behaviour (Michie et al., 2013). Understanding the active ingredients and mechanisms of change of theory-based interventions can lead to theory refinement and/or development (Michie & Prestwich, 2010). Theory, however, is often lacking in the development of health behaviour interventions (Michie et al., 2009; Prestwich et al., 2014), including childhood obesity prevention interventions (Redsell et al., 2016). In addition, intervention effectiveness trials are often hampered by poor reporting (Baron et al., 2018) and variable levels of intervention delivery and implementation (JaKa et al., 2016; Toomey et al., 2019).

Recent advances in behavioural science, such as the development of the Behaviour Change Technique Taxonomy (Michie et al., 2013), have the potential to improve the quality of intervention research. Identification and specification of the potent behaviour change techniques used in interventions, and the dose necessary for change, should facilitate knowledge translation (Tate et al., 2016).

This review aims to address the knowledge gaps outlined above by addressing the following questions:

1. Are health professional-delivered behavioural interventions effective in reducing the risk of overweight and obesity, directly or indirectly, in children under the age of two?
2. What behaviour change theories and/or techniques are associated with more effective interventions?

4.2 Methods

4.2.1 Design

This systematic review adhered to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) standardised reporting guidelines (Moher, Liberati, Tetzlaff, & Altman, 2009). The PRISMA checklist is provided in Table S1. The review protocol was registered with the International Prospective Register for Systematic Reviews (PROSPERO) CRD42016050793.

4.2.2 Search strategy

Initial key word search terms were identified by author consensus, through identification of terms used in previous reviews of a similar nature (Blake-Lamb et al., 2016; Campbell & Hesketh, 2007; Ciampa et al., 2010; Hesketh & Campbell, 2010; Redsell et al., 2016; Summerbell et al., 2005; Waters et al., 2011; Yavuz et al., 2015) and in consultation with a specialist librarian. Key word searches, using combinations of key words and Medical Subject Headings (or equivalent), were used across six concepts using the AND Boolean operator: (1) child; (2) mother/parent; (3) BMI/obesity; (4) nutrition/physical activity/sleep/parenting; (5) intervention/prevention; (6) randomised controlled trial (RCT)/quasi-randomised trials. We initially included health professional-related terms as a seventh concept,

but this impacted on the ability of the search to include key papers, so this concept was removed. Within each of the categories, keywords were combined using the "OR" Boolean operator. The search strategy was purposefully broad enough to capture any study which might have assessed weight-related measures in children under the age of two. The search strategy was initially developed in Embase®, appropriately tailored for use within the other databases, and piloted before final searches were run. The final search strategy is available in Table S2.

We searched the following databases from inception to February 2017, updated on 04 April 2019, to identify eligible trials: CINAHL Complete (EBSCOhost; 1994); Embase® (Elsevier; 1980); MEDLINE (Ovid®; 1966); PsycINFO (Ovid®; 1978); PubMed (1996); The Cochrane library databases: The Central Register of Controlled Trials; Database of Systematic Reviews; Database of Abstracts of Reviews of Effect (Wiley; 1996). Conference proceedings and other grey literature were searched on: Open Grey (INIST-CNRS; 2011) and Web of Science™ (Thomson Reuters). ProQuest Dissertations & Theses Global, and ProQuest Dissertations & Theses – UK and Ireland, were used to identify eligible dissertation and thesis studies internationally. We searched the following databases for the registration of clinical trials to identify any ongoing or unpublished research trials: International Clinical Trials Registry Platform Search Portal; ClinicalTrials.gov; ISRCTN registry. In addition, reference lists of previous systematic reviews on this topic were manually searched (Blake-Lamb et al., 2016; Campbell & Hesketh, 2007; Ciampa et al., 2010; Hesketh & Campbell, 2010; Redsell et al., 2016; Summerbell et al., 2005; Waters et al., 2011; Yavuz et al., 2015). Searches were conducted by one reviewer (MH).

The reference lists of retrieved full texts were cross-checked for potentially eligible studies. Supplementary materials and trial registry protocols were also checked. No restrictions were applied to: language; date of publication; the length of follow-up of outcomes (given the diversity reported within systematic reviews to date); type of setting; mode of delivery. All records were imported into an Endnote database and duplicates were removed. They were then imported into COVIDENCE software (www.covidence.com) and any remaining duplicates removed. In cases where additional articles were identified from the reference lists of included trials (e.g. the published trial protocol), these were retrieved and included to supplement the analysis.

4.2.3 Study inclusion and exclusion criteria

We included studies–as per Cochrane systematic review criteria–if they were randomised controlled trials, including cluster-randomised controlled trials, or quasi-randomised trials comparing any behavioural intervention, led by or involving health professionals, with 'usual care'/active comparator which aimed to prevent over weight/obesity (by directly/explicitly focusing on childhood obesity prevention, or by indirectly focusing on childhood obesity-related risk factors) in children under the age of two that were born at term (37 to 42 weeks' gestation). Included studies reported at least one adiposity/weight outcome (either as a primary or secondary outcome in their study). The primary outcome of interest in this review was any type of child adiposity/weight outcome measure. Trials must have reported at least one child adiposity/weight-related measure, taken at intervention end (any point during the first 1,000 days) or at any follow-up time point thereafter; as mentioned above, there was no limit on the length of follow-up of outcomes. Trials only reporting infant birth weight were excluded. The full list of inclusion and exclusion criteria is available in Table S3.

4.2.4 Study selection

Titles and abstracts of references were independently screened by two reviewers (MH and LT). Following the retrieval of full-texts, two reviewers (MH and LVR) independently reviewed them for inclusion. Disagreements were resolved through discussion, with a third author where necessary.

4.2.5 Data extraction

For trials with multiple publications (39 trials: range 1-12 papers, mean = 5), all relevant publications identified were used for data extraction, and findings are presented for each trial. Data were extracted using a pre-piloted data extraction tool. Intervention descriptions were extracted following the criteria outlined in the TIDieR reporting guidelines (Hoffmann et al., 2014). All published papers and supplementary material related to the study (e.g. protocol papers and trial registry protocols, reference to websites with working hyperlinks, long-term follow-up studies) were used alongside the included article for data extraction. Data were

extracted by the lead author (MH) and 20% were checked for accuracy by a second reviewer (HCW). Any discrepancies were resolved through discussion.

4.2.6 Effectiveness assessment

A study was classified as supporting 'intervention effectiveness' where there was (i) a statistically significant difference between intervention and comparator in an objective measure of adiposity/weight (e.g. weight, BMI, BMI z-score, or percent overweight) AND (ii) at least one statistically significant difference between groups in a measure of any behavioural determinant of obesity (i.e. the secondary outcome(s) of interest of the review, e.g. nutrition, physical activity, sleep behaviours) at intervention end or alternative follow-up time point. A similar definition of effectiveness was used previously by Golley and colleagues (Golley et al., 2011). Although we did not place a limit on the length of follow-up of outcomes in this review, we did apply a cut-off for effectiveness. This cut-off was pragmatically defined as within 12 months of follow-up of the intervention endpoint for this review (i.e. child aged two years, plus a maximum of 12 months follow-up) given the variable duration of interventions and timing of follow-up assessments. For example, one intervention had a follow-up period of 16 years (Martin et al., 2017). The frequency of 'intervention effectiveness' by BCTs and use of theory was assessed. We also noted the number of studies with a significant change in adiposity/weight, but not behavioural changes; and studies with no significant change in adiposity/weight, but at least one significant change in a behavioural outcome.

4.2.7 Quality assessment

Risk of bias was assessed independently by two reviewers (MH and LVR) using the Cochrane Collaboration's risk of bias assessment tool (Higgins & Green, 2011). Each item was evaluated as "high risk", "low risk," or "unclear risk". Disagreements were resolved through discussion; with a third author (ET) where necessary, until 100% agreement was achieved. No overall quality rating was provided, as per recommendations in the Cochrane Handbook for Systematic Reviews of Interventions (Higgins & Green, 2011). Furthermore, no interventions were excluded from the review based on the results of the quality assessment.

4.2.8 Theory coding

Two coders (MH and LVR) independently coded all trials to determine the extent to which interventions were theory-based using the Theory Coding Scheme (Michie & Prestwich, 2010). We included 11 of the 19 items of the Theory Coding Scheme as these are the items which measure whether interventions are based on theory. Disagreements were resolved through discussion; with a third author (ET) where necessary, until 100% agreement was achieved.

4.2.9 BCT coding

Intervention descriptions as reported (and comparator arms) were independently coded by two coders (MH and LVR) into component BCTs (i.e. 'active ingredients') using the BCT Taxonomy V1 (Michie et al., 2013). MH had completed an online training course in using the BCT Taxonomy V1 (http://www.bct-taxonomy.com/). BCTs were simply recorded as present or absent. A BCT had to be explicitly present to be coded as included. The reliability of the method was assessed and improved in iterative rounds of coding. In the first step, a sample of five trials were independently coded. Coding differences were resolved through discussion, until 100% agreement was achieved. If agreement could not be reached, the views of a third party experienced in BCT coding (ET) were sought.

4.2.10 Data synthesis

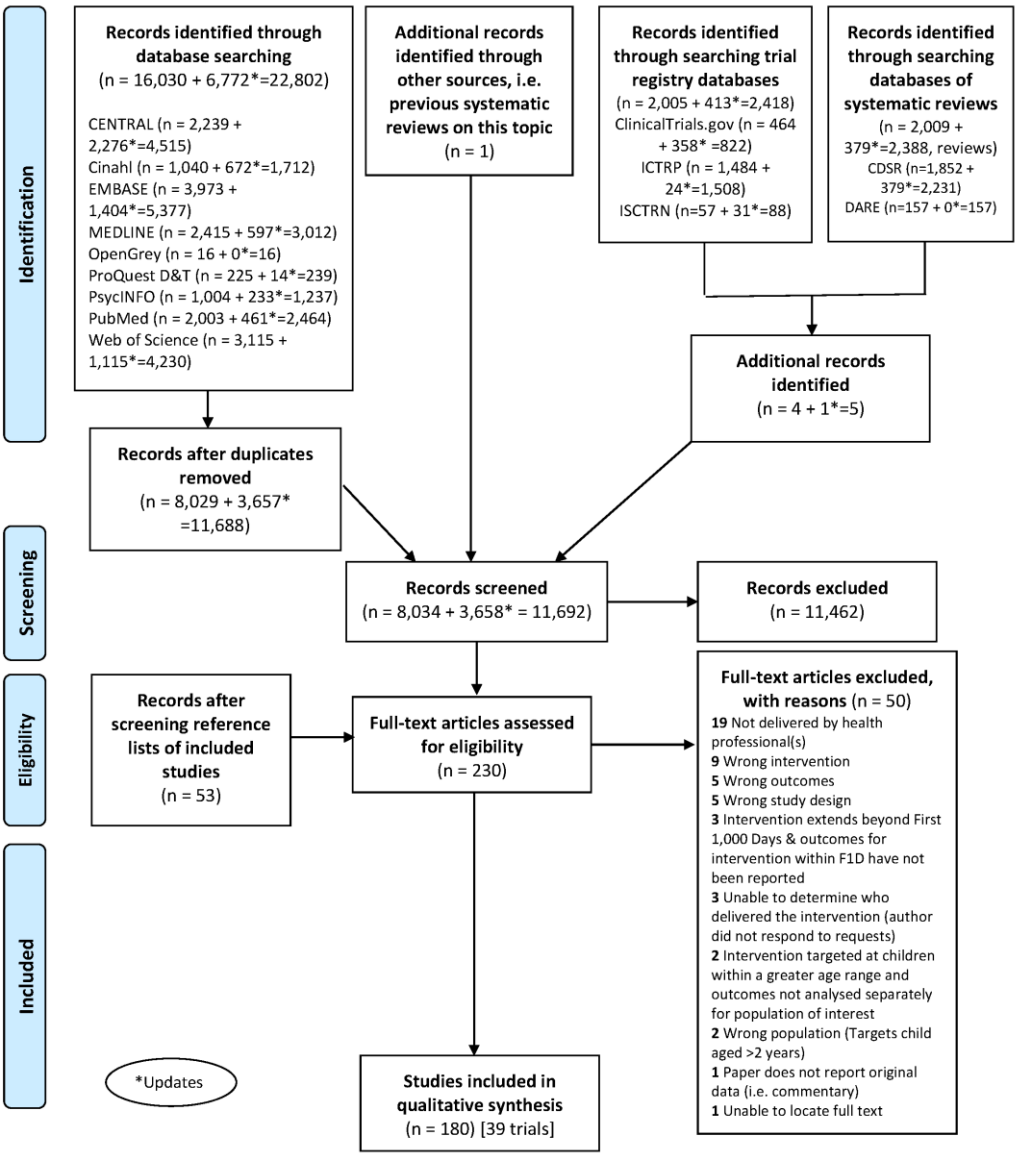
Due to the heterogeneity of participant characteristics and program features including length, outcomes measured and time of assessment, meta-analysis was not possible. Findings are presented descriptively in data summary tables and synthesized qualitatively in text.

4.3 Results

Electronic and hand searches identified 27,609 references (see Figure 4.1 below). After duplicate removal, and title and abstract screening, 230 references were selected for full text review. 180 eligible studies were identified, describing 39 trials, comprising 46 interventions (Albernaz, Victora, Haisma, Wright, & Coward, 2003; Bonuck, Avraham, Lo, Kahn, & Hyden, 2014; Campbell et al., 2013; Carlsen

et al., 2013; Daniels et al., 2015; de Vries et al., 2015; Dodd et al., 2018; Döring, Ghaderi, et al., 2016; Ekström, Abrahamsson, Eriksson, & Mårtensson, 2014; Eline, L'Hoir, Grieken, Hein, & Magda, 2016; Fiks et al., 2017; Fornari, Morandi, Tommasi, Tomasselli, & Maffeis, 2018; French et al., 2012; Froozani, Permehzadeh, Motlagh, & Golestan, 1999; Gross, Mendelsohn, Gross, Scheinmann, & Messito, 2016; Horan et al., 2016; Jonsdottir et al., 2014; Jungmann, Kurtz, Brand, Sierau, & von Klitzing, 2010; Kazemi & Ranjkesh, 2011; Kolu et al., 2016; Lakshman et al., 2018; Martin et al., 2017; Mustila, Raitanen, Keskinen, Saari, & Luoto, 2012b; Neyzi et al., 1991; Niinikoski et al., 2007; Ordway et al., 2018; Parat et al., 2019; Paul et al., 2018; Paul et al., 2011; Rauh, Günther, Kunath, Stecher, & Hauner, 2015; Schroeder et al., 2015; Schwartz, Vigo, Oliveira, & Giugliani, 2015; Shah, Fenick, & Rosenthal, 2016; Tanvig et al., 2015; Taylor, Gray, et al., 2018; Taylor et al., 2017; Vesco et al., 2016; Wake, Price, Clifford, Ukoumunne, & Hiscock, 2011; Wen et al., 2015). Five trials had more than one eligible intervention arm (French et al., 2012; Mustila et al., 2012b; Paul et al., 2011; Schwartz et al., 2015; Taylor, Gray, et al., 2018). A list of included trials is available in Table S4. For the purposes of this paper, only one paper per trial is referenced (denoted by * in Table S4), usually that describing the primary outcome of interest.

Figure 4.1 PRISMA flow diagram



4.3.1 Intervention characteristics

The intervention descriptions for each trial, as per the TIDieR reporting guidelines, are available in an open access repository (https://osf.io/g2zmy/): A brief version is provided in Table S5 (Appendix 4).

The majority of studies were randomised controlled trials – 24 were individual RCTs and 13 were cluster RCTs; the remaining two were quasi-RCTs. Main papers for included studies were published between 1991 and 2019, with just 5 (13%) published before 2011. Trials were predominantly conducted in high-income countries (n=33), with six conducted in upper middle-income countries, as defined

by the World Bank (World Bank, 2018). Interventions were heterogeneous, differing in focus, content, and delivery period, agent and mode.

A summary of key intervention characteristics can be found in Table 4.1. Although all 39 studies were directed at pregnant women and/or parents of children aged under two years, in two studies the intervention was directly targeted at health professionals, and indirectly at women (Ekström et al., 2014; Martin et al., 2017). Interventions were diverse in focus, and included those that focused on: multiple behaviours (infant only): e.g. infant feeding / nutrition / physical activity / sedentary behaviour / sleep (n=13; 28%); infant feeding (i.e. focused on formula feeding / breastfeeding / introduction to solids; breastfeeding and introduction to solids) (n=10; 22%); maternal diet/physical activity/gestational weight gain (GWG) (n=9; 20%); infant feeding: breastfeeding only (n=8; 17%). The 46 intervention arms of the 39 trials were conducted during the following time periods: antenatal only (n=7; 15%), birth to 2 years only (n=26; 57%), and antenatal and birth to 2 years (n=13; 28%). Half (n=23; 50%) of the interventions were specifically designed with a focus on childhood obesity prevention. Intervention duration (defined as the duration from start to finish of the total intervention delivery period) was highly varied - ranging from 10-15 minutes (Bonuck et al., 2014) to 2.5 years (Jungmann et al., 2010): the majority ranged in duration from >3 to ≤6 months (n=14; 30%) and >6 to ≤12 months (n=13; 28%). It should be noted that five of the included interventions were delivered beyond the child's second birthday [BBOFT+: 0-36 months (Eline et al., 2016); INSIGHT: 2 weeks-30 months (Paul et al., 2018); PRIMROSE: 9-48 months (Döring, Ghaderi, et al., 2016); Starting Early: third trimester to child age 33 months (Gross et al., 2016); STRIP: 7 months to 36 months (Niinikoski et al., 2007)], however, only duration/results for the period of delivery of interest (i.e. within the first 1,000 days) are reported in this paper. Half of interventions were conducted in a health centre / clinic / hospital (n=23; 50%), with almost one in four delivered in homes (n=11; 24%). Interventions were delivered by a wide range of health professionals. Twenty-five (54%) were delivered by a single health care professional type; these included general/research nurses (n=10; 26%); dietitians or nutritionists (n=6; 13%); public health nurses or maternal and child health nurses (n=4; 9%); lactation consultants (n=2; 4%); midwife (n=1; 2%); pediatrician (n=1; 2%); psychologist (n=1; 2%). Intervention mode(s) of delivery varied. The majority were delivered in individual, face-to-face sessions (n=24; 52%) or individual, face-to-face

and group, face-to-face sessions (n=11; 24%). Only one intervention was delivered without a face-to-face element (Carlsen et al., 2013).

Table 4.1 Key characteristics of interventions

Characteristic	Category	Studies	
		N	%*
Trial design (N=39)	RCT	24	62
	Cluster RCT	13	33
	Quasi-randomised controlled trial	2	5
Year of publication, by primary paper (N=39)	Pre-2011	5	13
	2011-2016	24	62
	2017-Present	10	26
Country of delivery (N=39)	United States	10	26
	Australia	5	13
	Finland	3	8
	Brazil	2	5
	Denmark	2	5
	Germany	2	5
	Iran	2	5
	New Zealand	2	5
	Sweden	2	5
	The Netherlands	2	5
	France	1	3
	Iceland	1	3
	Ireland	1	3
	Italy	1	3
	Republic of Belarus	1	3
	Turkey	1	3
	United Kingdom	1	3
Intervention target (N=46)	Infant feeding: breastfeeding only	8	17
	Multiple infant feeding behaviours (i.e. focused on formula feeding / breastfeeding / introduction to solids; breastfeeding and introduction to solids)	10	22
	Maternal diet/physical activity/gestational weight gain	9	20
	General parenting	1	2
	Physical activity only (child)	1	2
	Sleep only (child)	2	4
	Multiple behaviours (Infant): e.g. infant feeding / nutrition / physical activity / sedentary behaviour / sleep	13	28
	Maternal diet/physical activity/GWG AND Infant feeding (i.e. focused on formula feeding / breastfeeding / introduction to solids; breastfeeding and introduction to solids)	2	4

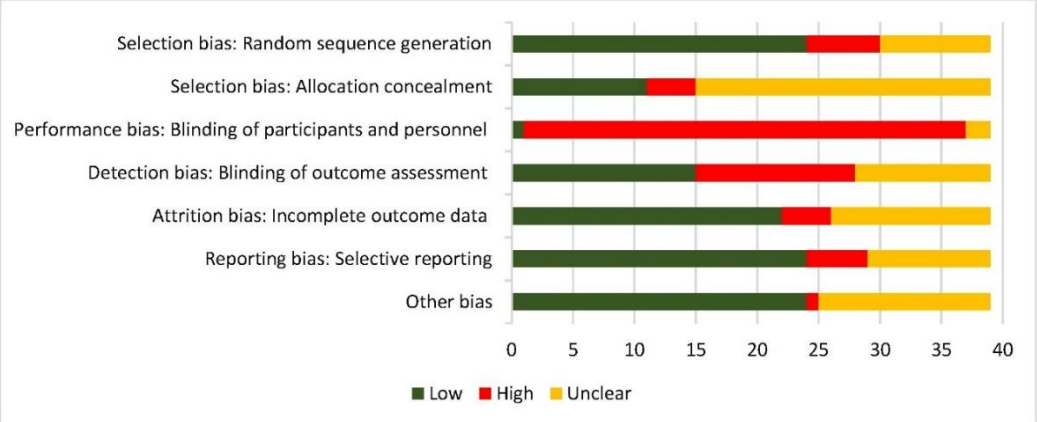
Characteristic	Category	Studies	
		N	%*
Intervention delivery period (N=46)	Antenatal only	7	15
	Birth to 2 years only	26	57
	Antenatal and birth to 2 years	13	28
Intervention duration *within limits of the scope of this review; i.e. first 1,000 days* (N=46)	≤3 months	4	9
	>3 to ≤6 months	14	30
	>6 to ≤12 months	13	28
	>12 to ≤18 months	3	7
	>18 to ≤24 months	9	20
	>24 to ≤30 months	3	7
	>30 to ≤33 months	0	0
Intervention setting (N=46)	Community	1	2
	Health centre / clinic / hospital	23	50
	Home (8) / Home or place convenient to mother (1) / Home; telephone (2)	11	24
	Telephone	1	2
	Health centre / clinic / hospital; home	7	15
	Online; unclear (location of in-person meetings)	1	2
	Research facility (1) / Research facility or home (1)	2	4
Delivery agent type (N=46)	Nurse (3; in one study they were also a lactation consultant) | research nurse (7)	10	26
	Dietitian (3) | nutritionist (3)	6	13
	Maternity Health Care Nurses (i.e. Public Health Nurses; 2) | Public Health Nurse (1) | Maternal and Child Health Nurses (1)	4	9
	Lactation consultant (in one study they also registered nurses)	2	4
	Midwife	1	2
	Paediatrician	1	2
	Psychologist	1	2
	Multiple delivery agent types (all health professionals)	14	30
	Multiple delivery agent types including, but not all, health professionals)	7	15
Intervention mode of delivery (N=46)	Individual, face-to-face (including 2 unclear)	24	52
	Individual, telephone	1	2
	Group, face-to-face	3	7
	Group, online; group, face-to-face	1	2
	Individual, face-to-face; group, face-to-face	11	24
	Individual, face-to-face; individual, telephone	3	7
	Individual, face-to-face; group, face-to-face; individual, email or telephone	3	7

Note: *Nos. rounded so total may not add up to 100

4.3.2 Risk of bias

A summary of risk of bias assessments for each trial is provided in Figure 4.2; assessments by trial are available in Table S6, while reasons for assessments are available in an open access repository (https://osf.io/g2zmy/). The methodological quality of included trials was mixed. None of the 39 included studies were judged low risk in all seven risk-of-bias domains. Most studies had a high risk of performance bias due to knowledge of the allocated interventions by participants and personnel during the study (36/39; 92%). Almost two in five studies had an unclear (9/39; 23%) or high (6/39; 15%) risk of selection bias in how random sequences were generated, while over seven in ten studies had a high (4/39; 10%) or unclear (24/39; 62%) risk of selection bias in how allocations were concealed. Three in five studies had a high (13/39; 33%) or unclear (11/39; 28%) risk of detection bias due to knowledge of the allocated interventions by outcome assessors. Two in five studies had an unclear (13/39; 33%) or high (4/39; 10%) risk of attrition bias, and similar numbers had unclear (10/39; 26%) or high (5/39; 13%) risk of reporting bias. Almost two in five studies had an unclear (14/39;36%) risk of 'other' bias.

Figure 4.2 Risk of bias assessment, by trial (N=39)



4.3.3 Effectiveness

The outcomes for each included intervention – including measurement method and timing – are available in an open access repository (https://osf.io/g2zmy/), while a summary is available in Table S7. Brief results are provided in Table S5 (Appendix 4).

Of the 46 intervention arms, only 4 (9%) were effective, based on our definition, at the end of intervention delivery or within 12 months of follow-up of the intervention endpoint for this review (i.e. child aged two years, plus a maximum of 12 months follow-up): the Baby Milk Trial (Lakshman et al., 2018); Froozani 1999 (Froozani et al., 1999); Healthy Beginnings (Wen et al., 2015) and INSIGHT (Paul et al., 2018). The Baby Milk Trial had a positive impact on rapid weight gain (≥+0.67 SDS increase from baseline) at intervention end (infant aged 6 months) and at six-month follow-up (infant aged 12 months) (Lakshman et al., 2018). This intervention, however, was not effective on its primary outcome of change in weight standard deviation score from birth to age 12 months; though it did slow weight gain from baseline to 6 months. The intervention also had a positive impact on infant energy intake and diet at age 8 months, and milk intake, ml/day at 3, 4, 5 and 6 months. The breastfeeding intervention described by Froozani (1999) had a positive impact on infant weight, and rates & duration of exclusive and predominant breastfeeding, at intervention end (infant aged 4 months) (Froozani et al., 1999). Healthy Beginnings had a positive impact on its primary outcome, child BMI and BMI z score at intervention end (child age 2 years). This was not sustained at age 3.5 years and at 5 years, and/or rates of overweight or obesity at 3.5 years and at 5 years. This intervention had a positive effect on a range of nutrition, activity, sedentary, and environment-related behaviours at age ≤2 years, but again most outcomes were not significant at 3.5 and 5 years follow up. The INSIGHT intervention (Paul et al., 2018) was delivered up until child aged 3 years, and therefore only results within the period of the first 1,000 days were considered in this review. The intervention had a positive impact on conditional infant weight gain score at 6 months; weight-for-length percentiles at 1 year; rate of overweight at 1 year; rates of overweight and obesity at age 2 years. It is also worth noting that although outside the scope of this review, the intervention had a positive impact on BMI z score at intervention end: child age 3 years. The intervention, however, had no impact on BMI > 85th and 95th percentiles at 3 years (INSIGHT's primary outcome); BMI z score at 2 years; accelerated weight gain (0.67 z score change) at any time-point: 0-4 months, 0-12 months. The INSIGHT intervention also had a positive impact on a range of nutrition, sleep and environment-related outcomes (see Table S7).

Six interventions showed positive impacts on child adiposity/weight outcomes only (de Vries et al., 2015; Ordway et al., 2018; Parat et al., 2019; Paul et

al., 2011; Vesco et al., 2016). The Early Obesity Intervention Programme, which focused on infant physical activity, had a positive impact on sum of skinfolds and supra-iliacal skinfolds (mm) at follow-up at child aged 2.5 years (primary outcome; 19 months from intervention end) (de Vries et al., 2015). ETOIG (Education Thérapeutique Obésité Infantile Grossesse) (Parat et al., 2019) had a positive impact on BMI >19 kg/m2 (97^{th} percentile; overweight according to French BMI curves) at follow-up at child aged 2 years (22-month follow-up from intervention end) (Parat et al., 2019). It targeted maternal diet and physical activity, and infant feeding. Healthy Moms, an intervention targeting healthy eating during pregnancy, showed positive effects on infant weight averaged across time and weight-for-age z-score at child age 1 year (12 months from intervention end) (Vesco et al., 2016). Minding the Baby had a positive impact on BMI, BMI-for-age z score, and rates of obesity at the end of the intervention when children were aged 24 months; it was a home visiting programme focused on general parenting behaviours (Ordway et al., 2018). The SLIMTIME Sooth/Sleep intervention had a positive impact of rate of weight gain at the end of intervention delivery when infants were aged 4-6 months, and also at follow-up at age 1 year (Paul et al., 2011). The SLIMTIME combined Sooth/Sleep and Introduction to Solids intervention had a positive impact on weight-for-length percentiles at the end of intervention delivery when infants were aged 4-6 months, and also at follow-up at age 1 year (Paul et al., 2011). Starting Early, an intervention focused on breastfeeding and introduction to solid foods, had positive impacts on weight for length Z-scores at intervention end and follow-up, however, results for the behavioural outcomes at intervention end and follow-up have not yet been published (Gross et al., 2016).

Twenty-two trials had positive impacts on behavioural outcome measures only (Table 1). Behavioural targets of these interventions were: breastfeeding (Albernaz et al., 2003; Carlsen et al., 2013; Ekström et al., 2014; Kazemi & Ranjkesh, 2011; Martin et al., 2017; Neyzi et al., 1991); infant feeding: bottle feeding (bottle weaning) (Bonuck et al., 2014); infant feeding: introduction to solids (French et al., 2012; Paul et al., 2011; Taylor et al., 2017) and child feeding (Daniels et al., 2015); breastfeeding and complementary feeding (Jonsdottir et al., 2014; Schwartz et al., 2015); infant and child feeding/eating and breastfeeding (Niinikoski et al., 2007); sleep (Taylor, Gray, et al., 2018); maternal eating habits (French et al., 2012); multiple behaviours: infant feeding (including breastfeeding & introduction to

solids), sleep, and parenting (Fiks et al., 2017); infant feeding, diet, physical activity, and television viewing (Campbell et al., 2013); infant feeding, infant physical activity, and sedentary behaviour (Taylor, Gray, et al., 2018); infant feeding, infant physical activity, sedentary behaviour, and sleep (Taylor, Gray, et al., 2018); infant/child feeding and physical activity (Schroeder et al., 2015).

4.3.4 Use of theory

The extent to which each of the behavioural interventions included in this review met the criteria of the Theory Coding Scheme is illustrated in Table 4.2; assessments by trial are available in Table S8, while reasons for assessments are available in an open access repository (https://osf.io/g2zmy/). No study met all the criteria. Twenty of the 46 interventions (43%) explicitly mentioned a theory or model of behaviour. The overall Theory Coding Scheme score ranged from 0 to 7 (where the maximum score was 12; Table 4.2). Fifteen different theories were identified. Responsive Parenting was the most frequently cited theory (n=7), followed by Social Cognitive Theory (n=6), Social Learning Theory (n=3) and the Precede Proceed Model (n=3) (see Table S9). Nine interventions were based on one theory alone, while nine drew on two theories, and two studies were based on three different theories.

Table 4.2 Theoretical grounding of interventions, by Theory Coding Scheme categories (N=46)

Criterion	No. of studies	
	N	%
1. Theory/model of behavior mentioned	20	43
2. Targeted construct mentioned as predictor of behaviour		
2a. 'Targeted' construct	9	20
2b. Evidence that the psychological construct relates to (correlates/ predicts/causes) behavior	5	11
3. Intervention based on single theory	6	13
4. Theory/predictors used to select recipients for the intervention	0	0
5. Theory/predictors used to select/develop intervention techniques	14	30
6. Theory/predictors used to tailor intervention techniques to recipients	0	0
7. All intervention techniques are explicitly linked to at least one theory relevant construct/predictor	0	0
8. At least one, but not all, of the intervention techniques are explicitly linked to at least one theory-relevant construct/predictor	7	15
9. Group of techniques are linked to a group of constructs/predictors	0	0
10. All theory-relevant constructs/predictors are explicitly linked to at least one intervention technique	0	0
11. At least one, but not all, of the theory relevant constructs/predictors are explicitly linked to at least one intervention technique	7	15

Note: Response options were 'yes' and 'no'. 'Not applicable' was coded as 'no'.

The majority of effective interventions, as defined by our review criteria, were theory-based (i.e. explicitly stated that they were underpinned by a specific theory/theories). For those interventions that were ineffective, 17 (out of 42) were based on theory (Table 4.3). Of the seven interventions that had a positive impact on weight outcome(s) only (i.e. and not a behavioural outcome), four of these were based on theory (57%). On the other hand, just eight of the 22 interventions that only had a positive impact on behavioural outcome(s) were theory-based (36%).

Table 4.3 Behaviour change theories and effectiveness of interventions

Intervention based on theory			Positive impact on weight AND behavioural outcome(s)				Positive impact on weight outcome(s) only		Positive impact on behavioural outcome(s) only	
Yes /No	Frequency									
			Effective (N=4)		Ineffective (N=42)		Effective (N=7)		Effective (N=22)	
	n	%	n	%	n	%	N	%	N	%
Yes	20	44	3	75	17	40	4	57	8	36
No	26	56	1	25	25	60	3	43	14	64

Note: Interventions judged as 'No' if judged to be not effective, or N/A

4.3.5 BCTs

Table 4.4 shows the BCTs that were used in the included 46 trial arms assessments by trial are available in Table S10, while reasons for assessments are available in an open access repository (https://osf.io/g2zmy/). The number of BCTs identified in individual interventions ranged from 1 to 15, with an average of 6.4 BCTs per intervention. Excluding "Credible source" (as all interventions were delivered by health professionals and therefore included this BCT), "Instruction on how to perform a behaviour" was used by most of the studies (n=41; 89%), followed by "Demonstration of the behaviour (n=21; 46%), and "Behavioural practice/rehearsal" (n=16; 35%) and "Information about health consequences" (n=16; 35%). Of note, 62 BCTs from the 93-item BCT Taxonomy V1 were not used in any study (i.e. only 31 were used).

The following BCTs were most frequently associated with effective interventions as defined by our review criteria (i.e. significant impact on weight AND behavioural outcome(s)): problem solving; review behaviour goal(s); feedback on behaviour; feedback on outcome(s) of behaviour; social support (unspecified); instruction on how to perform a behaviour; demonstration of the behaviour; information about health consequences.

Table 4.4 Frequency of BCTs among studies of effective and ineffective interventions (N=46)

BCT no.	BCT label	Cluster	Frequency (N=46)		Effective studies, by our review criterion (N=4)		Ineffective studies, by our review criterion (N=42)		Effective on weight outcome(s) only (N=7)		Effective on behavioural outcome(s) only (N=22)	
			n	%	n	%	N	%	n	%	n	%
1.1	Goal setting (behaviour)	Goals and planning	10	22	1	25	9	21	2	29	1	5
1.2	Problem solving		9	20	2	50	7	17	2	29	3	14
1.3	Goal setting (outcome)		3	7	0	0	3	7	1	14	1	5
1.4	Action planning		6	13	1	25	5	12	1	14	0	0
1.5	Review behaviour goal(s)		7	15	2	50	5	12	1	14	0	0
2.1	Monitoring of behaviour by others without feedback	Feedback and monitoring	1	2	1	25	0	0	0	0	0	0
2.2	Feedback on behaviour		15	33	3	75	12	29	2	29	7	32
2.3	Self-monitoring of behaviour		11	24	1	25	10	24	1	14	2	9
2.4	Self-monitoring of outcome(s) of behaviour		3	7	1	25	2	8	1	14	0	0
2.7	Feedback on outcome(s) of behaviour		5	11	2	50	3	7	1	14	0	0
3.1	Social support (unspecified)	Social support	15	33	2	50	13	31	2	29	11	50

BCT no.	BCT label	Cluster	Frequency (N=46)		Effective studies, by our review criterion (N=4)		Ineffective studies, by our review criterion (N=42)		Effective on weight outcome(s) only (N=7)		Effective on behavioural outcome(s) only (N=22)	
			n	%	n	%	N	%	n	%	n	%
3.2	Social support (practical)		3	7	0	0	3	7	2	29	0	0
3.3	Social support (emotional)		3	7	0	0	3	7	2	29	0	0
4.1	Instruction on how to perform a behaviour	Shaping knowledge	41	89	4	100	37	88	6	86	20	91
4.2	Information about antecedents		5	11	0	0	5	12	2	29	1	5
4.3	Re-attribution		2	4	0	0	2	5	2	29	0	0
5.1	Information about health consequences	Natural consequences	16	35	3	75	13	31	2	29	7	32
5.3	Information about social and environmental consequences		8	17	0	0	8	19	1	14	5	23
6.1	Demonstration of the behaviour	Comparison of behaviour	21	46	2	50	19	45	4	57	9	41
7.1	Prompts/cues	Associations	2	4	1	25	1	2	0	0	0	0
8.1	Behavioural practice / rehearsal	Repetition and substitution	16	35	1	25	15	36	5	71	6	27
8.2	Behaviour substitution		6	13	0	0	6	14	2	29	1	5
8.3	Habit formation		4	9	0	0	4	10	2	29	2	9
8.4	Habit reversal		2	4	0	0	2	5	2	29	0	0

BCT no.	BCT label	Cluster	Frequency (N=46)		Effective studies, by our review criterion (N=4)		Ineffective studies, by our review criterion (N=42)		Effective on weight outcome(s) only (N=7)		Effective on behavioural outcome(s) only (N=22)	
			n	%	n	%	N	%	n	%	n	%
9.1	Credible source	Comparison of outcomes	46	100	4	100	4	100	7	100	22	100
10.4	Social reward	Reward and threat	3	7	1	25	2	5	1	14	1	5
12.1	Restructuring the physical environment	Antecedents	3	7	0	0	3	7	0	0	2	9
12.2	Restructuring the social environment		3	7	0	0	3	7	0	0	2	9
12.3	Avoidance / reducing exposure to cues for the behaviour		1	2	0	0	1	2	0	0	0	0
12.5	Adding objects to the environment		9	20	1	25	8	19	3	43	4	18
13.1	Identification of self as role model	Identity	10	22	1	25	9	21	1	14	6	27

Note: Results shaded are where BCT present in at least 50% of interventions

4.4 Discussion

This is the first systematic review to synthesise the evidence on effectiveness of health professional-delivered interventions to prevent childhood obesity during the first 1,000 days, and to explore what behaviour change theories and/or techniques, or combinations of techniques, were associated with intervention outcomes.

There has been a sharp increase in the number of studies focusing on childhood obesity prevention during the first 1,000 days of life over the last eight years. This review identified 46 interventions delivered by health professionals to prevent childhood obesity (directly and/or indirectly) during the first 1,000 days, and also 24 ongoing trials (see details in Table S11). The previous review by Redsell and colleagues, identified 24 behavioural interventions during this period, including – but not limited to – those delivered by health professionals (Redsell et al., 2016).

4.4.1 Key findings

We found weak evidence to support the effectiveness of such interventions on weight and behavioural outcomes, but more evidence for effectiveness on behavioural outcomes only. Four out of the 46 identified interventions supported intervention effectiveness according to our review criteria (Froozani et al., 1999; Lakshman et al., 2018; Paul et al., 2018; Wen et al., 2015). A further six interventions showed positive impacts on child adiposity/weight outcomes only. A review of healthcare professional-delivered early life feeding interventions also found inconsistent effects on feeding practices, dietary intake and weight outcomes within the ten trials identified (Matvienko-Sikar et al., 2018). This is not an uncommon finding in the literature on childhood obesity, with many reviews of interventions (not delineated by intervention delivery agent) reporting limited impact on adiposity/weight outcomes in this age group (Laws et al., 2014; Redsell et al., 2016), and indeed children aged 0-5 years more generally (Hesketh & Campbell, 2010; Laws et al., 2014). The most recent Cochrane systematic review and meta-analysis of childhood obesity prevention interventions found strong evidence to support beneficial effects on BMI, especially for interventions targeting school-aged

children. It may be that interventions targeting older children have a greater chance of impacting on adiposity/weight outcomes.

Due to the heterogeneous nature of the included studies in our review, including outcomes, we were unable to conduct a meta-analysis. We found a wide variety of outcomes, measurement time points, and measurement tools used in studies, with varied levels of reporting. This impacted on the ability to evaluate and synthesise the results; limiting the conclusions that can be drawn for policy and practice. This has also been noted in trials of childhood obesity treatment (Bryant et al., 2014). It is possible that if results from interventions during the first 1,000 days could be pooled in an analysis, then greater insights into effectiveness could be observed within this age group. For example, when data from four of the included trials (Healthy Beginnings, INFANT, NOURISH and POI) were pooled, Askie and colleagues observed a reduction in BMI z-scores at 18-24 months to a moderate degree (Askie et al., 2014). Differences in 'usual care' between studies may also potentially contribute to variance in effectiveness.

Lack of adiposity/weight impacts notwithstanding, it is important not to overlook the positive impacts on behavioural outcomes in these interventions as these will potentially lead to positive weight outcomes over longer time periods, as behaviours track into later childhood. Twenty-two trials had positive impacts on behavioural outcome measures only. These trials were varied in focus, but predominantly centred on breastfeeding, infant and child feeding (bottle feeding; introduction to solids/complementary feeding), and multiple behavioural targets – namely infant feeding (including breastfeeding & introduction to solids), sedentary behaviour, sleep, and parenting. These findings somewhat reflect findings from systematic reviews of early life risk factors for obesity, with current evidence only promising/tentative for the positive effects of breastfeeding and appropriate solid food introduction on weight measures (Weng et al., 2012). There was a general lack of follow-up beyond intervention end in many of the included studies in our review. However, it is noteworthy that several of the interventions that had later follow-ups did not demonstrate sustained effects (e.g. Healthy Beginnings had no impact on weight outcomes at 1.5 and 3 years from intervention end (Wen et al., 2015)); therefore, sustainability of effects is an important area for future research. The INSIGHT Trial is one included intervention that is currently addressing this, by

following up children from age 3 years through school-entry around age 6 years and into middle childhood at age 9 (Paul, 2018).

Six interventions reported a statistically significant difference between groups on child adiposity/weight outcomes, without any significant differences between groups on behavioural outcomes that might account for these. It should be noted however that this was primarily due to methodological/reporting issues, e.g. behavioural outcomes of interest in infants/children not reported (Ordway et al., 2018; Vesco et al., 2016), all behavioural outcomes at intervention end and follow-up not yet published (Gross et al., 2016; Parat et al., 2019), and inadequate reporting of behavioural outcomes in the case of the SLIMTIME Sooth/Sleep and combined Sooth/Sleep and Introduction to Solids interventions (Paul et al., 2011). The Early Obesity Intervention Programme had a positive impact on child weight/anthropometric measures (though not all) but not on behavioural outcomes (i.e. daily physical activity levels) (de Vries et al., 2015). The authors of this study suggest a number of potential reasons for this including that the reduction in skinfold thickness could have been mediated by changes in motor development and/or physical activity pre-intervention and that effects lasted into toddler age (de Vries et al., 2015).

It was difficult to draw any firm conclusion as to what characteristics of interventions make them more effective. While all of the interventions within this review were delivered by health professionals, only 16 were clearly delivered as part of routine care, with a further two partly delivered as such. None of the four effective interventions was delivered as part of routine care, perhaps impacting on the sustainability of such interventions and their integration into routine practice. An adapted version of the Healthy Beginnings Trial - Communicating Healthy Beginnings Advice by Telephone (CHAT) – to be delivered at scale, is currently being tested for efficacy (Wen et al., 2017). In our analysis of the available data, we did not observe that interventions that were more intensive (i.e. had greater dosage) were more likely to be effective. Healthy Beginnings (Wen et al., 2015) involved eight home visits over a period of 24 months. INSIGHT (Paul, 2018) comprised mailed instructions at 2 weeks, 4 home visits, 2 research centre visits, and 2 telephone contacts over 30 months. The trial described by Froozani 1999 (Froozani et al., 1999), involved seven visits/contacts over a period of 4 months. The Baby

Milk Trial incorporated 3 x 30 - 45-minute face-to-face contacts (at baby's ages 2-12 weeks, 4-5 and 6-7 months) and 2 x 15 - 20-minute telephone contacts (at 2-3 months and 5-6 months) in addition to theory-based intervention leaflets (at 2 and 4 months) (Lakshman et al., 2018). However, other interventions, with similar levels of contact (e.g. INFANT, NOURISH, POI), were not effective in changing weight outcomes. It is possible that the populations recruited into the various trials impacts on the differing levels of effectiveness observed. For example, Healthy Beginnings targeted those with low socio-economic status, thereby potentially with more scope for improvement than trials such as InFANT and NOURISH. The review by Redsell and colleagues noted a lack of research on interventions to prevent childhood obesity, delivered during the antenatal period and beyond (Redsell et al., 2016). We noted earlier that the number of interventions delivered during this period are increasing. More interventions focusing on maternal nutrition/physical activity/gestational weight gain are also now reporting infant follow-up (Dodd et al., 2018; Horan et al., 2016; Mustila, Raitanen, Keskinen, Saari, & Luoto, 2012a; Rauh et al., 2015; Tanvig et al., 2015; Vesco et al., 2016); only the ETOIG (Education Thérapeutique Obésité Infantile Grossesse) Trial had a positive impact on child adiposity/weight, however.

While we documented the BCTs within interventions and comparator groups, where possible, we were unable to show that interventions containing particular BCTs have a greater likelihood of success, given the limited number of effective interventions identified within the review. We were also unable to identify BCTs that have the potential to be effective, or BCTs which do not contribute to effectiveness, but are frequently included in intervention packages (Michie, West, Sheals, & Godinho, 2018). That said, interventions involving more active engagement strategies - such as problem solving, review behavioural goal(s), feedback on behaviour, feedback on outcome(s) of behaviour and social support (unspecified) – were more often associated with effectiveness. Martin and colleagues only identified one BCT that may be effective in childhood obesity prevention interventions targeting children aged 2-18 years (i.e. prompting generalisation of a target behaviour) (Martin, Chater, & Lorencatto, 2013). They further concluded that the BCTs - providing information on the consequences of behaviour in general, providing rewards contingent on successful behaviour and facilitating social

comparison - were not effective components of such interventions (Martin et al., 2013). In their review of interventions that involve parents to improve the weight-related nutrition intake and activity patterns of children aged 1-18 years, Golley and colleagues, found that goal setting, self-monitoring of behaviour, environmental restructuring, and performance feedback were more common in effective interventions (Golley et al., 2011). Although not all BCTs in the BCT Taxonomy V1 might be appropriate for obesity prevention interventions delivered by health professionals, the findings of this review suggest that there may be opportunities to assess the potential of additional BCTs in future trials given that only 31 of the 93 BCTs within the BCT Taxonomy V1 were used.

We were unable to establish what theories were associated with intervention effectiveness, given that only four interventions were classified as effective - on both weight and obesity-related outcomes - within our review. Of these, three had an explicit theoretical basis: Baby Milk Trial – Social Cognitive Theory (Lakshman et al., 2018); Healthy Beginnings – Health Belief Model and Social Learning Theory (Wen et al., 2015); INSIGHT – Responsive Parenting (Paul et al., 2018). It should be noted that although interventions may not explicitly state an underlying theory, these interventions are likely to be guided by an implicit theory underpinning the selection of BCTs (Dalgetty et al., 2019).

Nearly half (20/46, 43%) of the interventions explicitly mentioned a theory or model of behaviour. Matvienko-Sikar and colleagues also noted lack of theory use in their recent review of infant feeding interventions in children aged 0-2 years; only 50% of trials stated an explicit theoretical underpinning (Matvienko-Sikar et al., 2019). Responsive Parenting was the most frequently cited theory (n=7), followed by Social Cognitive Theory (n=6), Social Learning Theory (n=3) and the Precede Proceed Model (n=3). Responsive feeding and Social Cognitive Theory were also the most frequently identified theories in the review by Matvienko-Sikar and colleagues (Matvienko-Sikar et al., 2019). Social Cognitive Theory is often used as the theoretical basis for childhood obesity interventions (Ng et al., 2018), and Responsive Parenting increasingly so, with some of the more prominent obesity prevention interventions, using this as its theoretical underpinning, e.g. INSIGHT and POI (Paul et al., 2018; Taylor, Gray, et al., 2018).

4.4.2 Implications for research

While there has been a rapid increase in the number of trials in this area, and there is now a sizeable research base, several gaps remain. The optimal interventions - timing, content, dose, mode of delivery, theory, active ingredients – have yet to be established. While past reviews in this area have called for increased research within this age group (Hesketh & Campbell, 2010; Laws et al., 2014), we suggest that efforts should focus on the conduct and reporting of research in this area. A lot of positive work is being conducted and the area would benefit from the sharing of more detailed information with the broader research community.

Use of standard reporting guidelines such as TIDieR (Hoffmann et al., 2014) to describe intervention, and also comparator, content would facilitate greater transparency and promote intervention fidelity. Given the complex nature of obesity, future research should consider the reporting of intervention context (Cotterill et al., 2018). Such descriptions could be included within intervention protocols and/or results papers. Where possible, researchers could code BCTs within their interventions a priori and publish these descriptions within protocol papers, e.g. as per the Baby Milk Trial (Lakshman et al., 2018); otherwise, publish intervention development papers in peer reviewed journals that include descriptions of the intervention with sufficient detail to allow coding of BCTs by others (Tate et al., 2016). Accurate and complete descriptions of interventions, the target populations and settings, and use of comparable behavioural outcomes would enable identification of effective BCTs across studies (Bull, Dombrowski, McCleary, & Johnston, 2014). While we are aware that interventions based on theory are potentially more likely to be effective than those that are not (Craig et al., 2008; Taylor et al., 2012; Webb et al., 2010), our current ability to discuss theory use in interventions is limited due to methodological and reporting reasons, and should be a focus for future research.

More harmonized and transparent reporting of outcomes in trial protocols and published reports would facilitate comparison of outcomes across trials, maximize the usability of findings, reduce bias, enable trial replication, improve trial design and conduct, and ultimately reduce research waste and help improve participant outcomes (Butcher et al., 2019). That said, there are challenges in generating a core outcome set for obesity research, partly because of the complexity

and variability in intervention targets thus requiring potentially different outcomes (Bryant et al., 2014). Matvienko-Sikar and colleagues recently developed a core outcome set for trials of infant feeding interventions to prevent childhood obesity (under review). Given the multi-behaviour focus of many interventions during the first 1,000 days, questions need to be answered about what to measure, when and how, without overburdening research participants and trial costs. Furthermore, there is a need to develop brief tools to measure early life obesity-related behaviours, particularly those assessing sedentary behaviour and sleep, and tools that cover multiple domains (Byrne et al., 2019).

Trials should be adequately powered, and longer-term (>12 month) post-intervention follow-up is required – we appreciate, however, that the latter is often subject to funding constraints. Greater attention to assessments of fidelity would enhance our ability to interpret intervention outcomes, while attention to external validity would enhance our understanding of the potential for implementation in routine service delivery. We only identified five interventions that included economic assessments. Previous reviews have also noted the lack of assessment of the cost-effectiveness of interventions (Hodder et al., 2018). Other authors have also noted the lack of economic evaluations of childhood obesity interventions (Döring, Mayer, Rasmussen, & Sonntag, 2016; Moodie & Carter, 2010), particularly in the early years (Hayes et al., 2019); this is changing however (Zanganeh, Adab, Li, & Frew, 2019). In the current climate of expenditure cuts to health services, it is difficult for health professionals to protect time to deliver such interventions. Future research should consider the costs of delivering interventions, as this will be valuable to decision-makers in deciding whether to adopt interventions into practice.

4.4.3 Implications for practice

While the National Institute for Health and Care Excellence (NICE) advocates multi-component interventions (i.e. addressing nutrition, physical activity, sedentary behavior, behavior change and parenting) to prevent childhood obesity, it has not been able to state what the active ingredients of such interventions should be (NICE, 2015b). In this review, we identified several BCTs which were associated with intervention effectiveness – namely problem solving, review behaviour goal(s),

feedback on behaviour, feedback on outcome(s) of behaviour, social support (unspecified), instruction on how to perform a behaviour, demonstration of the behaviour, and information about health consequences. There is some evidence, therefore, however flawed, that these BCTs should be incorporated into obesity prevention interventions delivered by health professionals during the first 1,000 days.

4.4.4 Strengths and limitations

We used a comprehensive and rigorous methodology in this review, including a broad search strategy and range of databases, no restrictions by language or country, the screening of trials and extraction of data by two independent review authors, and the appraisal of risks of bias within the included studies. We also included trials where adiposity/weight was not considered to be a primary trial outcome, as in practice such interventions are delivered in the context of other health initiatives. Siontis and Ioannidis (2018) have highlighted the increasing numbers of evidence syntheses, and the resultant overlap, redundancy, and duplication. We set out to extend the extant knowledge base by further deconstructing interventions to examine active ingredients. Theories, behaviour change techniques and intervention descriptions were categorised according to established frameworks (Michie & Prestwich, 2010; Michie et al., 2013). Previous reviews of obesity prevention interventions during the first 1,000 days have not investigated associations between use of theory and behaviour change techniques and intervention effectiveness.

Several limitations to the work must be acknowledged, however. Firstly, we defined effectiveness as statistically significant differences between intervention and comparator groups, as reported by the respective study authors. Such a measure of effectiveness is insufficient for decision-making on its own – the size of the intervention effects in clinical practice (clinical significance) are also necessary (Laupacis, Sackett, & Roberts, 1988). As noted in the previous reviews of BCTs, intervention descriptions are not always sufficiently detailed, so further BCTs, and indeed theories, may have been present which could not be coded based on descriptions within the included published papers/abstracts, supplementary materials, protocols and other publicly available intervention materials (Bull et al., 2014;

Lorencatto, West, Stavri, & Michie, 2013). Contacting authors for further information, e.g. study manuals, might have resulted in more detailed intervention descriptions (Abraham & Michie, 2008); however, only a percentage of authors respond to requests (Black et al., 2018) therefore we did not seek further information for consistency. Coding of unpublished content may have led to the identification of further BCTs (Johnson, Zarnowiecki, Hendrie, Mauch, & Golley, 2018). When the authors were unsure whether a BCT was present in both the Theory Coding Scheme and/or BCT Taxonomy, the behaviour change technique was marked as absent. Furthermore, poor comparator group content descriptions prevented their coding in many instances (e.g. comparator purely described as 'usual care'), and comparator intervention content may have an important impact on intervention outcomes. For example, de Bruin and colleagues found that intervention effectiveness decreased with increasing levels of standard care (de Bruin, Viechtbauer, Hospers, Schaalma, & Kok, 2009). We only reported BCTs included in interventions, not specific to target behaviours (where interventions targeted more than one behaviour). The analysis conducted as part of this review did not attempt to fully isolate the impact of BCTs on individual behaviours. That said, methods for identifying effective BCTs linked to target behaviour and context all have important inherent limitations (Michie et al., 2018). Further research is needed to identify which components of interventions or combinations of components can optimally improve intervention effectiveness. Future work could consider BCT coding in relation to coding of behavioural targets and style of BCT delivery to further understand BCT effects which could benefit both evidence syntheses and intervention development and delivery (Black et al., 2018). Greater specificity of the techniques used to change behaviour, when they are used, the dose intended, dose delivered, and dose received at the technique level are questions that can help us advance our science of intervention implementation by linking them with theory and outcomes (Tate et al., 2016). We did not apply an equity lens to this review to assess the effects of the included interventions on health equity and to ensure that health inequities are not increased; future work should consider application of the PROGRESS-Plus framework (O'Neill et al., 2014) to assess same. Finally, we did not include a patient and public involvement (PPI) element to this review, nor did we engage with health professionals around the design, conduct and/or reporting of the study. This may

have added value to this review in terms of improving quality and relevance to health professionals and other stakeholders (INVOLVE, 2012).

4.4.5 Conclusion

This review identified 46 interventions delivered by health professionals which aim to prevent childhood obesity (directly/indirectly) during the first 1,000 days. Only four of the 46 interventions were effective on an adiposity/weight outcome and a behavioural outcome. A further six interventions showed positive impacts on child adiposity/weight outcomes only, while twenty-two trials had positive impacts on behavioural outcome measures only. It was not possible to establish what theories and BCTs were associated with intervention effectiveness. That said, we did identify several BCTs which were associated with intervention effectiveness – namely problem solving, review behaviour goal(s), feedback on behaviour, feedback on outcome(s) of behaviour, social support (unspecified), instruction on how to perform a behaviour, demonstration of the behaviour, and information about health consequences. These BCTs should be incorporated into research and practice. Several methodological limitations were noted, impacting on efforts to establish the active ingredients of interventions. Future work should also focus on the conduct and reporting of interventions.

4.5 Acknowledgements

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4.6 Conflict of interest

No conflict of interest was declared.

4.7 Deviation from protocol

The review protocol was registered with the International Prospective Register for Systematic Reviews (PROSPERO) CRD42016050793. Several amendments were made to the protocol as the review progressed. Aim of eligible studies clarified to facilitate screening: aim to reduce the risk of overweight and obesity "directly or indirectly" (added the latter). Removed Scopus and Trip from the list of databases searched due to access issues. Changed "search strategy will be initially developed in PubMed" to Embase on advice of research librarian. Clarified intervention eligibility to facilitate screening: (i) "We will include interventions which target key risk factors for childhood obesity (Weng et al., 2012) including: early rapid weight gain, infant feeding method, timing of introduction of solid foods, and gestational weight gain. We will look at interventions which target behaviours such as: breastfeeding duration, timing of introduction of solid foods, responsive feeding, active play, sedentary behaviours, healthy growth". Added definition of health professionals: (ii) "Health professionals will be defined according to the International Standard Classification of Occupations (ISCO) ISCO-08 (International Labour Office, 2012). For the purposes of this review, research nurses, lactation consultants, psychologists and social workers will additionally be classified as health professionals". Added the following to the study ineligibility criteria: Only report anthropometric measures at birth as an outcome (we are particularly interested in studies that report differences in infant weight over time); Do not involve health professionals in the delivery of the intervention (for completeness); Do not involve human participants (filter not applied during searches). Intervention details extracted according to the description of interventions outlined in the TiDiER checklist, rather than WIDER, as this was deemed more appropriate for the review.

4.8 Author contributions

MH led the review including drafting the review protocol, conducting the searches, screening articles, extracting the data, conducting quality assessments, coding BCTs and theories, conducting external validity checks, synthesising the findings and writing the paper. LvR conducted double-screening of full-texts and independent coding of BCTs, theories and quality assessment. RL and HW

completed sample checks of external validity and data extraction, respectively. CH, MB, RL and ET provided independent advice on queries raised during the review process. All authors contributed to the review protocol and critically reviewed drafts of the manuscript, approving the final manuscript submitted.

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Chapter 5 Study 2b: Health professional-delivered obesity prevention interventions during the first 1,000 days: A systematic review of external validity reporting

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Abstract

Background: Childhood obesity prevention interventions delivered by health professionals during the first 1,000 days of life show some evidence of effectiveness, particularly in relation to behavioural outcomes. External validity refers to how generalisable interventions are to populations or settings beyond those in the original study. The degree to which external validity elements are reported in such studies is unclear however. This systematic review aimed to determine the extent to which childhood obesity interventions delivered by health professionals during the first 1,000 days report on elements that can be used to inform generalizability across settings and populations.

Methods: Eligible studies meeting study inclusion and exclusion criteria were identified through a systematic review of 11 databases and three trial registers. An assessment tool based on the RE-AIM (Reach, Effectiveness, Adoption, Implementation, Maintenance) framework was used to assess the external validity of included studies. It comprised five dimensions: reach and representativeness of individuals, reach and representativeness of settings, implementation and adaptation, outcomes for decision making, maintenance and/or institutionalisation. Two authors independently assessed the external validity reporting of 20% of included studies; discrepancies were resolved, and then one author completed assessments of the remaining studies.

Results: In total, 39 trials involving 46 interventions published between 1999 and 2019 were identified. The majority of studies were randomized controlled trials (n=24). Reporting varied within and between dimensions. External validity elements that were poorly described included: representativeness of individuals and settings, treatment receipt, intervention mechanisms and moderators, cost effectiveness, and intervention sustainability and acceptability.

Conclusions: Our review suggests that more emphasis is needed on research designs that consider generalisability, and the reporting of external validity elements in early life childhood obesity prevention interventions. Important gaps in external validity reporting were identified that could facilitate decisions around the translation and scale-up of interventions from research to practice.

Keywords: external validity, childhood obesity, generalisability, intervention, implementation science, health professional, prevention, replication, systematic review

5.1 Background

In 2018, approximately 41 million children under the age of five year were classified as having overweight or obesity (World Health Organisation, 2018). Child obesity prevention is a public health priority, with early intervention advocated (World Health Organisation, 2016b). Effective, scalable, and affordable strategies that do not widen health inequities are needed to address childhood obesity (Blake-Lamb et al., 2016; Wake, 2018). In addition, interventions that can be embedded into ongoing practice and existing systems are required, rather than implementing interventions that are resource-intensive and cannot be maintained in the long-term (Waters et al., 2011; World Health Organisation, 2016a). This was echoed in a recent research prioritisation study in which 'Implementation science' and 'How to integrate obesity prevention into existing service structures' were the third and fourth ranked research priorities identified by researchers, policymakers and practitioners (Hennessy, Byrne, et al., 2019). To date, there has been limited scale-up of childhood obesity prevention interventions.

Appraising scalability prior to investment is vital (Indig, Lee, Grunseit, Milat, & Bauman, 2017; McCrabb et al., 2019). Scalability is defined by the World Health Organization as 'the deliberate effort to increase the impact of successfully tested health interventions so as to benefit more people and to foster policy and program development on a lasting basis' (World Health Organisation, 2010). An understanding of the external validity of the intervention is critical to determining scalability, in addition to understanding the fit between an intervention and the political and strategic context. External validity refers to the generalizability of the results of an intervention to or across target populations or settings, while applicability refers to generalizability to any populations or settings (Murad, Katabi, Benkhadra, & Montori, 2018). To understand the external validity of an intervention, decision-makers need to have sufficient information on the reach and acceptability of the intervention, core intervention components required for fidelity, any differential

effects on the target population, unintended consequences, costs versus benefits, and the clinical or policy significance of the intervention effects to inform decisions about whether interventions should be scaled-up (Bonell, Oakley, Hargreaves, Strange, & Rees, 2006; Burchett, Blanchard, Kneale, & Thomas, 2018; Glasgow et al., 2006; Jamal et al., 2015; Lavis et al., 2009). The poor reporting of external validity elements in childhood obesity prevention interventions also limits decision-makers' ability around translation of interventions into practice (Klesges et al., 2008; Laws et al., 2014).

As public health interventions are usually complex, and context dependent, it can be difficult to assess their generalisability to other contexts (Burchett et al., 2018). There are many tools for assessing generalisability, however, there is no consensus on which should be used, or when (Burchett et al., 2018). Indeed, Burchett and colleagues argue that such tools may not be the best method for generalisability assessments, instead advocating a focus on mechanisms of action through which an intervention exerts its effect – and which contextual elements underpin them, rather than solely on intervention characteristics (Burchett et al., 2018). To improve reporting across behavioural interventions and enhance the translation of research into practice, Glasgow and colleagues developed the RE-AIM (Reach, Effectiveness, Adoption, Implementation, Maintenance) framework to evaluate the degree to which behavioural interventions report on external validity factors (Glasgow, Klesges, Dzewaltowski, Bull, & Estabrooks, 2004; Glasgow et al., 1999). Reach is the number, proportion of the intended target population, and the representativeness of participants compared with the intended target population. Effectiveness (or efficacy, depending on the study design) is the degree to which the intervention changes behavioural, quality of life, and participant satisfaction outcomes as well as physiologic endpoints, and includes attention to positive, unintended and negative results. Adoption is the number and proportion of settings and staff members that agree to initiate an intervention and how representative they are of the target setting and staff. Implementation is the degree to which settings and staff members deliver an intervention as intended, the adaptations made, and the related costs. Finally, maintenance is sustained effectiveness at the participant level and sustained (or adapted) delivery at the setting or staff level. At the individual level, it refers to the long-term results of intervention (defined as a minimum of six

months following the last contact) (Glasgow et al., 1999; Green & Glasgow, 2006; Kessler et al., 2013). RE-AIM is the most frequently applied framework in the translation of research evidence into policy and practice (Milat & Li, 2017). It has been used to assess reports of external validity factors across a variety of areas, including weight loss maintenance interventions (Akers, Estabrooks, & Davy, 2010), behavioural interventions that target physical activity (Estabrooks & Gyurcsik, 2003), mobile health physical activity promotion interventions (Blackman et al., 2013), physical activity promotion in Latin American populations (Galaviz et al., 2014), behavioural intervention studies conducted in community settings (Dzewaltowski, Estabrooks, Klesges, Bull, & Glasgow, 2004), school health promotion studies (Estabrooks, Dzewaltowski, Glasgow, & Klesges), behavior change interventions in healthcare settings (Glasgow, Bull, Gillette, Klesges, & Dzewaltowski, 2002), and housing improvement (Thomson & Thomas, 2012).

Based on the RE-AIM framework, Green and Glasgow proposed a set of ratings to assess external validity (Green & Glasgow, 2006). These were further adapted by Laws and colleagues (Laws et al., 2012) and have been used to assess external validity in diabetes prevention research (Laws et al., 2012) and obesity prevention in children aged 0-5 years (Laws et al., 2014).

Reviews of external validity reporting in childhood obesity interventions identify insufficient reporting of elements necessary to make decisions about generalisability (Klesges et al., 2008; Laws et al., 2014). A review of external validity reporting in 19 long-term follow-up childhood obesity prevention trials (children aged 0-18 years) published between 1980 and 2004 found that all studies lacked full reporting on potential generalizability and dissemination elements; the most infrequent were reports of setting level inclusion and exclusion criteria and representativeness, characteristics regarding intervention staff, implementation of intervention content, costs, and program sustainability (Klesges et al., 2008). A more recent review of external validity reporting in 32 trials of interventions to prevent obesity or improve obesity related behaviours in children aged 0-5 years from socioeconomically disadvantaged or Indigenous families found similar issues with reporting (Laws et al., 2014). Health professional-delivered interventions to prevent childhood obesity during the first 1,000 days of life (i.e. the period from conception to a child's second birthday) have limited impacts on adiposity/weight outcomes, but

have more positive impacts on behavioural outcomes (Hennessy, Heary, et al., 2019a). Despite the increasing numbers of trials to assess the impact of early life obesity prevention interventions, there is relatively little reporting on the potential for these interventions to be translated into routine practice. Furthermore, there is little evidence that interventions with demonstrated efficacy have been translated beyond the research setting and been broadly adopted. Given that it can take up to 17 years to translate evidence into practice (Morris et al., 2011), it is important to assess the extent to which trials report on factors that can provide additional explanation for variability in intervention outcomes, insights into successful adaptations of interventions, inform generalizability across settings and populations, and help guide policy decisions.

This study aims to determine the extent to which childhood obesity interventions delivered by health professionals during the first 1,000 days report on factors that can be used inform generalizability across settings and populations, and to provide recommendations for researchers planning to conduct similar studies.

5.2 Methods

We conducted a systematic review of obesity prevention interventions delivered by health professionals targeting children in the first 1,000 days of life. A separate paper reports on the effectiveness of such interventions and what behaviour change theories and techniques are associated with more effective intervention outcomes (Hennessy, Heary, et al., 2019a). The review protocol was registered with the International Prospective Register for Systematic Reviews (PROSPERO) CRD42016050793 on 3rd November 2016. This paper adheres to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) standardised reporting guidelines (Moher et al., 2009); the PRISMA checklist is available on OSF (Hennessy, Heary, et al., 2019b).

5.2.1 Search strategy

Key word searches, using combinations of key words and Medical Subject Headings (or equivalent), were used across six concepts using the AND Boolean operator: (1) child; (2) mother/parent; (3) BMI/obesity; (4) nutrition/physical

activity/sleep/parenting; (5) intervention/prevention; (6) randomised controlled trial (RCT)/quasi-randomised trials. Within each of the categories, keywords were combined using the "OR" Boolean operator. The search strategy was purposefully broad enough to capture any study which might have assessed weight-related measures in children under the age of two. The search strategy was initially developed in Embase® (see extended data (Hennessy, Heary, et al., 2019b)), appropriately tailored for use within the other databases, and piloted before final searches were run.

One reviewer (MH) searched the following databases from inception to 04 April 2019 using pre-specified search strategies: CINAHL Complete (EBSCOhost; 1994); Embase® (Elsevier; 1980); MEDLINE (Ovid®; 1966); PsycINFO (Ovid®; 1978); PubMed (1996); The Cochrane library databases: The Central Register of Controlled Trials; Database of Systematic Reviews; Database of Abstracts of Reviews of Effect (Wiley; 1996). Conference proceedings and other grey literature were searched on: Open Grey (INIST-CNRS; 2011) and Web of Science™ (Thomson Reuters). ProQuest Dissertations & Theses Global, and ProQuest Dissertations & Theses – UK and Ireland, were used to identify eligible dissertation and thesis studies internationally. We also searched the International Clinical Trials Registry Platform Search Portal, ClinicalTrials.gov, and the ISRCTN registry to identify any ongoing or unpublished research trials. Reference lists of previous systematic reviews on this topic were manually searched, as well as those of retrieved full texts.

Supplementary materials and trial registry protocols were also checked. No restrictions were applied to: language; date of publication; the length of follow-up of outcomes (given the diversity reported within systematic reviews to date); type of setting; mode of delivery. Records were de-duplicated in Endnote, imported into COVIDENCE and any remaining duplicates removed.

5.2.2 Study inclusion and exclusion criteria

Table 5.1 details the study inclusion and exclusion criteria. We included randomised controlled trials, including cluster-randomised controlled trials, or quasi-randomised trials comparing any behavioural intervention, delivered by health

professionals, with ‘usual care’/active comparator which aimed to prevent overweight/obesity in children under the age of two that were born at term. Studies had to report at least one infant/child-related adiposity and/or weight outcome measure at follow-up, which could be immediately post-intervention, or at any time point thereafter); trials only reporting infant birth weight were excluded.

Table 5.1 Study inclusion criteria

Design	**Randomised, and quasi-randomised, controlled trials, including individual cluster randomised trials**
Participants	Studies which targeted pregnant women and/or parents (including mothers/fathers/carers/guardians) of healthy infants less than two years old and/or infants born at term gestation (37 to 42 weeks of gestation) and up to two years of age. o No restrictions for sex, ethnicity, socio-economic group, or region, were applied. o Studies where children aged under two years were part of a family group receiving the intervention were included only if data could be extracted separately for these children
Intervention	o Behavioural interventions designed to prevent obesity (by directly/explicitly focusing on childhood obesity prevention, or by indirectly focusing on childhood obesity-related risk factors) in infants (e.g. individual counselling, face-to-face sessions, audio-visual packages, support groups, online interventions/forums) delivered by health professionals antenatally and/or up to a child's second birthday. o Behavioural interventions were defined as "those that require the active participation of a target group (e.g. patient, individual, health professional) in a programme delivered by a trained interventionist with the goal of changing health-related behaviour" (Bacon et al., 2015). o Interventions targeting key risk factors for childhood obesity (Weng et al., 2012), including: early rapid weight gain, infant feeding method, timing of introduction of solid foods, and gestational weight gain o Health professionals were defined according to the International Standard Classification of Occupations (ISCO) ISCO-08 (International Labour Office, 2012). For the purposes of this review, research nurses, lactation consultants, psychologists, and social workers were also classified as health professionals
Comparator	Participants who were not exposed to an intervention/wait-list control, or an active comparator, or who received 'usual care'. 'Usual care' is defined as standard support and/or appointments without an obesity prevention focus
Outcomes	<u>Primary</u> o Infant/child body mass index (BMI) z score o Additional anthropometric/growth-related: e.g. growth rates (weight gain, linear growth, and head growth, change in BMI z score), percent fat content, ponderal index, skin-fold thickness <u>Secondary</u> (*intermediate behavioural outcomes)

	○ Diet-related*: e.g. breastfeeding initiation and duration (total and exclusive); dietary intake and quality; timing of introduction of solid food(s) ○ Feeding/eating behaviour-related*: e.g. responsive feeding practices ○ Physical activity-related*: e.g. physical activity, tummy time, play, screen time ○ Sedentary time/behaviour-related*: e.g. frequency/time spent: being inactive, doing specific low-energy behaviours such as screen time ○ Sleep* ○ Environment-related*: e.g. outcomes related to the physical (e.g. food availability) and social environment ○ Cost effectiveness/costs of the intervention
Publications	Trials reported only as abstracts were deemed eligible for inclusion if sufficient information was available from the report, or from contact with the authors, to fulfil the inclusion criteria

5.2.3 Study selection

MH and LT independently screened titles and abstracts against the inclusion criteria, and following the retrieval of full-texts, MH and LvR independently reviewed them for inclusion. Disagreements were resolved through discussion, with a third author (MB / CH / RL) where necessary.

5.2.4 Data extraction

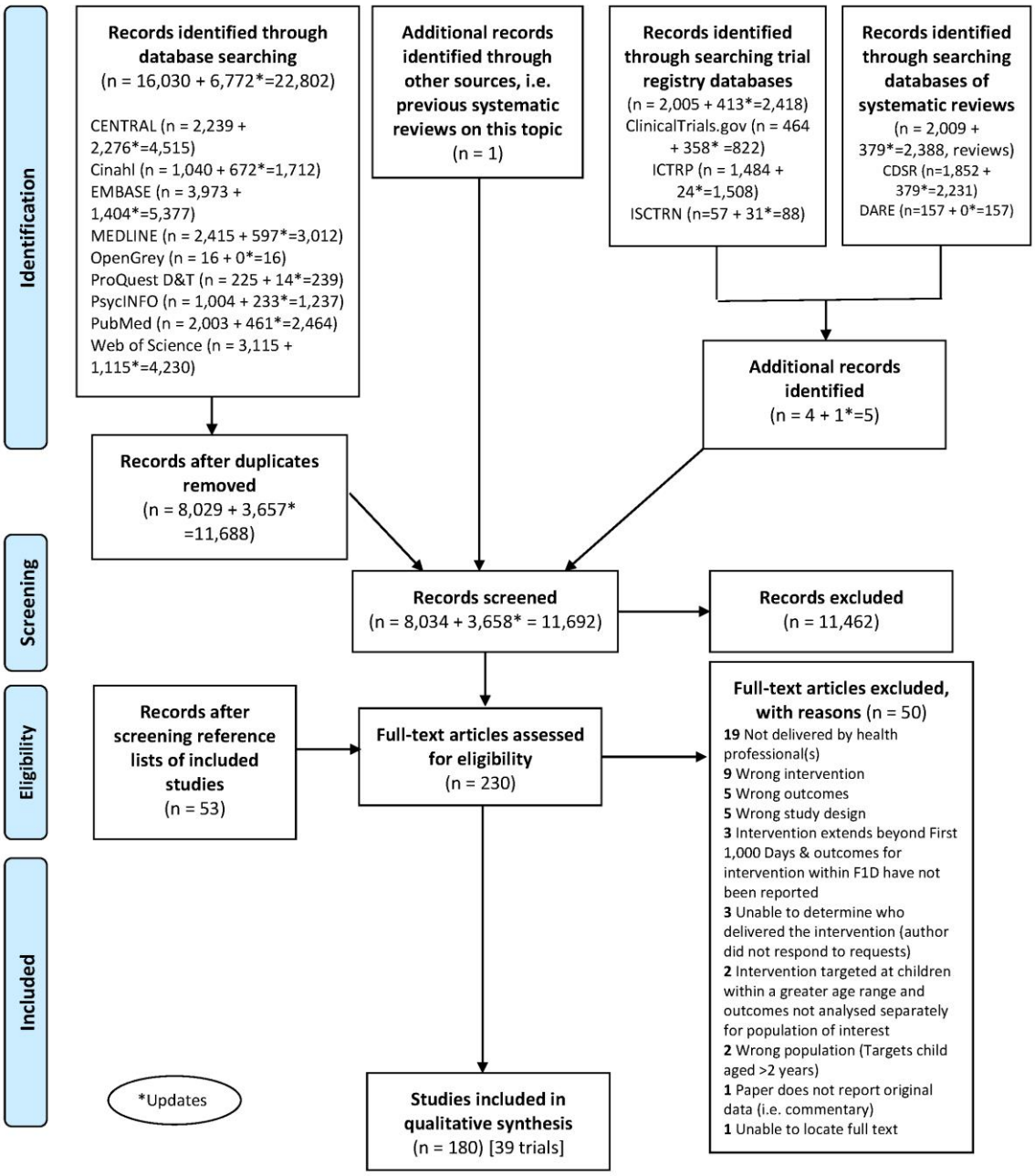
All published papers and supplementary material related to the study (e.g. protocol papers and trial registry protocols, reference to websites with working hyperlinks, long-term follow-up studies) were used alongside the included article for data extraction. Data were extracted by one author (MH) using a pre-piloted data extraction tool (see extended data (Hennessy, Heary, et al., 2019b)), with 20% double-checked by a second reviewer (HCW). Intervention descriptions were extracted following the criteria outlined in the TIDieR reporting guidelines (Hoffmann et al., 2014). The external validity assessment tool previously developed by RL (Laws et al., 2014; Laws et al., 2012) was used to assess the extent to which included studies/trials reported on elements that would aid decision-making around whether the findings of such studies/trials could be generalised to populations or settings beyond those in the original study (Green & Glasgow, 2006). This tool

includes five main dimensions (defined in Table 5.2): 1) reach and representativeness (individuals); 2) reach and representativeness (settings); 3) implementation and adaptation (of intervention), which includes fidelity considerations; 4) outcomes for decision makers; 5) maintenance and institutionalisation (i.e. the potential for implementation of the intervention in routine service delivery). Included studies were coded according to whether they met each criterion (yes, no, or not applicable). Initially, two authors (MH and RL) independently assessed the external validity reporting of 20% of included studies. Any discrepancies were resolved through discussion, and then one author (MH) completed assessments of the remaining studies. We did not exclude any studies on the basis of the effectiveness and/or quality assessment.

5.3 Results

Electronic and hand searches identified 27,609 references (see Figure 5.1). Following duplicate removal and title and abstract screening, 230 references were selected for full text review. We identified 39 eligible studies with 46 unique intervention arms and a total of 180 eligible papers (Albernaz et al., 2003; Bonuck et al., 2014; Campbell et al., 2013; Carlsen et al., 2013; Daniels et al., 2015; de Vries et al., 2015; Dodd et al., 2018; Döring, Ghaderi, et al., 2016; Ekström et al., 2014; Eline et al., 2016; Fiks et al., 2017; Fornari et al., 2018; French et al., 2012; Froozani et al., 1999; Gross et al., 2016; Horan et al., 2016; Jonsdottir et al., 2014; Jungmann et al., 2010; Kazemi & Ranjkesh, 2011; Kolu et al., 2016; Lakshman et al., 2018; Martin et al., 2017; Mustila et al., 2012b; Neyzi et al., 1991; Niinikoski et al., 2007; Ordway et al., 2018; Parat et al., 2019; Paul et al., 2018; Paul et al., 2011; Rauh et al., 2015; Schroeder et al., 2015; Schwartz et al., 2015; Shah et al., 2016; Tanvig et al., 2015; Taylor, Gray, et al., 2018; Taylor et al., 2017; Vesco et al., 2016; Wake et al., 2011; Wen et al., 2015). Five trials had more than one eligible intervention arm (French et al., 2012; Mustila et al., 2012b; Paul et al., 2011; Schwartz et al., 2015; Taylor, Gray, et al., 2018).

Figure 5.1 PRISMA flow diagram



Studies were mostly published from 2011 onwards (n=34), conducted in high-income countries (n=33), and targeted the period from birth to 2 years only (n=26). They focused on a range of behaviours and outcomes, including: multiple infant behaviours (n=13); infant feeding: formula feeding / breastfeeding / introduction to solids (n=10); maternal diet/physical activity/gestational weight gain (n=9); infant feeding: breastfeeding only (n=8). Only 16 of the 46 interventions were clearly delivered as part of routine care, with a further two partly delivered as such. Details of intervention descriptions and outcomes are available as extended data (Hennessy, Heary, et al., 2019b).

The assessment of the reporting of external validity elements of the 39 included studies is summarised in Table 5.2, with a summary by study available as extended data (Hennessy, Heary, et al., 2019b). Inter-rater reliability, using percent agreement, was high (88.2%). Full details of the these assessments, including supporting statements for each study, are available as extended data (Hennessy, Heary, et al., 2019b). The number and percentage of studies reporting all elements of each dimension of external validity are outlined in Table 5.3.

5.3.1 Reach and representativeness of participants

Only 15% of studies reported on all elements of this external validity dimension (Table 5.3). While almost all studies outlined the target population for generalizability (97%) and inclusion and exclusion criteria (97%), less reported the recruitment method (77%), enrolment rate (67%), and recruitment rate (67%) (Table 5.2). Just over half (54%) reported all of the specified participant characteristics - gender, age, any socioeconomic indicators (education, employment status, or income – and participation by racial or ethnic minority groups. Only one in four studies included comparisons between individuals who participated versus either (1) those who declined to participate or (2) target population.

5.3.2 Reach and representativeness of settings

One in four studies reported on all elements of ‘reach and representativeness of settings’ (Table 5.3). Almost all studies provided details of the target setting for intervention delivery (92%); however, the remaining criteria were poorly described:

inclusion and exclusion criteria (21%), how settings were recruited/reached to participate in delivering the intervention (14%) (Table 5.2). Only one study reported the participation level among eligible sites (5%); this was also the case for the representativeness of setting(s) (4%).

5.3.3 Implementation and adaptation

No studies reported on all elements of this external validity dimension (Table 5.3). Most studies described the intervention characteristics (97%) and the characteristics and training of delivery agents (95%). Less described the time to deliver the intervention (65%), and intervention delivery and exposure (65%) (Table 5.2). Delivery agents' participation (11%), methods to recruit delivery agents (8%), fidelity assessment: treatment receipt (10%), and mechanisms for intervention effects (5%) were very poorly reported. Only five of the studies tested an intervention that was adapted from a previous trial - none reported on how the study intervention was similar or different to original efficacy studies.

5.3.4 Outcomes for decision making

No studies reported on all elements of 'outcomes for decision making' (Table 5.3). Almost all studies reported outcomes in a way that could be compared to either clinical targets or public health goals (92%) (Table 5.2). Less than half of studies reported whether they examined the occurrence of unintended consequences (46%). Only six studies reported the total costs of the intervention (15%); of these, four studies reported the cost of intervention components (67%), and three examined cost effectiveness (50%). Ten studies (26%) examined effect moderators by participant characteristics; however, none reported effect moderators by delivery agent/setting. Only one study (3%) reported a sensitivity analyses to assess dose-response effects of the intervention.

5.3.5 Maintenance / institutionalisation

Only one study – INSIGHT – reported on all elements of maintenance / institutionalisation (Table 5.3). Almost all studies (97%) reported on the number of

individuals dropping out and/or lost to follow up (Table 5.2). Data on attrition by condition or population sub-group reported by 90% of studies (Note: we took condition to mean by intervention or control group). Only 50% of studies addressed the representativeness of completers/dropouts. Half of studies (49%) reported data on longer term effects on health-related outcomes (at least 12 months following program implementation, or environmental or policy change). Only 10% of studies reported on the sustainability (or reinvention or evolution) or plans for sustainability of the intervention. Only 36% reported on the acceptability of the intervention by stakeholders.

Table 5.2 Number and percentage of studies reporting external validity elements[1]

External validity dimension	Definition	Studies reporting	
		Yes/Total[2]	%
Reach and representativeness of individuals			
Target population for generalizability	Is the intended target population acknowledged/stated (at the individual level) for which the findings intend to be generalised to?	38/39	97
Method to recruit target population	Was information provided about how the target population was recruited/reached (e.g., radio, newspaper, TV, school meeting)?	30/39	77
Inclusion or exclusion criteria	Were individual inclusion and exclusion criteria stated?	38/39	97
Enrolment rate	Is the enrolment rate or data needed to calculate the enrolment rate among individuals reported? Proportion of people who are eligible for participation who actually enrol in the study	26/39	67
Recruitment rate	Is the recruitment rate or data needed to calculate the recruitment rate among individuals reported? Proportion of potential participants (those invited or expressing interest) who actually enrol in the study	26/39	67
Representativeness of individuals	Are there comparisons between individuals who participated versus either (1) those who declined to participate or (2) target population?	10/39	26
Participant characteristics	Are all of the following reported: • Gender • Age • Any socioeconomic indicators (education, employment status, or income) • Participation by racial or ethnic minority groups	21/39	54
Reach and representativeness of settings			
Target setting	Is the target setting for intervention delivery stated (such as workplace, general practice, outpatient facilities, churches, etc.)?	35/38	92
Method to recruit setting	Is information provided about how the site(s) within a given setting were	4/28	14

	recruited/reached to participate in delivering the intervention?		
Inclusion or exclusion criteria	Were inclusion and exclusion criteria for selection of sites within a given setting stated? In the case of single sites, were the characteristics of the site described?	6/28	21
Participation rate	Is the participation level or data need to calculate the participation level among eligible sites reported (only applies to studies with more than one site)?	1/19	5
Representativeness of setting(s)	Are there comparisons between site(s) participating in the intervention and 1) those that decline to participate or 2) the target setting?	1/28	4
Implementation and adaptation			
Intervention characteristics	Were the intervention components described?	38/39	97
Intervention adaptation	Is information reported about how the study intervention is similar or different to original efficacy studies? Note: Only applicable to studies where an intervention is adapted from a previous trial	0/5	0
Time to deliver intervention described	Is the number and length of sessions or time required to deliver the intervention described?	24/37	65
Intervention delivery and exposure	Was the extent to which individuals were exposed to the intervention described? (e.g. proportion of planned intervention sessions actually attended (dose); content delivered as specified; provider adherence to intervention plan)	24/37	65
Delivery agents: characteristics and training	Is information provided on who delivered the intervention, such as the type of professional, or the amount of experience, skill or training required to deliver the intervention?	37/39	95
Methods to recruit delivery agents	Is information provided about how the delivery agents were identified/selected?	3/36	8
Delivery agents' participation	Is the participation level amongst delivery agents reported (% of delivery agents agreeing to participate)?	4/35	11
Fidelity assessment: treatment receipt	Is information reported about whether the program was received as	4/39	10

	intended? (e.g. degree to which the participants understood the intervention and/or ability to perform the intervention skills)		
Mechanisms for intervention effects	Was retrospective analysis conducted to identify the mediating variables through which the intervention achieved its effect?	2/39	5
Outcomes for decision making			
Outcomes that can be compared to standards	Are outcomes (at least one) reported in a way that can be compared to either clinical targets or public health goals?	36/39	92
Adverse consequences	Does the article report whether they examined the occurrence of unintended consequences?	18/39	46
Effect moderators by participant characteristics	Are there any analyses of moderator effects by subgroups of participants	10/39	26
Effect moderator by delivery agent/setting	Are there any analyses of moderator effects by delivery agents or settings	0/37	0
Dose response effect of intervention (sensitivity)	Are there sensitivity analyses to assess dose-response effects of the intervention?	1/39	3
Total costs of intervention	Are total costs of the intervention presented?	6/39	15
Cost of intervention components	If costs are presented, were the costs itemized by intervention components (e.g., personnel, equipment)?	4/6	67
Cost effectiveness	If costs are presented, was there any analysis done to assess cost-effectiveness or cost-benefit of the program or policy?	3/6	50
Maintenance / institutionalisation			
Long term effects (at least 12 months)[3]	Are data reported on longer term effects on health-related outcomes, at least 12 months following program implementation, or environmental or policy change?	19/39	49
Institutionalization: sustainability / plans for sustainability	Are data reported on the sustainability (or reinvention or evolution) or plans for sustainability of the intervention?	4/39	10
Attrition	Are data reported on the number of individuals dropping out and/or lost to follow up	38/39	97
Differential attrition (by condition or population sub-group)	Are data on attrition by condition or population sub-group reported?	35/39	90

Representativeness of completers/dropouts	Did the study report statistically significant differences in those that dropped out of treatment and those that finished?	19/38	50
Acceptability of the intervention by stakeholders	Was information provided about acceptability of the intervention by stakeholders?	14/39	36

Notes:
[1]Laws et al. (adapted from Green et al.)
[2]Total = the no. of overall studies (n=39) minus the no. of studies reporting not applicable to the relevant element
[3]In RE-AIM (Reach, Effectiveness, Adoption, Implementation, Maintenance), long-term results of intervention are defined as a minimum of six months following the last contact; long-term is defined as a minimum of 12 months by Laws et al.

Table 5.3 Number and percentage of studies reporting all elements of each dimension of external validity[1]

External validity dimension	No./Total[2]	%	Studies
Reach and representativeness of participants	6/39	15	NOURISH, PRIMROSE, Baby Milk Trial, INSIGHT, BLISS, POI
Reach and representativeness of settings	9/38	24	ProKind, Baby Milk Trial, Minding the Baby, SLIMTIME, INSIGHT, BLISS, POI, Healthy MOMS, Healthy Beginnings
Implementation and adaptation	0/39	0	None
Outcomes for decision making	0/39	0	None
Maintenance / institutionalisation	1/39	3	INSIGHT

Notes:
[1]Laws et al. (adapted from Green et al.)
[2]No. taken as sum of no. of studies reporting yes or not applicable to each of the element. Total excludes any studies for which the external validity criterion was not applicable (e.g. Grow2Gether was a social media intervention therefore 'research and representativeness of settings' criterion was not applicable).

5.4 Discussion

Early life interventions delivered by health professionals have the potential to influence important health behaviours, in addition to child weight. Understanding the reporting of external validity of such interventions is vital to address their potential for translation and scalability, as well as replication efforts. In this systematic review

we identified 39 studies, representing 46 interventions. External validity elements that were generally well reported included target populations and settings, participant inclusion and exclusion criteria, intervention characteristics, delivery agents, outcomes, and attrition. Similar to other reviews of childhood obesity interventions (Klesges et al., 2008; Laws et al., 2014), however, we identified important gaps in the reporting of external validity elements within studies, and factors that could enhance translation and scale-up of interventions across all five external validity dimensions. External validity elements that were poorly reported included: representativeness of individuals and settings, treatment receipt, intervention mechanisms and moderators, cost effectiveness, and intervention sustainability and acceptability.

Key gaps in informing the translation and scalability of health professional-delivered early life obesity prevention interventions were identified in this review. These included understanding the representativeness of settings, and whether these settings and delivery agents could be engaged to deliver these types of interventions in a sustained way, in a way that is acceptable to those involved. This is especially important given that only 16 of the 46 interventions (35%) in this review were clearly delivered as part of routine care, with a further two partly delivered as such, i.e. contacts as part of routine care but additional contacts also (Starting Early (Gross et al., 2016) and STRIP (Niinikoski et al., 2007)). The focus of the majority of studies was on establishing efficacy rather than effectiveness or how such interventions could be scaled up and translated into routine practice. This may account for the poor reporting of external validity in relation to settings and delivery agents. It could be argued that efficacy trials should not be held to the same level of accountability regarding reporting of external validity elements. Such information however is important regardless of trial type, not only to inform generalisability, but also to enhance understanding of the active ingredients of interventions and core components to retain in effectiveness trials or the scale-up of interventions.

Reporting of external validity elements considered important to inform decision-makers was generally poor also. This included cost and cost-effectiveness measures, and an understanding of the intervention mechanisms and dose-response effects. While most interventions that are scaled up need to be adapted to fit the delivery context, knowing information about dose-response and the mechanism of

intervention effects is essential in informing adaptions so that effectiveness of the intervention is not lost. The recent systematic review by McCrabb and colleagues highlights the decreased intervention effects when obesity interventions are scaled up – they found that effects on weight status, physical activity/sedentary behaviour, and nutrition reported in scaled-up interventions were typically 75% or less of the effects reported in pre–scale-up efficacy trials (McCrabb et al., 2019). Reporting of fidelity components in our review was also varied – training (95%), delivery (65%), and receipt (10%). This has been noted in other childhood obesity-related reviews (JaKa et al., 2016; Toomey et al., 2019), and has important implications for the interpretation, as well as the generalisability, of study findings.

Despite calls for greater attention to external validity for almost 40 years now (Glasgow et al., 2006; Huebschmann, Leavitt, & Glasgow, 2019; Klesges, Dzewaltowski, & Christensen, 2006; Rothwell, 2005), we noted that problems with attention to generalisability persist. Only one trial within this review, the INSIGHT trial (Paul et al., 2018), reported on all elements of the external validity assessment tool developed by RL (Laws et al., 2014; Laws et al., 2012). Earlier this year, Huebschmann and colleagues made a further call for increased attention to external validity (Huebschmann et al., 2019). For trialists, there is a tension between internal validity and external validity, with preference historically for ensuring the former and minimising the risk of bias, at the expense of generalisability and applicability to real-world settings. Standard reporting guidelines such as the CONSORT statement for the reporting of randomized controlled trials (Schulz, Altman, & Moher, 2010), the CONSORT extension for cluster trials (Campbell, Piaggio, Elbourne, & Altman, 2012) and the CONSORT extension for pragmatic trials (Zwarenstein et al., 2008) traditionally focus on internal validity elements, with limited focus and guidance around external validity. The TIDieR reporting guidelines for intervention description and replication somewhat address this gap (Hoffmann et al., 2014).

We acknowledge the challenging context in which triallists work and that there are many positive activities in this area. We have a number of suggestions for moving work in this area forward nevertheless. Triallists could plan their interventions with scalability and sustainability in mind, giving due consideration to the type of trial conducted as well as the intervention characteristics. Few researchers plan for the sustainability of their interventions (Johnson et al., 2019). The

aforementioned reporting guidelines can be used in combination to report on study findings, with additional materials published to enhance external validity assessment, including protocols and more detailed information made accessible via supplementary materials or open access repositories. Researchers could also use models such as RE-AIM to guide reporting of external validity elements. If researchers used RE-AIM as a planning tool when designing their intervention and evaluation, this might also overcome some of the difficulties in reporting RE-AIM components relevant to external validity. Glasgow and Estabrooks note the challenges in comprehensively reporting on all RE-AIM dimensions within community and clinical settings with limited resources, however, highlighting that even well-funded NIH grants and published research studies, stating use of the RE-AIM framework, only employ it partially, and inconsistently when they do so (Glasgow & Estabrooks, 2018). Inconsistencies in the degree to which authors report each RE-AIM dimension in its entirety as well as inaccuracies in reporting elements within each dimension have been highlighted by other authors also (Harden et al., 2015; Kessler et al., 2013). Further work is needed with researchers to embed such frameworks appropriately. As mentioned above, increasing the availability of protocols and more detailed information via supplementary materials or open access repositories is one such step. Research to understand the facilitators and barriers to reporting elements of external validity, as well as work with stakeholders to prioritise the most important elements/dimensions of external validity reporting would be useful to enhance work in this area. A recently published tool on assessment of scalability contains several elements relevant to external validity assessment (Milat et al., 2019). These include: costs and cost effectiveness, intervention characteristics, information on delivery agents, participation rate of settings, outcomes that can be compared to standards, effect moderators, adverse consequences, and acceptability. Such elements should be prioritised by researchers in planning studies and reporting findings.

Funding bodies, review panels, journals/journal editorial boards, and policymakers could also take action to promote the integration of external validity considerations into the funding, design, conduct, reporting, synthesis and translation of research (Glasgow et al., 2004; Green, Glasgow, Atkins, & Stange, 2009; Huebschmann et al., 2019; Rothwell, 2005). This need not be at the expense of

internal validity, and can help facilitate credible research and knowledge translation (Green et al., 2009; Huebschmann et al., 2019). The inclusion of a PRECIS-2 graphic when proposing or reporting on a study can also be undertaken to enable the assessment of external validity (Huebschmann et al., 2019).

5.4.1 Strengths and limitations

The strengths of this work are the use of a comprehensive and rigorous methodology, including a broad search strategy and range of databases, no language restrictions, and the screening of trials and extraction of data by two independent review authors. A number of limitations, however, must be noted. While we included journal articles, protocols, grey literature and supplementary materials, it is possible that researchers of the reviewed studies may have collected some of the information required to complete the external validity assessment but did not report it in the articles published to date. Furthermore, the external validity tool only codes items as present, absent, or not applicable. The extent, or quality, to which the studies report on the various external validity elements, e.g. fidelity, is not assessed; this may result in an over-estimation of the reporting quality of some studies. While it is not necessary for all studies to be strong on all of the external validity criterion, researchers, decision-makers and others could use this information, if provided, to make judgments as to the applicability or generalisability of a study or review (Glasgow et al., 2006).

5.4.2 Conclusion

This review examined the reporting of external validity elements within 39 studies encompassing 46 early-life health professional-delivered interventions. While such interventions have the potential to influence important health behaviours, in addition to child weight, we identified important gaps in the reporting of external validity elements within studies, and factors that could enhance translation and scale-up of interventions across all five external validity dimensions. External validity elements that were poorly described included: representativeness of individuals and settings, treatment receipt, intervention mechanisms and moderators, cost effectiveness, and intervention sustainability and acceptability. More emphasis is

needed on research designs that consider generalisability, and the reporting of external validity elements in early life childhood obesity prevention interventions.

5.5 Data availability

Underlying data

All data underlying the results are available as part of the article and no additional source data are required.

Extended data

Open Science Framework: Health professional-delivered obesity prevention interventions during the first 1,000 days: A systematic review of external validity reporting. https://doi.org/10.17605/OSF.IO/G2ZMY (Hennessy, Heary, et al., 2019b)

This contains the following underlying data:

- SearchStrategy_v1_HealthProfessional-deliveredObesityPreventionF1D.pdf (Search strategy)
- DataExtractionForm_v3_HealthProfessional-deliveredObesityPreventionF1D.pdf (Data extraction form)
- InterventionDescriptions_v7_HealthProfessional-deliveredObesityPreventionF1D.xlsx (Intervention descriptions)
- InterventionOutcomes_v5_HealthProfessional-deliveredObesityPreventionF1D.xlsx (Intervention outcomes)
- FullDetailsofExternalValidityAssessments_v2_HealthProfessional-deliveredObesityPreventionF1D.pdf (Full details of external validity assessments)
- SummaryTable-ExternalValidity-ByStudy_v3_HealthProfessional-deliveredObesityPreventionF1D.xlsx (Summary table of external validity assessments by study)

5.6 Reporting guidelines

Open Science Framework: PRISMA checklist for 'Health professional-delivered obesity prevention interventions during the first 1,000 days: A systematic review of external validity reporting'. https://doi.org/10.17605/OSF.IO/G2ZMY (Hennessy, Heary, et al., 2019b)

5.7 Author contributions

Marita Hennessy: Conceptualisation; Data Curation; Formal Analysis; Funding Acquisition; Investigation; Methodology; Project Administration; Writing – Original Draft Preparation; Writing – Review & Editing

Caroline Heary: Conceptualisation; Supervision; Writing – Review & Editing

Rachel Laws: Conceptualisation; Investigation; Supervision; Writing – Review & Editing

Luke Van Rhoon: Investigation; Writing – Review & Editing

Elaine Toomey: Investigation; Writing – Review & Editing

Hazel Wolstenholme: Investigation; Writing – Review & Editing

Molly Byrne: Conceptualisation; Supervision; Writing – Review & Editing

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5.9 Competing interests

No competing interests were disclosed.

5.10 Grant information

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Chapter 6 "They just need to come down a little bit to your level": A qualitative study of parents' views and experiences of early life interventions to promote healthy growth and associated behaviours

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Note: Additional information for this chapter is available in Appendix 5.

Abstract

Background: The first 1,000 days – the period between conception and a child's second birthday – is a critical window of opportunity to promote healthy growth and associated behaviours. Health professionals can play an important role in part due to the large number of routine contacts they have with parents. There is an absence of published research on the views of parents towards obesity prevention, and the range of associated behaviours during this time period. This study aimed to elicit parents' views on early life interventions to promote healthy growth/prevent childhood obesity, particularly those delivered by health professionals.

Methods: Semi-structured interviews were conducted with 29 parents (24 mothers, 5 fathers) who were resident in Ireland and had at least one child aged under 30 months. Participants were recruited through community groups and social media. Interviews were audio-recorded, transcribed verbatim, and data analysed using reflexive thematic analysis.

Results: Two central themes were generated from the data: (1) Navigating the uncertainty, stress, worries, and challenges of parenting whilst under scrutiny, and (2) Accessing support in the broader system. Becoming a parent brings challenges relating to balancing various roles, lack of knowledge and/or confidence in their parenting role, and feeling judged for their parenting/feeding decisions. Over time, with support, and/or with subsequent children, parents report becoming more confident. While parents require support, however, they face barriers to accessing and engaging with services. They are also often on the receiving end of uninformed, conflicting, confusing, changing and/or unsolicited advice. Relationships and relatability with those providing information/support are key (be they health professionals or others), and information and support needs to be tailored to parents' needs.

Conclusions: Parents are receptive to, and would welcome, support during this critical time period; particularly around feeding. Such support, however, needs to be practical, realistic, evidence-based, timely, accessible, non-judgemental, and from trusted sources, including both health professionals and peers. Various levels of support and intervention are required, at individual, inter-personal, organisational, community, and policy levels. Interventions to promote healthy growth and related

behaviours need to be developed and implemented in a way that supports parents, their views and circumstances.

Keywords: childhood obesity, prevention, parent, qualitative, interview, thematic analysis, infant feeding, intervention, pregnancy, infancy

6.1 Background

The first 1,000 days - the period from conception to a child's second birthday - is a critical window of opportunity to promote the health of women and their children (Birch & Doub, 2014; Farpour-Lambert et al., 2018). Early life environmental conditions set the foundations for health states in later childhood and adulthood (Gluckman, Buklijas, & Hanson, 2016). Eating and physical (in)activity-related habits, behaviours and patterns are established during the first two years of a child's life (Birch & Doub, 2014; Cashdan, 1994; Cooke, 2007), which track into later childhood and young adulthood (Craigie et al., 2011; Nicklaus et al., 2005; Reidy et al., 2017; Skinner et al., 2002). Parents play a key role in the healthy growth and development of their children, especially during the early years when children are dependent on them for a range of needs including nutrition and care (Golan & Crow, 2004; Lindsay et al., 2006).

Early life factors – such as high maternal pre-pregnancy weight, smoking during pregnancy, high infant birth weight and rapid weight gain, infant feeding mode, and the early introduction of solid foods – are associated with the development of childhood overweight/obesity (Monasta et al., 2010; Weng et al., 2012; Woo Baidal et al., 2016) and amenable to intervention during this period. Interventions that can be embedded into ongoing practice and existing systems are needed (World Health Organisation, 2016a). How to integrate obesity prevention into existing service structures was identified as the fifth most important priority for childhood obesity prevention research (Hennessy, Byrne, et al., 2019).

Parents have regular contact with health professionals during pregnancy and the first two years of life as part of routine health visits (World Health Organisation, 2016a). Early life childhood obesity prevention interventions delivered by health professionals show some evidence of effectiveness, particularly in relation to

behavioural outcomes (Hennessy, Heary, et al., 2019a). The acceptability of such interventions by parents and health professionals is poorly reported (Hennessy, Heary, et al., 2019c). Research is required to understand how to support and engage parents, and how to support practitioners to support parents (Hennessy, Byrne, et al., 2019).

To date, research has examined parents' views of interventions around discrete behaviours or topics (Appleton, Laws, et al., 2018; Heslehurst et al., 2017; Holton et al., 2017; Nikolopoulos et al., 2017; Redsell et al., 2010; Russell et al., 2016; Tully et al., 2019; Whelan & Kearney, 2015), often focusing on the views of primiparous mothers. Limited attention has been paid to parents' overall perceptions of interventions to promote healthy growth, as well as specific topics such as active play/physical activity and sedentary behaviour. Much existing research has tended to focus on pre-school aged children and older (O'Kane et al., 2018; Penilla, Tschann, Sanchez-Vaznaugh, Flores, & Ozer, 2017). That said, one study has, however, explored parental views of obesity risk identification during infancy, finding that while parents find it acceptable, they also experience high levels of parental responsibility, fear of judgement and self-blame (Bentley et al., 2017; Rose et al., 2019).

This study aims to address current gaps in the literature by examining parents' views of early life interventions to promote healthy growth and/or prevent obesity and those delivered by health professionals in particular. We defined intervention broadly as any advice, help or support regarding a child's weight and/or growth, and associated behaviours, from any source, whether solicited or unsolicited. Findings will aid the development and/or adaptation of early life interventions to promote healthy growth.

6.2 Methods

6.2.1 Design and study setting

Face-to-face, semi-structured interviews were conducted. The philosophical underpinnings of this research combined constructivist ontology with interpretivist epistemology, with the aim of providing insight into participants' constructions of reality and the ways in which such constructions are socially and culturally situated.

Ethical approval was granted by the NUI Galway Research Ethics Committee (Ref: 17-May-08). The Standards for Reporting Qualitative Research were followed in writing this paper (O'Brien et al., 2014) (See Additional File 1).

A Parent Advisory Group (three mothers, one father) reviewed and refined the study protocol, and study materials (available on OSF (Hennessy, Byrne, Laws, & Heary, 2020)).

This study was conducted in Ireland, where over 60,000 babies are born annually (Healthcare Pricing Office, 2018). Women ordinarily resident in Ireland are entitled to free maternity care (Health Service Executive, 2018e); care is also available privately, and postnatal care is provided to all women. There are 25 routine contacts between parents and the health service between conception and a child's second birthday. See Additional File 2 for further context.

6.2.2 Participants and recruitment

We included parents and/or primary caregivers of children aged under 30 months living in Ireland. Parents were purposively recruited, on a range of criteria, to ensure variety in the sample: mothers/fathers; socio-economic backgrounds; prima/multi-parous parents; parents whose babies were breast-/formula-fed; location – urban/rural; ethnic/cultural backgrounds; body mass index (BMI). This information was captured in a brief demographic questionnaire administered to participants before each interview. Participants were asked to self-report their height and weight, and BMI was calculated.

Participants were recruited through community groups (e.g. Mother and Toddler Groups; groups that target fathers/men) and social media. Gatekeepers in community groups provided a copy of the information sheet and consent form to potential participants. Parents were asked to make contact with the lead researcher if interested in participating, or if they required more information. Upon agreeing to take part, participants completed a consent form, and a suitable time and location for the interview was agreed.

6.2.3 Conduct of interviews

Interviews were conducted by MH, a 38-year-old female, experienced in public health and health services research, who was neither a parent/ever pregnant. An interview guide (Additional File 3) included questions on: views of childhood obesity and perceived importance of the issue and healthy infant growth; understanding of behaviours associated with healthy growth; experiences around infant growth and associated behaviours; views about interventions to prevent childhood obesity/promote healthy growth – particularly those delivered by health professionals. The interview guide was piloted with a mother and father, following review by the Parent Advisory Group; no amendments were necessary and both pilot interviews were included in the analysis. Interviews lasted between 45 minutes and 2.5 hours. They were digitally recorded, and following each interview, participants were provided with a document outlining sources of information and support, and a copy of the signed consent form. The interviewer also made detailed field notes.

We deemed that sufficient sampling occurred when the major categories showed depth and variation in terms of their development. We focused on achieving a high level of 'information power' (i.e. the more information the sample holds, a lower number of participants is needed) rather than 'saturation', which is incompatible with reflexive thematic analysis (Virginia Braun & Victoria Clarke, 2019b).

6.2.4 Analysis

Interview audio recordings were transcribed verbatim, checked for accuracy, and de-identified. Transcripts were imported into NVivo (QSR International Pty Ltd. Version 11, 2015) and data analysed using reflexive thematic analysis (Braun & Clarke, 2006, 2013). MH read and re-read, and then coded each transcript, and subsequently examined the codes and collated data to identify potential themes, in discussion with CH, MB and RL – all parents of young children. MH then checked and refined the candidate themes against the dataset before developing a detailed analysis of each theme and deciding on an informative name for each. To enhance the rigour and credibility of the findings we interviewed mothers and fathers purposively to get as complete a picture as possible of views and experiences of

parents. We also engaged in peer debriefing as a study team, maintained an audit trail through comprehensive notes, and provide thick description of the context and findings.

6.3 Results

We interviewed 24 mothers and 5 fathers, with infants/children ranging in age from 7 weeks to 25 months, with two of the interviewees also being pregnant at the time of interview. Participant characteristics are outlined in Table 6.1.

Table 6.1 Participant characteristics

Relationship to child	Mother (n=24), father (n=5)
Age range	<25y (n=1), 25-30 (n=2), 31-39 (n=21), 40+ (n=5)
Marital status	Married (n=23), co-habiting (6)
Parity	1st child (n=14), 2nd/subsequent child (n=15)
Age of infants*	7 weeks to 25 months
Feeding mode*	All tried breastfeeding (1h – 24+ months); 25 exclusively breastfed (8w – 6 months; Average = 5 months, with some babies <6 months still being breastfed)
Parent BMI range	<18.5 (n=1), 18.5-24.9 (n=15), 25.0-29.9 (n=12), ≥30 (n=1)
Parent born in Ireland	Yes (n=23), no (n=6)
Ethnicity	White Irish (n=25), other (n = 4)
Highest level of education	Secondary school (n=3), post-secondary technical qualification (n=2), degree (n=6), postgraduate (n=18)
Employment status	Currently on maternity leave (n=11), employee (n=14), self-employed/unemployed/other (n = 4)

*Most recent child, if parent of more than one child

Two central themes, with several sub-themes, were generated from the data: (1) Navigating the uncertainty, stress, worries, and challenges of parenting under scrutiny and (2) Accessing support in the broader system.

6.3.1 Theme 1: Navigating the uncertainty, stress, worries, and challenges of parenting under scrutiny

This theme describes the challenges parents experienced in navigating this stage of life. New parents felt vulnerable, full of uncertainty, and experienced stress and worry as a result. This was compounded by both felt and perceived judgement, stigma and guilt in relation to their parenting. Most spoke about the challenges of parenting and trying to maintain balance between caring for their child(ren), work and other commitments. All of this influenced their need for support, and their ability to access information and support, but also to put it into practice. With growing experience, parents' confidence increased.

Sub-theme 1.1: Finding your way around in the dark

Almost all participants spoke about how parents experienced various stresses relating to their parenting role. Some highlighted how mothers are particularly vulnerable in the early postnatal period. Many mentioned their lack of knowledge as a first-time parent, but also particularly on breastfeeding and introducing solids. Most felt it was important to know what to expect and be prepared when it came to breastfeeding, and, to a lesser extent, child weight and general parenting. Some stated that they had felt well prepared antenatally: *"…one of the best things in that group was the whole understanding and expectation that you may not find it easy or any way doable to breastfeed for the first two or three or four days."* (D04). Others, however, felt that they did not know what to expect, one saying *"it's like you're finding your way around in the dark"* (D01).

While many felt that breastfeeding was often perceived as 'easy', the reality, initially at least, was quite different, and stressful. Various challenges were experienced: getting breastfeeding established, physiological problems, and knowing that their baby was getting enough milk and gaining sufficient weight. Many described how they persevered with breastfeeding, or with other aspects of child feeding (e.g. introducing solids/baby led weaning) to a lesser extent. For the majority, when they saw the outcomes of their efforts, it gave them confidence in their ability/decision. Many spoke of the pride they felt when their babies were doing well as a result of their efforts. For some, however, particularly in instances where a

baby's weight needed to increase, they had to let go of their desire to exclusively breastfeed.

Most participants had concerns about their child's weight/growth at one point or another, particularly insufficient weight gain. Some spoke about the stress associated with weight and/or developmental checks, especially if their child had an issue identified, and questioned their parenting ability: *"…I was just making sure, trying to make sure that we were feeding her enough and that she would have enough. So I was a bit anxious about the midwives' visit to weigh her*." (M13). A few spoke about becoming unnecessarily 'obsessed' about weighing their children. Other concerns centred on infant's sleep, fear around giving birth, and generally 'keeping them alive'.

Most parents highlighted the importance of early intervention and parental support: *"If you can give them the support and information early on, in their pregnancy, and that you start building those layers of confidence…*" (M04); with some noting that parents with less resources may require additional support.

Sub-theme 1.2: Felt and enacted judgement, stigma and guilt

Judgement, or fear of being judged by others, was experienced by almost all participants – especially in relation to infant feeding issues, and parenting more generally. This impacted on their views and experiences, particularly in terms of who they discussed issues with/sought advice and support from, with many negative encounters with health professionals, peers, and family members relayed.

Participants spoke about maternal feelings of guilt or shame around infant feeding/parenting. Discussions often centred on the breastfeeding versus formula-feeding 'divide', and feelings of guilt or shame if women could not meet their breastfeeding goals, with decisions to breastfeed for an extended period/follow baby-led weaning less frequently mentioned. Some spoke about negative relationships with, or support from, their own mothers or other women, particularly if these women had not breastfed/met their own breastfeeding goals. Many felt that:

You breastfeed and you get like flack for it, or you're defending yourself or you're covering yourself up. Or… you don't breastfeed, and you're giving a bottle to your child… there's just so much guilt and shame and judgement around so many different things with parenting. (M16).

Participants also mentioned comments from others around child size/weight and felt that parents were often, or could be, judged by others if their child had a weight issue.

Some participants spoke about judgement experienced – directly or indirectly – in online forums, particularly in relation to infant feeding. Some were cautious of online forums, and just 'lurked', and while the pros outweighed the cons for some, others stopped using them altogether. The importance of a supportive, open and inclusive environment within in-person groups was also mentioned by some participants. This included breastfeeding support groups that permitted those who didn't exclusively breastfeed to participate: *"Some people were expressing and some people were doing half formula half breastfeeding. And that just led to much more, being able to talk about what's hard about it. And that actually makes you breastfeed longer."* (M12).

Some parents felt that their parenting skills would be judged by others if they sought support because *"when you're a first-time mum, you put a lot of pressure on yourself…You feel like you can't ask for help because then everyone will think you're useless"* (M17). Many spoke about instances where they did not disclose or tell the truth about certain issues *'for an easy life'* (M01) or fear of judgement: *"you think, they're going to get me locked up. They're going to take my baby away."* (M04). This could be in relation to infant feeding (practices/experiences, or not following advice to top-up with formula) primarily, or infant sleep and activity during pregnancy, for example.

Some felt that how breastfeeding is promoted/discussed led to judgement, stigma, shame or guilt. Some participants spoke of interactions with those who had strict or 'militant' views about breastfeeding: *"…it's great that there's movement towards trying to encourage it, but (.) some people take that to the extreme."* (M03). There was a general feeling that *"they [haven't] really cracked it yet, how to talk*

about breastfeeding." (M15). Participants noted that while *"Breastfeeding is promoted…they're not doing anything to support it."* (M13), citing societal, cultural and economic reasons which shaped attitudes and norms around infant feeding and child growth, and undermined women's beliefs in their ability to feed their babies. The need for more support for breastfeeding was stressed by many – to make it *'more normal'* (M16), and to provide more practical supports to mothers/parents, including around enabling them to make informed infant feeding decisions. Participants viewed exposure to breastfeeding, and positive support received, as enablers.

The majority stressed the importance of non-judgemental, positive, and reassuring information and support, and that a *"wider cultural shift [is needed]….I think we need to be much more supportive of parents in general."* (M02). This was primarily in relation to breastfeeding (but also child growth/development, child feeding and sleep), and from health professionals and peers/friends. They valued the confidence boost it provided, often by confirming that the issues they were experiencing were 'normal' and/or that they were doing a good job.

Sub-theme 1.3: Increasing confidence and learning to trust your instincts

Most parents relayed how their confidence grew with support and time/experience. Some spoke specifically about how their confidence increased as they grew into their parenting role: *"We're a lot more confident in everything we do with [Niall], you know what I mean, compare to poor little [Rosie] who was like our first and we stressed about everything"* (M17). Many highlighted how learning what was 'normal' for babies (e.g. in relation to their size, feeding, sleep), while acknowledging that all babies are different (even within families), and finding or accepting their own normal, was important. Many spoke about the need for parents to trust their own judgement, and 'go with their guts' or instincts, sometimes citing that they don't, but over time learn to trust them more. A few parents spoke about not asking questions, particularly as a first-time parent, and how they would ask if they were in similar situations again.

Some participants spoke about being 'less wound up' on subsequent pregnancies – not worrying about things as much (or having the time to) and/or

doing as much information seeking. Some highlighted that increased knowledge/confidence meant that they did not need or rely on such support on subsequent pregnancies, some mentioned that health professionals held less power, while others stated that people just 'leave you at it':

> *…for first time mums there's so much interfering and advice giving and shoving it down your throat. And it's just such an anxious time already because you don't know what to do… Whereas the second time people go oh yeah look she knows what she's doing and they leave you at it, and EVERYTHING is easier.* (M02)

6.3.2 Theme 2: Accessing support in the broader system

Theme 2 describes how parents navigated and accessed supports in the broader system. They had a range of sources, with health professionals (during routine contacts and antenatal classes primarily), peers/family, online, fathers and 'own research' most often mentioned. Health professionals encountered included general practitioners (GPs), midwives, public health nurses (PHNs), lactation consultants, and, to a lesser extent obstetricians, pediatricians, and practice nurses. Parents primarily recalled discussions with health professionals around infant/child feeding, as well as child growth assessments, with tummy time also frequently mentioned; other topics received less attention and often only took place when parents brought them up. Further details are provided in Additional File 4.

Parents highlighted structural, inter-personal and personal barriers and facilitators to accessing support. Health professional support was often perceived difficult to access. Parents appreciated the accessibility of online peer support. Levels of trust varied in information sources. Parents were often in receipt of lots of advice from different sources, which was often unhelpful if not clear and tailored to their needs. Relationships and relatability were highly valued. Resultantly, parents valued a combination of both professional and peer support.

Sub-theme 2.1: Ability to access and engage with supports/services

Most participants spoke about the importance of being able to access and/or engage with services and supports, especially when you needed them. There were mixed reports about the difficulty (or ease) in getting appointments with health professionals. Lack of access to lactation consultants in hospital was a significant issue: *"one lactation consultant who does the whole of [Maternity Hospital 3], which is not enough."* (M07). Difficulties accessing other breastfeeding supports, lack of choice in what health professionals (e.g. PHN) you get to see, and delays in between PHN checks or falling through the system were also highlighted. Many felt that services and health professionals (especially midwives, GPs and PHNs) were 'stretched', which impacted on availability of health professionals, as well as time available to discuss issues and provide support, primarily around breastfeeding. Some women reported feeling *'on the clock'* during appointments, and that interactions lacked meaningful engagement: *"… at every appointment they have a little blurb that they have to say that they explained X Y and Z to you, like breastfeeding's best for baby…… They tick their box and they hand you the leaflet…"* (M01). Similar was reported in relation to developmental checks, seen merely as *"a tick-box exercise to see is your child progressing against certain milestones"*. (M08)

Many participants spoke about having to access supports privately, particularly for lactation consultants, tongue tie releases, and/or, to a lesser extent, antenatal classes. The majority had accessed such private supports but noted the cost implications (though some could claim back from private health insurer), and how this was not possible for everyone.

Being able to contact PHNs, lactation consultants and peer breastfeeding supports by phone (call/text) with any queries was mentioned positively by several participants. Some also spoke about the benefits of the internet for its 24/7 support, particularly in relation to breastfeeding. The ability to have opportunistic discussions with PHNs at peer support groups was valued by some.

Many participants spoke about doing their own research to supplement (and sometimes check) information from other sources and/or to find alternatives that would work for them: *"…they'll give you some [information] and then I feel like it*

was up to me to go off and find out more." (M17). Many also spoke about the importance of being able to ask questions, particularly in relation to being able to engage with a health professional, ask them questions, or challenge their advice. The need and ability to judge the quality of information received was also stressed.

Sub-theme 2.2: Relationships and relatability are key

Many highlighted the importance of continuity of care and support, primarily in relation to health professionals; this facilitated trust and relationship building – which wasn't the experience for many. Those on homebirth, DOMINO or Early Transfer Home schemes (see explanations in Additional File 1) generally reported positive experiences in this regard, as did those who had extra contact with health services, e.g. due to gestational diabetes: *"She [community midwife] knew me. She knew the history with me and the birth, everything. I wasn't talking to another random stranger."* (M09). A few participants spoke about the importance of contacts made during the antenatal period (e.g. during classes) which extended postnatally and *"it meant that I had a contact for when I was postnatal and things weren't going particularly well."* (M11).

Participants had mixed levels of trust in health professionals, within and across disciplines. While some noted that as a first-time parent you have total faith in health professionals and 'go with what they say', this trust sometimes waned. This could be due to negative experiences such as feeling unsupported during encounters and/or receiving (perceived) incorrect or conflicting advice, including inaction or mis- or late diagnoses (e.g. in relation to tongue-tie and allergies/intolerances). This often left parents seeing that *"they are just people with just information, and they don't necessarily have all the answers.*" (M02). Some participants spoke about trusting peers and/or friends or family, sometimes more than health professionals: *"they get where you're coming from so then you tend to believe them more."* (M18), or a perception that health professionals *"can deal with the normal stuff, but they can't deal with anything outside the realm of normal"* (M02). Others reported trusting health professionals more than information received through online forums. The majority stressed the need for a mix of information sources.

Social support (or lack thereof), encompassing emotional, informational and practical support, from peers and/or family members was discussed by all participants. Face-to-face peer support groups (as well as online, e.g. for breastfeeding and baby led weaning) were generally highly regarded, as you could *"…see how other people are getting on and how are you getting on… you're all in the same boat"* (M09). Peer support via WhatsApp, text or phone call was also mentioned and valued.

Many participants (mothers and fathers) stressed the importance of dads as a source of practical and emotional support for mothers, particularly around breastfeeding. Some noted that fathers might not be as supportive when difficulties were encountered (instead placing emphasis on the needs/health of the mother), or when babies were breastfed for an extended period. Some highlighted the need to and/or value of engaging dads and also the role they play in their children's lives. Despite this, three of the participant fathers spoke about feeling undermined/patronised by health professionals: *"they treat you like you're a bit thick you know. And you're kind of, no I'm actually mad into this"* (D02).

Most parents stressed the value of support from someone that understands, with experience and who could empathise, as *"they've had kids themselves, so they understand, you know, that not everything is going to happen by the book"* (M03). Many spoke about reassurance received from health professionals, primarily around their child's growth at checks but also in relation to gestational weight gain or child feeding. Some spoke about the importance of health professionals listening to, and being respectful of, parents. A few participants spoke about the need for health professionals to see the 'bigger picture' (e.g. patterns of growth, rather than once-off assessments), and also respect parents views and wishes, particularly in relation to developmental checks/growth assessment. Some felt that PHNs took a narrow view and needed to *"come down a little bit to your level"* (M16), whereas GPs took more account of context: *"[GP] had no issue [with the child's growth] because he knew more of the background I guess of the family".* (M22). Some also felt that midwives provided more holistic care to both mother and baby compared to other health professionals, and *"… always really human and just asking well how are YOU doing."* (M12).

Sub-theme 2.3: Everyone has an opinion

Almost all participants described instances where they were on the receiving end of unhelpful attitudes, advice, and support or pressure to engage in certain practices, from a wide range of sources, and whether sought or not. Again, much of this centred around infant feeding, and breastfeeding in particular. Participants highlighted the value of clear communication from health professionals and the importance of consistent messaging/advice between different health professionals and/or other information and support sources.

Conflicting, unclear or inconsistent advice, from health professionals was often reported. This was primarily in relation to infant/child feeding, for example, *"…they were trying to encourage her [sister-in-law] to get to six months [before introducing solids], but they were telling me it was okay from four months…"* (M01). The internet was also a place where *"you'd see conflicting things. Often it's people's opinions."* (M03).

Parents voiced concern that while health professionals promoted breastfeeding, they were quick to offer formula. Pressure to give a breastfed baby formula was frequently mentioned, especially in relation to the early postnatal period in hospital, with formula top-ups arising from concerns about weight loss, as well as perceived widespread availability and unprompted provision of formula:

> *hospitals need to be less pushy with their formula……And I didn't get any support on that either you know as in like there was no expressing equipment or anything like that, so it was just you know a case of do you want a bottle, do you want a bottle…And then even when we were leaving the hospital they gave us a box of bottles.* (M10).

Health professionals were seen to prioritise weight over breastfeeding:

…one of the most stressful things is those four or five weeks after you give birth, where the first, Jesus like if you're baby doesn't make their weight back up in the first ten days, God help you… (M18)

Lack of support from family members around breastfeeding was also raised, as was unsolicited advice from members of the public: *"... the hardest thing that I've found about being a parent, is everybody else."* (M07).

Some participants felt that they received no new, useful, or relevant information, during contacts with health professionals or via online/printed resources. More tailored approaches were suggested: "*general information probably doesn't work so well with me. It's like people actually figuring out what's YOUR specific issue and solving that."* (M11). Many participants spoke about lack of knowledge or skills amongst all categories of health professionals, particularly concerning breastfeeding, and child growth patterns. Many spoke about the need for health professionals, particularly GPs and PHNs, to be more pro-active in providing support and/or raising issues – even if could be hard for parents to hear, particularly in relation to a mother's weight and related behaviours, or a child's weight/growth. Some, however, felt that if there was an issue their health professional would raise it (particularly around weight). Some felt that health professionals required more education/training to be able to raise and/or discuss issues, and keep up-to-date, particularly around infant feeding and especially baby led weaning.

Sub-theme 2.4: Information and support that meets parents where they are at

Most parents stressed the need for information to be practical and realistic, with some mentioning that they didn't follow advice 'to the letter' if this wasn't the case. They also welcomed being shown how to do things. Practical support in relation to breastfeeding, particularly in hospital to get it established or from lactation consultants, was highly valued. Such demonstration of behaviours was also appreciated in relation to hands-on activities in antenatal classes and weaning workshops, or during routine checks (by health professionals demonstrating behaviours, and/or providing resources/leaflets which did). Videos were also popular, especially amongst fathers. Participants also liked guidance to be clear, not too directive, and that they could adapt to their own situation. Some spoke about how some antenatal classes engaged fathers really well, with some also noting how they and/or their partners were highly engaged when information around the science of breastfeeding was presented.

Most participants highlighted the value of timely information and support. They also expressed a preference for a staged approach to information provision, rather than receiving lots in one go: this involved receiving information specific to a child's developmental stage/needs, at the right time. Some also highlighted that information only becomes relevant when going through a particular issue/stage, e.g. information provided at antenatal classes only becomes relevant when the baby arrives.

Some participants also made explicit reference to the mode of delivery of information or support, with some preferring face-to-face as they could ask questions. As mentioned earlier, group support was valued by many (in-person and online), while a few preferred one-to-one support, as either they did not like being in groups and/or appreciated the tailoring to their individual circumstances.

6.4 Discussion

This study set out to examine parents' views on early life interventions to promote healthy growth/prevent childhood obesity, particularly those involving health professionals. Two central themes were generated from the data. The first relates to parents themselves "Navigating the uncertainty, stress, worries, and challenges of parenting whilst under scrutiny". Parents, particularly first-time parents, felt vulnerable during this period, in which there is a lot of uncertainty, stress and worry, often exacerbated by both felt and perceived judgement, stigma and guilt in relation to their parenting/feeding practices, which were often under scrutiny. With the right support and time, however, their confidence increased, underscoring the importance of supporting and reassuring parents during this key life stage. The second theme "Accessing support in the broader system" demonstrates that while parents are receptive to, and would welcome, such support, particularly around feeding, several critical components need to be considered.

The first theme reinforces much of what is known about the transition to parenthood, a challenging time for both mothers and fathers (Baldwin et al., 2018; Barimani et al., 2017; Chin et al., 2011; Paul, Downs, Schaefer, Beiler, & Weisman, 2013; Philpott et al., 2019; Vismara et al., 2016). Parents often felt they had a lack of knowledge and felt insufficiently prepared for the realities of parenting, particularly

breastfeeding, which has been noted elsewhere (Blixt, Johansson, Hildingsson, Papoutsi, & Rubertsson, 2019; Earle & Hadley, 2018; Hoddinott, Craig, Britten, & McInnes, 2012). Consistent with previous research, our study findings highlight the judgement, stigma and guilt/shame that parents perceive around parenting and infant growth (Appleton et al., 2017; Bentley et al., 2017), but particularly in relation to infant feeding (Appleton, Laws, et al., 2018; Barimani et al., 2017; Fallon et al., 2017; Gallagher & James, 2015; Grant et al., 2018; Guell et al., 2018; Komninou et al., 2017; McGorrigan et al., 2010; Thomson, Ebisch-Burton, & Flacking, 2015). Judgement within online forums was also noted, similar to recent studies concerning breastfeeding (Regan & Brown, 2019; Tugwell, 2019), child growth (Appleton, Fowler, & Brown, 2014) and mothering (Johnson & Quinlan, 2019). Parents require non-judgemental support and reassurance to allay concerns and build their infant feeding/parenting self-efficacy.

Many participants in our study, however, noted how health professionals often prioritised weight gain over all else, with infant formula often provided in hospitals if infants were not gaining sufficient weight. This was also observed in a study involving women with a higher weight in Sweden (Claesson et al., 2018). Women could also become unnecessarily obsessed with having their babies weighed, for example at baby clinics/groups provide, even though it provided opportunities for them to feel pride in their maternal achievement and 'good mothering', as previously observed in the literature (Hanafin et al., 2019; Keenan & Stapleton, 2010; Nolan et al., 2015). It is critical that interventions are framed and developed and/or adapted and implemented in ways that consider these factors, and provide non-judgemental support to parents. Interventions that promote healthy growth in young children in a way that is appropriate to the stage of development, focuses on key behaviours, and positively supports parents are needed.

Participants highlighted how better approaches to breastfeeding promotion were needed, as some women could feel pressured to breastfeed (Hoddinott & Pill, 2000; Lagan et al., 2014) and feel judged for not doing so (Darwent & McInnes, 2015). Having to justify reasons for breastfeeding can create divisions between formula-feeding and breastfeeding mothers and can impact on social support for all (Woollard, 2019). Increasingly there are calls in the wider literature for: a move away from the perception that breastfeeding is best, emphasis on wider values other

than the health benefits of breastfeeding, and a message that every feed matters (Brown, 2016). Including support around formula-feeding may be important to reduce the risk of alienating women and improve reach and retention of interventions (Thomson et al., 2015; Trickey & Newburn, 2014). It is also important that the social context is taken into consideration, given that judgement can also come from health professionals, peers, family members and the general public. Our findings also demonstrate that over time, with support, and/or with subsequent children, parents become more confident.

The second theme generated in the study focuses on what parents require in terms of information and support. Support around infant feeding, particularly breastfeeding, was highlighted in particular. This is perhaps unsurprising, given that most participants interviewed (or their partners) had breastfed their babies, coupled with the fact that Ireland has one of the lowest rates of breastfeeding globally (Victora et al., 2016), with initiation rates of 60% and 49% of 'any' and 'exclusive' breastfeeding, respectively (Healthcare Pricing Office, 2018). Introducing solids and infant growth were other areas where parents felt they needed more support. Information and support received from health professionals during pregnancy was highly varied; as noted elsewhere, e.g. in relation to weight and/or gestational weight gain diet/nutrition, and physical activity (Baron et al., 2017; Stockton & Nield, 2020; Waller et al., 2016; Weeks, Halili, Liu, Deonandan, & Adamo, 2020). Resultantly, parents expressed a desire for health professionals to be more pro-active in raising issues, with many feeling interactions to be tick-box exercises, something that health professionals themselves acknowledge (De Vivo & Mills, 2019).

Barriers highlighted by parents in this study such as lack of time, knowledge, and resources may account for this, and should be addressed within interventions. Indeed lack of knowledge, confidence and/or relationships with women, time, continuity of care, and resources, are identified barriers to health professionals in supporting women around a range of health behaviours (De Vivo & Mills, 2019; Edwards, Jepson, & McInnes, 2018; Esselmont et al., 2018; McCann et al., 2017; McLellan et al., 2019; Yang et al., 2018). Similarly, maternal and child health nurses in Australia raised concerns about parental receptiveness and maintaining rapport as key barriers to addressing obesity prevention in routine practice (Laws et al., 2015). In line with previous research, participants were generally supportive of health

professionals raising issues such as maternal weight and pregnancy weight gain (Criss et al., 2016; Holton et al., 2017; Jones & Jomeen, 2017; Nikolopoulos et al., 2017; Stockton & Nield, 2020) and to child growth/weight (Bentley et al., 2017) even if they would be hard to hear, but if done in a non-judgemental way. Continuity of care, and the associated development of trusting, respectful relationships and rapport with health professionals, were highly valued by parents in this study, similar to prior research concerning antenatal care (Stockton & Nield, 2020), weight and/or gestational weight gain (Olander, Berg, Berg, & Dencker, 2019; Vanstone, Kandasamy, Giacomini, DeJean, & McDonald, 2017; Walker, Choi, Alexander, Mazza, & Truby, 2019), and infant feeding (Blixt et al., 2019; Hoddinott & Pill, 2000). Thus parents desire more support, and for health professionals - with whom they have good rapport with - to be more pro-active in raising such issues.

It is clear from our study that there is no one intervention and/or approach that will work for all parents. Parents wanted high quality information, in a variety of formats (e.g. face-to-face/online; individual/group). Consistent with other research, particularly around infant feeding, parents felt that they were often in the receiving end of conflicting and confusing advice (Lakshman et al., 2012; Matvienko-Sikar et al., 2018; Tully et al., 2019) and were critical of the quality of information received, often supplementing with other sources. Research by Lupton has also found that while parents valued online support, they highly value expert advice and expressed the desire for increased information and support offered by healthcare professionals (Lupton, 2016). Some parents in our study valued one-one-one support, whereas others valued group interaction; this has been noted in previous breastfeeding research (Hoddinott, Pill, & Chalmers, 2007; Hunt & Thomson, 2017). Women value practical demonstrations and being shown how to feed their baby (particularly time patiently spent watching them feed their baby), rather than be told how to do them (Hoddinott & Pill, 2000). Indeed some studies also note how parents value a combination of professional and peer support in relation to breastfeeding (Fox, McMullen, & Newburn, 2015; Leahy-Warren, Creedon, O'Mahony, & Mulcahy, 2017; Nolan et al., 2015). Our study further highlights that it is important to support all parents, including fathers, who can often feel excluded/patronised during encounters with health professionals (Chin et al., 2011; Cosson & Graham, 2012; Earle & Hadley, 2018; Hrybanova et al., 2019; Kowlessar et al., 2015) but

particularly those who are first-time parents. It is crucial that inadequacies in universal provision are considered. Efforts should be made to improve delivery of interventions that promote healthy growth during routine care. Support, however, must be practical, realistic, tailored, evidence-based, timely, accessible, and from trusted sources, including both health professionals and peers. This study builds the evidence base concerning parents' views and experiences of early life interventions to promote healthy growth, and the range of associated behaviours, including active play/physical activity and sedentary behaviour. Specifically, it provides insight into parents' experiences of interventions concerning the range of these behaviours in the context of child growth, particularly those delivered by health professionals/within routine care, which has received limited attention to date.

6.4.1 Strengths and limitations

The strengths of this study include: the inclusion of both mothers and fathers, primiparous and multi-parous parents, the examination of a broad range of factors related to healthy growth in young children, not simply infant feeding, and the involvement of parents in the design and conduct of the study. Several limitations should be noted, however. Despite our best efforts to engage a diverse group of parents, our sample had a high level of parents with higher education levels and those who breastfed/were breastfeeding their children. Furthermore, many of the participants worked in health and social care roles so this may have influenced their views. The role of social desirability bias was considered in this study, particularly given the 'surveillance' and judgement parents feel that they are under. That said, every effort was made to establish rapport with parents during the interviews and ensure that they knew that we were interested in hearing their views and opinions. While we were interested in views of interventions, particularly those involving health professionals, we only interviewed parents. Further studies should examine health professionals' views and also wider perspectives, including those of grandparents/other caregivers.

6.5 Conclusions

The first 1,000 days of life is a critical window of opportunity to support the development of healthy growth and associated behaviours in children. Interventions involving health professionals in particular can be important, given the large number of routine contacts between parents and the health service during this period. This study examined parents' views and experiences of interventions, in general and specifically those delivered by health professionals. Parents were receptive to, and would welcome, support during this critical time period, particularly around feeding. Support, however, needs to be practical, realistic, evidence-based, timely, accessible, non-judgemental, and from trusted sources, including both health professionals and peers. Various levels of support and intervention are required, at individual/intra-personal, inter-personal, organisational, community, and policy levels. Interventions to promote healthy growth and related behaviours need to be developed and implemented in a way that supports parents, their views and circumstances.

6.6 List of abbreviations

BMI Body Mass Index

GP General Practitioner

PHN Public Health Nurse

6.7 Declarations

6.7.1 Ethics approval and consent to participate

The study was approved by the Research Ethics Committee of NUI Galway (ref 17-May-08) and all participants provided written informed consent prior to participating in the study.

6.7.2 Consent for publication

Not applicable

6.7.3 Availability of data and material

The data that support the findings of this study are available on request from the corresponding author [MH]. The data are not publicly available due to them containing information that could compromise research participant privacy/consent.

6.7.4 Competing interests

The authors declare that they have no competing interests.

6.7.5 Funding

This research was funded by the Health Research Board SPHeRE/2013/1. The funding body had no role in the design of the study, in the collection, analysis, and interpretation of data, or in writing the manuscript.

6.7.6 Authors' contributions

The study was designed by MH with input from MB, RL and CH. MH conducted the interviews and the analysis. CH, MB and RL provided input into the analysis. The first draft of the paper was written by MH and all authors provided critical input and revisions. All authors read and approved the final manuscript.

6.7.7 Acknowledgements

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Chapter 7 Discussion

7.1 Chapter overview

This thesis aimed to develop the evidence base to maximise the effectiveness of early life obesity prevention interventions delivered by health professionals. In this final chapter, I will present an integrated summary of the findings of the three studies therein, and their contribution to the existing evidence base. Implications for research, policy and practice will then be discussed. The strengths and limitations of the overall body of research will be highlighted, before final conclusions are drawn.

7.2 Summary of the research findings and contribution to the evidence base

Interest in early life obesity prevention interventions has grown over the last ten years, particularly at a policy level, and there has been a large increase in the number of interventions conducted also. Such interventions report mixed findings, however. In addition, they often fail to consider the behaviour change techniques or relevant theories underlying the interventions. By following the Medical Research Council (MRC) Framework for Developing and Evaluating Complex Interventions (Craig et al., 2008), this body of research contributes to identifying both evidence and theory concerning early life interventions to prevent childhood obesity and/or promote healthy growth, particularly those delivered by health professionals.

Initially set against a backdrop of priorities for childhood obesity prevention research and illumination of barriers and facilitators to knowledge translation, this thesis then focuses specifically on early life interventions. By utilising tools from both behavioural and implementation science, such as the Theory Coding Scheme (Michie & Prestwich, 2010), Behaviour Change Technique (BCT) Taxonomy V1 (Michie et al., 2013), TIDieR checklist for intervention reporting (Hoffmann et al., 2014), and external validity reporting tool (Laws et al., 2014; Laws et al., 2012), this research contributes further insight into the effectiveness, active ingredients, generalisability, and conduct/reporting of interventions. Furthermore, qualitative interviews with parents garnered important insights into their views and experiences of interventions around the promotion of healthy growth and the associated

behaviours. The overarching, integrated results from this research (described in Table 7.1, pages 211-215) will now be summarised and discussed in the context of their contribution to the field.

7.2.1 Knowledge translation: getting research into practice

This thesis was designed with knowledge translation in mind, given that it can take up to 17 years for research evidence to reach practice (Morris et al., 2011). In addition, there have been calls for a focus on translating effective intervention components into practice and scaling up childhood obesity prevention interventions, (Waters et al., 2011). In the first study, research priorities for childhood obesity prevention were co-produced with national and international stakeholders, filling an identified research gap. Despite actions being taken at European and international levels to address childhood obesity, no priorities concerning prevention research in 0-18 year olds had been established prior to this. Both the European Union Action Plan on Childhood Obesity 2014–2020 (European Commission, 2014) and national obesity strategy in Ireland (Department of Health, 2016b) called for the identification of research agendas and priorities. The resultant priorities identified in Study 1 may help to shape the research agendas of funders and researchers, nationally and internationally, and aid in the conduct of policy-relevant research and the translation of research into practice in childhood obesity prevention.

Research prioritization is one method to reduce the gap between research, policy, and practice; understanding barriers and facilitators to knowledge translation is another. The latter were also the focus of Study 1, as these had not been investigated previously in the context of childhood obesity. Aspects of implementation science featured strongly in both the identification of barriers and facilitators, and research priorities. ‘Implementation science: process’ was within the top five research priorities, while a focus on implementation research was one of the prioritised facilitators of knowledge translation. ‘Research which is incompatible with scalability’ was identified as a barrier to knowledge translation. It is accepted that effective, scalable, and affordable strategies that do not widen health inequities are needed to address childhood obesity (Blake-Lamb et al., 2016; Wake, 2018). Indeed interventions that can be embedded into ongoing practice and existing systems are required, rather than implementing interventions that are resource-

intensive and cannot be maintained in the long-term (Waters et al., 2011; World Health Organisation, 2016a). Findings from Studies 2a and 3 within this thesis can also shine insight on the extent to which this is the case, or indeed the potential for interventions to be embedded as such.

'How to integrate obesity prevention into existing service structures' was within the top 5 research priorities identified in Study 1. Despite the increasing numbers of trials to assess the impact of early life obesity prevention interventions, there is relatively little reporting on the potential for these interventions to be translated into routine practice. Furthermore, there is little evidence that interventions with demonstrated efficacy have been translated beyond the research setting and been broadly adopted. While all of the included interventions in Study 2a were delivered by health professionals, only 16/46 were clearly delivered as part of routine care, with a further two partly delivered as such. None of the four effective interventions was delivered as part of routine care, perhaps impacting on the sustainability of such interventions and their integration into routine practice. Findings from this thesis therefore, demonstrate scope to focus efforts in this area on developing, adapting and/or scaling up interventions that can be embedded within existing systems. This is something that parents also suggested during qualitative interviews in Study 3, whilst stressing the need for more support, particularly around infant/child-feeding, as well as healthy growth and parenting more broadly. While they would welcome such support in general, they also felt that health professionals should be proactive about raising issues during any encounters, including routine visits.

Important gaps in the reporting of external validity elements, and factors that could enhance translation and scale-up of health professional-delivered early life interventions were identified in Study 2b, building on similar work previously conducted on childhood obesity prevention interventions across childhood (Klesges et al., 2008) and in 0-5 year olds specifically (Laws et al., 2014). Gaps identified included: representativeness of individuals and settings, treatment receipt, intervention mechanisms and moderators, cost effectiveness, and intervention sustainability and acceptability. The outputs of this review can inform the prioritising, gathering and reporting of data by researchers/triallists to facilitate decision-making concerning external validity of interventions. Decision-makers need

to have sufficient information on the reach and acceptability of the intervention, core intervention components required for fidelity, any differential effects on the target population, unintended consequences, costs versus benefits, and the clinical or policy significance of the intervention effects to inform decisions about whether interventions should be scaled-up (Bonell et al., 2006; Burchett et al., 2018; Glasgow et al., 2006; Lavis et al., 2009). This need not be at the expense of internal validity, and can help facilitate credible research and knowledge translation (Green et al., 2009; Huebschmann et al., 2019).

7.2.2 The effectiveness, theoretical underpinning and active ingredients of early life obesity prevention interventions delivered by health professionals

In Study 2a, evidence for the effectiveness of early life health professional-delivered obesity prevention interventions was identified. This work builds on previous research (Blake-Lamb et al., 2016; Redsell et al., 2016), by specifically focusing on (i) effectiveness of interventions by provider, namely health professionals, and (ii) associations between the theoretical underpinning and active ingredients, and intervention effectiveness. The use of tools from behavioural science, i.e. the Theory Coding Scheme (Michie & Prestwich, 2010) and BCT Taxonomy V1 (Michie et al., 2013), had not been applied to this specific category of intervention previously. There was weak evidence to support the effectiveness of such interventions on weight and behavioural outcomes, but more evidence for effectiveness on behavioural outcomes only. Four out of the 46 identified interventions supported intervention effectiveness according to our review criteria; a further six interventions showed positive impacts on child adiposity/weight outcomes only. It was difficult to draw any firm conclusion as to what characteristics of interventions make them more effective, due to the limited number of effective trials identified. We did not observe that interventions that were more intensive (i.e. had greater dosage) were more likely to be effective.

While we documented the BCTs within interventions and comparator groups, where possible, we were unable to show that interventions containing particular BCTs have a greater likelihood of success, given the limited number of effective interventions identified within the review. That said, interventions involving more active engagement strategies - such as problem solving, review behavioural goal(s),

feedback on behaviour, feedback on outcome(s) of behaviour, and social support (unspecified) - were more often associated with effectiveness. Parental support for many of these BCTs was also evident in the qualitative study, where techniques such as the following were valued: problem solving; feedback on behaviour; feedback on outcome of behaviour; social support; instruction on how to perform a behaviour; demonstration of the behaviour; credible source. Although not all BCTs in the BCT Taxonomy might be appropriate for obesity prevention interventions delivered by health professionals, the findings of this review suggest that there may be opportunities to assess the potential of additional BCTs in future trials given that only 31 of the 93 BCTs within the BCT Taxonomy V1 were used. Such identification and specification of the potent BCTs used in interventions, and the dose necessary for change, should facilitate knowledge translation (Tate et al., 2016).

We were also unable to establish what theories were associated with intervention effectiveness, given that only four interventions were classified as effective—on both weight and obesity-related outcomes—within our review. Of these, three had an explicit theoretical basis. Nearly half of the interventions explicitly mentioned a theory or model of behaviour. Even when theory use was explicitly mentioned within studies, however, other elements relating to the theoretical grounding of the study (i.e. other aspects of the Theory Coding Scheme, such as 'targeted constructs') were often not reported. Our assessment was based on the information reported by authors within each study as to the theoretical underpinning of the respective interventions, which may have been limited. While the Baby Milk Trial (Lakshman et al., 2014) adopted an explicit and rigorous theory-based approach to intervention development and reporting, using the MRC Framework for the Development and Evaluation of Complex Interventions (for example, they identified theory, utilised a causal modelling approach to link "behavioural determinants" to "behavior" and "short-term and long-term outcomes", and used a validated a questionnaire to assess change in key constructs), the majority of studies did not. Furthermore, some of the identified theories, such as Responsive Parenting, do not have well-defined constructs, compared with the more developed health behaviour theories (e.g. Social Cognitive Theory, and Health Belief Model) which is not conducive to assessment using the Theory Coding Scheme.

Matvienko-Sikar et al. (2019) also noted lack of theory use in their recent review of infant feeding interventions in children aged 0 to 2 years; only 50% of trials stated an explicit theoretical underpinning. Responsive Parenting was the most frequently cited theory in our review (n = 7), followed by Social Cognitive Theory (n = 6), Social Learning Theory (n = 3), and the Precede Proceed Model (n = 3). Responsive feeding and Social Cognitive Theory were also the most frequently identified theories in the review by Matvienko-Sikar et al. (2019). Social Cognitive Theory is often used as the theoretical basis for childhood obesity interventions (Ng et al., 2018), and Responsive Parenting increasingly so, with some of the more prominent obesity prevention interventions, using this as its theoretical underpinning, e.g. INSIGHT (Paul et al., 2018) and POI (Taylor, Gray, et al., 2018). As previously mentioned in Section 1.11, a theory "presents a systematic way of understanding events or situations. It is a set of concepts, definitions, and propositions that explain or predict these events or situations by illustrating the relationships between variables" (Glanz & Rimer, 2005, p. 4). This definition is used within the Theory Coding Scheme, which also recognises that theories and models can fit within this definition, for example, the Health Belief Model or Trans-Theoretical Model (Michie & Prestwich, 2010). A model "typically involves a deliberate simplification of a phenomenon or a specific aspect of a phenomenon"; models are descriptive, whereas a theory is both explanatory and descriptive (Nilsen, 2015, p. 2). Like models, frameworks are descriptive; they describe phenomena by providing an outline, system or plan comprising categories (e.g. concepts, constructs or variables) (Nilsen, 2015). The types of theories/models reported by authors within interventions included within our systematic review varied, from those targeting understanding influences on behaviour (Social Cognitive Theory), to those supporting intervention development/delivery (e.g. Precede Proceed Model). It should also be noted that often the latter theories were used in combination with the former; for example, three interventions combined the Stages of Change with the Precede Proceed Model (Kolu et al., 2016; Mustila et al., 2012a, 2012b).

In the qualitative study with parents, it was evident that various levels of support and intervention are required, at individual, inter-personal, organisational, community, and policy levels in line with the Social Ecological Model and therefore focus on theoretical models that incorporate social dimensions is important. Thus, in

line with identifying theory within the development phase of the MRC Framework, while we identified theory, we were unable to connect theory use to intervention effectiveness. Greater use, reporting, and testing of theory/theories within intervention design is needed so that we can identify what works within interventions; this will also help to refine theory, and potentially abandon outdated theories (Sniehotta, Presseau, & Araújo-Soares, 2014). Findings from the qualitative work with parents challenges us to think about broader factors which impact on parents views and behaviours relating to promoting healthy growth and associated behaviours during pregnancy and the first two years of life.

7.2.3 Involving and supporting parents

Involving and supporting parents was a key theme across all studies – explicitly identified in studies 1, 2b and 3, and an inherent component of study 2a given that all interventions targeted parents. 'How to support and engage parents' was within the top 10 identified research priorities. Facilitators of knowledge translation included: 'involving key stakeholders from the start' and 'engagement with your target group', while 'parental knowledge, education, skills' were identified as barriers to knowledge translation. Intervention acceptability (encompassing views of parents and also those involved in delivery) was an element of external validity that was poorly described by studies within the systematic review. Finally, the qualitative study highlighted the individual and broader system challenges that parents encounter during the first 1,000 days. While many of these findings are unsurprising, they again highlight the centrality of parents in efforts to promote healthy growth in children (Golan & Crow, 2004; Lindsay et al., 2006).

A unique contribution of this body of research is in the qualitative work, given that obesity prevention research to date has tended to focus on older children, i.e. pre-school-aged children and older, and while some research has focused on children under the age of two, it has primarily focused on discrete topics such as infant feeding. It also involved a number of fathers and multi-parous parents, which is not often the case in this type of work, or indeed interventions. The qualitative study encompassed early life risk and protective factors for obesity including maternal pre-pregnancy overweight, high infant birth weight, rapid infant weight gain, breastfeeding and the introduction of solid foods (Weng et al., 2012); the

findings consolidate much of what is already known about these discrete topics, from a diverse range of disciplines, but often not within the context of healthy child growth. The depth and breadth of the findings from the qualitative work are a key strength, building a fuller picture of the views and experiences of parents concerning early life interventions.

The emotional toll associated with the various issues concerning growth and associated behaviours, such as uncertainty, stress, worry, stigma, judgement and guilt, have previously been documented, for example, in relation to parenting and infant growth (Appleton et al., 2017; Bentley et al., 2017) and infant feeding (Appleton, Laws, et al., 2018; Fallon et al., 2017; Grant et al., 2018; Komninou et al., 2017; Thomson et al., 2015). It is critical that parents are supported during this period, and that any interventions are cognisant of these issues. For example, parents highlighted how approaches to breastfeeding promotion and support could make some women feel pressured to breastfeed (Hoddinott & Pill, 2000; Lagan et al., 2014) and reinforce the moral context around infant feeding where women who do not breastfeed can be judged for not doing so (Darwent & McInnes, 2015). Many also noted how health professionals often prioritised weight gain over all else, breastfeeding in particular and without any respect for the mother's wishes or emotions, especially in relation to the provision of formula in hospitals if infants were not gaining sufficient weight. Focus, framing and language of interventions needs to be carefully considered. Parents also experienced many challenges in accessing support within the broader system. They are receptive to, and would welcome, support during this critical time period; particularly around breast-, infant-, and child feeding.

It is clear from the qualitative work also that there is no one intervention and/or approach that will work for all parents; instead a flexible approach is required to delivery (e.g. face-to-face/online; individual/group). Parents wanted high quality information, in a variety of formats (e.g. face-to-face/online; individual/group) (Abbass-Dick & Dennis, 2018). Consistent with other research, particularly around infant feeding, parents felt that they were often in the receiving end of conflicting and confusing advice (Lakshman et al., 2012; Matvienko-Sikar et al., 2018; Tully et al., 2019) and were critical of the quality of information received, often supplementing with other sources. Women value practical demonstrations and being

shown how to feed their baby (particularly time patiently spent watching them feed their baby), rather than be told how to do them (Hoddinott & Pill, 2000). Indeed some studies also note how parents value a combination of professional and peer support in relation to breastfeeding (Fox et al., 2015; Leahy-Warren et al., 2017; Nolan et al., 2015). Our study further highlights that it is important to support all parents, including fathers, who can often feel excluded/patronised during encounters with health professionals (Chin et al., 2011; Cosson & Graham, 2012; Earle & Hadley, 2018; Hrybanova et al., 2019; Kowlessar et al., 2015), but particularly those who are first-time parents. It is crucial that inadequacies in universal provision are considered, given that many parents within this study accessed supports privately if they had the financial means to. Efforts should be made to improve delivery of interventions that promote healthy growth during routine care. Support, however, must be practical, realistic, tailored, evidence-based, timely, accessible, and from trusted sources, including both health professionals and peers. This study builds the evidence base concerning parents' views and experiences of early life interventions to promote healthy growth, and the range of associated behaviours, including active play/physical activity and sedentary behaviour, which have received little attention to date.

Table 7.1 Integration of findings from all three PhD studies

Theme	Thesis findings			
	Study 1: Childhood obesity prevention: priority areas for future research and barriers and facilitators to knowledge translation, co-produced using the nominal group technique	**Study 2a: The effectiveness of health professional-delivered interventions during the first 1,000 days to prevent overweight/obesity in children: A systematic review**	**Study 2b: Health professional-delivered obesity prevention interventions during the first 1,000 days: A systematic review of external validity reporting**	**Study 3: Parents' views on obesity prevention interventions and specifically health professional-delivered obesity prevention interventions targeting children under the age of two (TBC)**
Knowledge translation: getting research into practice	Implementation science: process within the top 5 research priorities Focus on implementation research was one of the prioritised facilitators of knowledge translation Research which is incompatible with scalability identified as a barrier to knowledge translation	N/A	Important gaps in the reporting of external validity elements within studies, and factors that could enhance translation and scale-up of interventions identified	N/A

Opportunities to integrate obesity prevention into routine practice	How to integrate obesity prevention into existing service structures within the top 5 research priorities	While all of the included interventions were delivered by health professionals, only 16 were clearly delivered as part of routine care, with a further two partly delivered as such. None of the four effective interventions was delivered as part of routine care, perhaps impacting on the sustainability of such interventions and their integration into routine practice	N/A	Parents require more support. They felt that health professionals should be proactive about raising issues, during encounters, including routine visits
Focus on behaviours, not just weight/growth	-	Of the 39 trials involving 46 intervention arms, only four interventions were effective on a primary (adiposity / weight) and secondary (behavioural) outcome measure. A further six interventions showed positive impacts on child adiposity/weight outcomes only, while 22 trials had positive impacts on behavioural outcome measures only. It is important not to overlook the positive impacts on behavioural outcomes in these interventions	N/A	Key issues where parents felt they required more support included breastfeeding, as well as introduction to solids and healthy growth and/or development more generally (e.g. knowing if their child was growing / developing as they should be)

		as these will potentially lead to positive weight outcomes over longer time periods, as behaviours track into later childhood		
Theory: need to consider multiple levels of influence	Focus on social determinants within childhood obesity prevention common theme across research priorities and facilitators and barriers to knowledge translation	Twenty of the 46 interventions (43%) explicitly mentioned a theory or model of behaviour. Fifteen different theories were identified, including Responsive Parenting (n = 7); Social Cognitive Theory (n = 6); Social Learning Theory (n = 3); Precede Proceed Model (n = 3). Nine interventions were based on one theory alone, while nine drew on two theories, and two studies were based on three different theories. The majority of effective interventions, as defined by our review criteria, were theory-based (i.e., explicitly stated that they were underpinned by a specific theory/theories). For those interventions that were ineffective, 17 (out of 42) were based on theory	N/A	Various levels of support and intervention are required, at individual/intra-personal, inter-personal, organisational, community, and policy levels in line with the Social Ecological Model

		It was not possible to establish what theories were associated with intervention effectiveness		
Behaviour change techniques that should be included in interventions	N/A	It was not possible to establish what BCTs were associated with intervention effectiveness. Promising BCTs (all involved 'credible source' (✓)) included: (i) Problem solving (✓) (ii) Review behaviour goal(s) (iii) Feedback on behaviour (✓) (iv) Feedback on outcome(s) of behaviour (✓) (v) Social support (unspecified) (✓) (vi) Instruction on how to perform a behaviour (✓) (vii) Demonstration of the behaviour (✓) (viii) Information about health consequences Note: (✓) applies if BCT arose during interviews with parents	N/A	Parents value strategies / behaviour change techniques such as: (i) Problem solving (ii) Feedback on behaviour (iii) Feedback on outcome of behaviour (iv) Social support (v) Instruction on how to perform a behaviour (vi) Demonstration of the behaviour (vii) Credible source

Need to involve and support parents	'How to support and engage parents' within the top 10 research priorities Facilitators of knowledge translation included: 'involving key stakeholders from the start' and 'engagement with your target group' 'Parental knowledge, education, skills' identified as barriers to knowledge translation	N/A	Intervention acceptability was an element of external validity that was poorly described	Firstly, parents must navigate the uncertainty, stress, worries, and challenges of parenting during the first 1,000 days, whilst under scrutiny. Secondly, they experience many challenges in navigating and/or accessing support within the broader system. Parents are receptive to, and would welcome, support during this critical time period; particularly around breast-, infant-, and child feeding. Such support, however, needs to be practical, realistic, evidence-based, timely, accessible, flexible, non-judgemental, and from trusted sources, including both health professionals and peers

7.3 Implications for research, policy and practice

Set within the development phase of the MRC Framework for Developing and Evaluating Complex Interventions (Craig et al., 2008), this research has developed the evidence base for early life interventions to promote healthy growth and related behaviours. Implications of the overall thesis findings for research, policy and practice will now be discussed. This complements such discussions within the papers of each individual study.

7.4.1 Implications for research

Study 1 established priorities for childhood obesity prevention research which informed the studies undertaken within this thesis. These priorities have been adopted as recommendations for research within the Health Service Executive (HSE)'s Healthy Weight for Children (0-6 years) Framework (Health Service Executive, 2018d) and should be taken forward by other researchers in childhood obesity prevention, both nationally and internationally. Since this study was conducted, reporting guidelines for priority setting of health research (REPRISE) have been published (Tong et al., 2019). These guidelines include attention to (i) definition of the time frame – including interim, short-term, long-term priorities, and plans to revise and update, and (ii) description of plans, strategies, or suggestions to evaluate impact. The research priorities identified in Study 1 should be re-visited to evaluate their impact, and also updated, within an appropriate timeframe, ensuring that as wide a variety of stakeholders are included as possible, particularly parents and children themselves.

While there has been a rapid increase in the number of early life obesity prevention trials as identified within the systematic review, and there is now a sizeable research base, several gaps remain. The optimal intervention timing, content, dose, mode of delivery, theory, and active ingredients have yet to be established. Rather than continuing to develop new stand-alone interventions, efforts should now focus on the conduct and reporting of research in this area. A lot of positive work is being conducted, and the area of research would benefit from the sharing of more detailed information with the broader research community. Use of standard reporting guidelines such as the Template for Intervention Description and Replication (TIDieR) checklist and guide (Hoffmann et al., 2014) to describe

intervention, and also comparator, content would facilitate greater transparency and promote intervention fidelity. Given the complex nature of obesity, future research should consider the reporting of intervention context (Cotterill et al., 2018). Such descriptions could be included within intervention protocols and/or results papers. Where possible, researchers could code BCTs within their interventions a priori and publish these descriptions within protocol papers; otherwise, publish intervention development papers in peer-reviewed journals that include descriptions of the intervention with sufficient detail to allow coding of BCTs by others (Tate et al., 2016). This also applies to descriptions of usual care which should be described in full (Macklin & Natanson, 2020; Nicholls, Zwarenstein, & Taljaard, 2020). The underreporting of the active content of experimental and comparator interventions in published literature is an ongoing issue. For example, in their analysis of behavioural interventions for smoking cessation, de Bruin et al. (2020) found that only 35% of experimental and 26% of comparator group BCTs could be identified in published materials; experimental (vs. comparator) interventions were better reported. Accurate and complete descriptions of interventions, the target populations and settings, and use of comparable behavioural outcomes would enable identification of effective BCTs across studies (Bull et al., 2014).

While interventions based on theory are potentially more likely to be effective than those that are not (Craig et al., 2008; Taylor et al., 2012; Webb et al., 2010), our current ability to discuss theory use in interventions is limited due to methodological and reporting reasons and should be a focus for future research. More harmonized and transparent reporting of outcomes in trial protocols and published reports would facilitate comparison of outcomes across trials, maximize the usability of findings, reduce bias, enable trial replication, improve trial design and conduct, and ultimately reduce research waste and help improve participant outcomes (Butcher et al., 2019). That said, there are challenges in generating a core outcome set for obesity research, partly because of the complexity and variability in intervention targets thus requiring potentially different outcomes (Bryant et al., 2014). Matvienko-Sikar et al. (2020) developed a core outcome set for trials of infant feeding interventions to prevent childhood obesity. Given the multi-behaviour focus of many early life interventions, questions need to be answered about what to measure, when, and how, without overburdening research participants and trial costs.

Furthermore, there is a need to develop brief tools to measure early life obesity-related behaviours, particularly those assessing sedentary behaviour and sleep, and tools that cover multiple domains (Byrne et al., 2019).

Trials should be adequately powered, and longer-term (more than 12 months) post-intervention follow-up is required. The latter is often subject to funding constraints, and is therefore an important consideration for research funders and their policies and programmes. Greater attention to assessments of fidelity would enhance our ability to interpret intervention outcomes, while attention to external validity would enhance our understanding of the potential for implementation in routine service delivery.

Only five interventions included within the systematic review included economic assessments. Future research should consider the costs of delivering interventions, as this will be valuable to decision makers in deciding whether to adopt interventions into practice. Despite calls for greater attention to external validity for almost 40 years now (Glasgow et al., 2006; Huebschmann et al., 2019), problems with attention to generalisability persist. More emphasis is needed on research designs that consider generalisability, scalability, and the reporting of external validity elements, which need not be at the expense of internal validity.

This thesis set out to establish the evidence base for early life interventions to prevent childhood obesity, particularly those delivered by health professionals. Set within the development phase of the MRC Framework for Developing and Evaluating Complex Interventions (Craig et al., 2008), the initial purpose was to inform the development of an intervention to promote healthy growth during the first 1,000 days. As the various studies progressed however, it became apparent that the development of yet another intervention, would not be the best use of resources. Adapting and/or implementing interventions that have worked elsewhere can be more efficient however (Movsisyan et al., 2019). Many of the interventions identified within the systematic review could be adapted to the Irish context; the majority were not delivered within routine care however. Guidance for adapting complex population health interventions to new contexts is currently being developed through The ADAPT Study (Movsisyan et al., 2019). The active ingredients of interventions identified in study 2a can inform scope for adaptation and what components cannot be modified during the adaptation process. Such a

research endeavour could be co-produced with key stakeholders, including parents, health professionals, decision-makers and others. Indeed, there is increasing interest in co-designing childhood obesity prevention interventions with families and other groups (Hill et al., 2019; Hoeeg, Christensen, & Grabowski, 2019; Korn et al., 2018). Further research with parents with lower education and/or income levels, and those who engage in formula and/or mixed feeding would be required, as well as health professionals.

7.4.2 Implications for policy

There are two key implications for policy arising from this work. Firstly, there is a need for greater funding and resources for prevention and early intervention. This was identified as a key barrier to knowledge translation within Study 1, and by parents in the qualitative work in Study 3, particularly concerning breastfeeding. It has also been recognised in several national reports concerning childhood obesity (Canny et al., 2018; Houses of the Oireachtas Joint Committee on Children and Youth Affairs, 2018; Irish Heart Foundation, 2019). Lack of resources has previously been identified as a barrier to work on childhood obesity prevention policies by policymakers, nongovernmental organization representatives, and academics [37]. As mentioned in section 7.4.1, policy change concerning research funding is also required to enable the follow-up of interventions over longer periods. This first implication ties in with the second, which concerns focus, framing and language of policies to address obesity.

As mentioned in Chapter 1, several authors have argued that despite the issue of childhood obesity being presented as alarming by organisations and countries across the globe, modest interventions are proposed to address it and primarily place responsibility with parents without providing any necessary support (Noonan-Gunning, 2019; Vallgårda, 2018). There is a growing field of research which argues that public health policies and interventions that continue to individualise infant feeding practices, maternal eating habits and weight management are also problematic (Jarvie, 2016; Keenan & Stapleton, 2010). While recognising the importance of establishing good habits early and providing children aged 0-2 years with good nutrition and opportunities to be active, and their role in doing this, it is difficult for parents to implement the necessary behaviours in practice (Appleton et

al., 2017; Zehle et al., 2007). This can result in parents feeling distressed and/or blaming themselves when their child's weight becomes an issue (Appleton et al., 2017; Bentley et al., 2017). Indeed judgement, stigma, guilt and shame were key issues highlighted by parents during the qualitative study. There is no one intervention that will address obesity on its own (Rutter, 2012). Although individual-level changes are a necessary component of obesity prevention, they are only one part of a whole system response, and must be supported by upstream actions that focus on promoting healthier physical, economic and social environments (Rutter et al., 2017). This was reinforced by parents during Study 3 as they often faced challenges at multiple levels (e.g. intrapersonal, organisational, community and policy) when trying to engage in behaviours associated with the promotion of healthy growth in their children. It is also important that policy addresses action on upstream social determinants of health concerning obesity prevention and related behaviours, and does not drift downstream and focus primarily on individual lifestyle factors (Baum & Fisher, 2014; Popay et al., 2010; Williams & Fullagar, 2019). That said, individual behaviours must be recognised as key elements in a systems approach (Sniehotta et al., 2017).

7.4.3 Implications for practice

The first 1,000 days is a critical window of opportunity to establish positive health behaviours which can track into later childhood and adulthood. Findings from both the systematic review and interviews with parents highlight the need to focus on the behaviours associated with the promotion of healthy growth, and not simply weight/growth alone. Of the 39 trials involving 46 intervention arms, only four interventions were effective on a primary (adiposity/weight) and secondary (behavioural) outcome measure. A further six interventions showed positive impacts on child adiposity/weight outcomes only, while 22 trials had positive impacts on behavioural outcome measures only. It is important not to overlook the positive impacts on behavioural outcomes in these interventions as these will potentially lead to positive weight outcomes over longer time periods, as behaviours track into later childhood. Furthermore, during the qualitative work, parents highlighted key behaviours for which they required support, namely breast-, infant- and child-feeding.

While the National Institute for Health and Care Excellence (NICE) advocates multicomponent interventions (i.e. addressing nutrition, physical activity, sedentary behaviour, behaviour change, and parenting) to prevent childhood obesity, it has not been able to state what the active ingredients of such interventions should be (NICE, 2015b). In study 2a, we identified several BCTs that were associated with intervention effectiveness, namely problem solving, review behaviour goal(s), feedback on behaviour, feedback on outcome(s) of behaviour, social support (unspecified), instruction on how to perform a behaviour, demonstration of the behaviour, and information about health consequences. There is some evidence, therefore, however flawed, that these BCTs should be incorporated into obesity prevention interventions delivered by health professionals during the first 1000 days.

Much work has been undertaken in Ireland in recent years to standardise and increase the availability of supports for parents (and health professionals) concerning child health, including healthy growth, as part of the Nurture Programme (Gardner, Garcia, Staines, & Vaughan, 2019). Findings from this thesis, particularly in relation to the aforementioned BCTs, as well as insights from parents into their needs and preferences, can inform future development and implementation of this Programme, as well as the implementation of recommendations within national policies/action plans concerning healthy weight for children (Health Service Executive, 2018d), maternity care (Department of Health, 2016a), and breastfeeding (Health Service Executive, 2016), amongst others. Greater supports around breast-, infant- and child feeding in particular are needed. As mentioned previously, it is vital that supports for parents are practical, realistic, evidence-based, timely, accessible, non-judgemental, and from trusted sources, including both health professionals and peers. Interventions should target fathers as well as mothers, and first-time parents in particular, though all parents require support to some degree. There are also implications for the health services, including engaging health professionals in intervention and implementation efforts (for example, parents mentioned more training and education around child feeding and growth), as well as addressing the broader structures within which services/interventions are delivered, given that issues/barriers concerning continuity of care, availability of staff, and time were highlighted by parents during the qualitative interviews.

7.4 Strengths and limitations

The overall strengths and limitations of this thesis are presented in this section, as strengths and limitations of the individual studies have been acknowledged and addressed within the each of the papers (Chapters 3-6).

A key overall strength of this work was the transdisciplinary lens it employed, combining insights from psychology, public health, sociology, behavioural science, implementation science, and obesity studies. Obesity is a complex issue and it is only by combining such insights can we fully understand its causes and develop the most appropriate approaches to address it. The research underpinning this thesis was developed with knowledge translation in mind. It was formulated whilst on placement with the National Lead for Child Health within the HSE and in consultation with decision-makers and practitioners. Throughout the period of the doctoral programme, knowledge was exchanged with the HSE through invited membership of their Health Weight for Children Working Group. Achieving research impact involves seeking to shape wider debates, building relationships with policy makers, becoming a trusted collaborator and being available to provide relevant and practical solutions to questions of concern to policy makers at the appropriate time (Gentry, Milden, & Kelly, 2019). As mentioned in Chapter 1, mixed methods can bridge the gap between siloed research and everyday practice. This thesis incorporated a research prioritisation exercise to set the research agenda. Methods and insights from behavioural science and implementation science were used within the systematic review to identify the effectiveness, active ingredients and external validity reporting of interventions. Finally qualitative research with parents explored their views and experiences of interventions, prioritising and shedding invaluable insights into their lived experiences of negotiating this key life stage, often in the dark and under scrutiny.

There are limitations to this work however. Firstly, health professional-delivered interventions were a core interest of this thesis; the views of health professionals, however, were not incorporated within the empirical research conducted in Study 3 on views and experiences of interventions. Future development of this work would involve health professionals as key stakeholders and incorporate their views on intervention development and/or adaptation. Secondly, while patient and public involvement (PPI) was incorporated within Study 3, through the use of a

parent advisory group to advise on study focus and process, this could have been more extensive, and across all studies. Initially we had planned to involve parents in Study 1, however, it was decided that it would be best not to include them in this grouping - after a lengthy period of trying to recruit parents to the study. This was due to potential inequalities/power imbalances and the potential for their opinions to be "closed down", even with the most able facilitation skills (O'Shea, Boaz, & Chambers, 2019, p. 5). Indeed Williams, Robert, Martin, Hanna, and O'Hara ((forthcoming)) argue that a 'professional advantage' will always be held in PPI, even when efforts are made to neutralise them; this occurs for a variety of reasons, including questions of representation, and outcome or influence. The process of agreeing research priorities can be tokenistic due to lack of awareness or resistance to involvement amongst professionals, highly structured commissioning systems, technically defined subject areas, and tasks that may exclude patients and the public from contributing in meaningful ways (Tembo, Morrow, Worswick, & Lennard, 2019).

7.5 Conclusions

Childhood obesity is a global public health issue. Early life intervention is advocated to promote healthy growth and associated behaviours. which can track into later childhood and beyond. The current work utilised mixed methods to establish research priorities for childhood obesity prevention, and identify the evidence base and theory concerning health professional-delivered early life interventions. The importance of funding and resources, coproduction of research, and a focus on both implementation research and social determinants within the field of childhood obesity prevention were key issues highlighted in the research prioritisation exercise. The resulting priorities may help to shape the research agendas of funders and researchers, and aid in the conduct of policy-relevant research and the translation of research into practice in childhood obesity prevention.

A systematic review of evidence for the effectiveness of health professional-delivered early life obesity prevention interventions found that, while there was some evidence for their effectiveness, primarily in relation to behavioural outcomes, it was difficult to draw any firm conclusion as to what characteristics of

interventions make them more effective. Furthermore, it was not possible to establish what theories were associated with intervention effectiveness, given that only four interventions were classified as effective—on both weight and obesity-related outcomes. While we were unable to show that interventions containing particular BCTs have a greater likelihood of success, interventions involving more active engagement strategies—such as problem solving, review behavioural goal(s), feedback on behaviour, feedback on outcome(s) of behaviour, and social support (unspecified) —were more often associated with effectiveness. There is some evidence, therefore, however flawed, that these BCTs should be incorporated into practice, a unique contribution to existing knowledge. Building on this review, important gaps in external validity reporting were identified that could facilitate decisions around the translation and scale-up of interventions from research to practice. More emphasis is needed on research designs that consider generalisability, and the reporting of external validity elements. Qualitative work with parents prioritised their view and experiences of early life interventions to promote healthy growth and associated behaviours in young children, which have received limited attention to date. Parents are receptive to, and would welcome, support during this critical time period, particularly around feeding. Such support, however, needs to be practical, realistic, evidence-based, timely, accessible, non-judgemental, and from trusted sources, including both health professionals and peers. Various levels of support and intervention are required, at individual, inter-personal, organisational, community, and policy levels. Interventions to promote healthy growth and related behaviours need to be developed and implemented in a way that supports parents, their views and circumstances.

To conclude, this thesis makes a significant contribution to the knowledge-base on early life obesity prevention interventions. It establishes a research and knowledge translation agenda, identifies evidence and theory in relation to interventions using key tools from behavioural and implementation science. The findings provide the groundwork for the development and/or adaptation, of interventions to promote healthy growth during the first 1,000 days, a critical window of opportunity to impact lifelong health.

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Appendices

Appendix 1 Additional research outputs

Published abstracts

Hennessy, M., Byrne, M., Laws, R., Mc Sharry, J., & Heary, C. (2018). Setting the agenda in childhood obesity prevention: co-production of research priorities and facilitators and barriers to knowledge translation. *International Journal of Behavioral Medicine*, *25*(S1), S177-S177. Retrieved from https://doi.org/10.1007/s12529-018-9740-1. doi: 10.1007/s12529-018-9740-1

Hennessy, M., Heary, C., Laws, R., Van Rhoon, L., Toomey, E., & Byrne, M. (2018). Childhood obesity prevention: the effectiveness and active ingredients of interventions delivered by health professionals. *International Journal of Behavioral Medicine*, *25*(S1), S87-S88. Retrieved from https://doi.org/10.1007/s12529-018-9740-1. doi: 10.1007/s12529-018-9740-1

Oral presentations

Hennessy, M., Byrne, M., Laws, R., & Heary, C. (2019, May). *Healthy growth during the first 1,000 days: parental views and maximising their engagement in interventions*. Paper presented at the 33rd Annual Conference of the European Health Psychology Society, Dubrovnik.

Hennessy, M., Heary, C., Laws, R., Van Rhoon, L., Toomey, E., Wolstenholme, H., & Byrne. M. (2019, May). *Obesity prevention during the first 1,000 days: What is the evidence for the effectiveness of interventions delivered by health professionals?* Paper presented at the ASOI Annual Conference 2019, Convention Centre Dublin, Dublin.

Hennessy, M., Byrne, M., Laws, R., & Heary, C. (2019, May). *Obesity prevention during early life: Establishing the evidence base to maximise the effectiveness of interventions delivered by health professionals*. Paper presented at the School of Psychology Research Day, NUI Galway, Galway.

Hennessy, M., Byrne, M., Laws, R., & Heary, C. (2018, November). *Promoting healthy growth during the first 1,000 days: parents' views, experiences and preferences*. Paper presented at 'Obesity in Childhood: Let the conversation

begin': Centre of Nurse & Midwifery Education Mayo/Roscommon Conference, Claremorris, Co. Mayo. [Invited]

Hennessy, M., Heary, C., Laws, R., van Rhoon, L., Toomey, E., & Byrne, M. (2018, November). *Childhood obesity prevention: the effectiveness and active ingredients of interventions delivered by health professionals during the first 1,000 days*. Paper presented at the 15th International Congress of Behavioral Medicine, Santiago, Chile. [Symposium: The impact of early environments on maternal and child obesity and overweight. Convenor: Dr Barbara Mullan, Curtin University]

Hennessy, M., Byrne, M., Laws, R., Mc Sharry, J., O'Malley, G., & Heary, C. (2018, November). *Setting the agenda in childhood obesity prevention: Co-production of research priorities and facilitators and barriers to knowledge translation*. Paper presented at the 15th International Congress of Behavioral Medicine, Santiago, Chile.

Hennessy, M., Byrne, M., Laws, R., & Heary, C. (2018, November). *Obesity prevention during the first 1,000 days: Maximising the effectiveness of interventions delivered by health professionals*. Paper presented at the NUI Galway Threesis Competition 2018, NUI Galway, Galway.

Hennessy, M. (2018, October). *Impact / Knowledge Translation: Research with Impact. Widening my SPHeRE of Influence in Childhood Obesity Prevention*. Paper presented at the Association of University Department of General Practice in Ireland (AUDGPI) Career Development Meeting 2018, University of Limerick. [Invited]

Hennessy, M., Heary, C., Laws, R., van Rhoon, L., Toomey, E., & Byrne, M. (2018, August). *Early life obesity prevention: A systematic review of the effectiveness of health professional-delivered interventions*. Paper presented at the 32nd Annual Conference of the European Health Psychology Society: "Health Psychology Across the Lifespan: Uniting Research, Practice and Policy", NUI Galway, Galway. [Symposium: Obesity across childhood and adolescence. Convenor: Marita Hennessy]

Hennessy, M., Byrne, M., Laws, R., & Heary, C. (2018, June). *Widening my SPHeRE of influence in childhood obesity prevention: research, policy and*

practice. Paper presented at INTeRACT for Health: Increasing Integrated Knowledge Translation Capacity for Impact. School of Psychology, NUI Galway, Galway.

Hennessy, M., Byrne, M., Laws, R., & Heary, C. (2018, June). *Obesity prevention in early life: what do parents think and how can we maximise their engagement in interventions?* Paper presented at the 17th Scientific Annual Meeting for the International Society of Behavioral Nutrition and Physical Activity (ISBNPA): Advancing Behavior Change Science, Hong Kong, China. [Symposium: Parental engagement in obesity prevention interventions in early life: Key lessons and future research directions. Convenor: Prof Karen Campbell, Deakin University]

Hennessy, M., Heary, C., Laws, R., van Rhoon, L., Toomey, E., & Byrne M. (2018, June). *Obesity prevention in early life: the effectiveness and active ingredients of interventions delivered by health professionals*. Paper presented at the 17th Scientific Annual Meeting for the International Society of Behavioral Nutrition and Physical Activity (ISBNPA): Advancing Behavior Change Science, Hong Kong.

Hennessy, M., Byrne, M., Laws, R., & Heary, C. (2018, April). *Early life obesity prevention: Parents' views*. Paper presented at the School of Psychology Research Day 2018, NUI Galway, Galway.

Hennessy, M., Byrne, M., Laws, R., Mc Sharry, J., O'Malley, G., & Heary, C. (2018, January). *Co-creating research priorities on childhood obesity prevention using the nominal group technique*. Paper presented at the SPHeRE Network 4th Annual Conference, RCSI, Dublin.

Hennessy, M., Byrne, M., Laws, R., & Heary, C. (2017, November). *Childhood obesity prevention in early life*. Paper presented at Health Promotion Seminar, Waterford Institute of Technology, Waterford.

Hennessy, M., Byrne, M., Mc Sharry, J., O'Malley, G., & Heary, C. (2017, October). *Bringing POCKETS together: Co-creating research priorities for childhood obesity prevention*. Paper presented at the School of Psychology Research Seminar, NUI Galway, Galway.

Hennessy, M., Byrne, M., & Heary, C. (2017, May). *Informing the development of early-life interventions delivered by health professionals to prevent childhood obesity*. Paper presented at the Health Behaviour Change Research Group Seminar: PhD Pot Pourri, NUI Galway, Galway.

Hennessy, M., Byrne, M., & Heary, C. (2017, March). *Early life interventions to prevent childhood obesity: an Irish perspective*. Paper presented at the Institute for Physical Activity and Nutrition (IPAN), Deakin University, Melbourne.

Hennessy, M., Byrne, M., & Heary, C. (2016, June). *Early intervention to prevent obesity and reduce obesity inequalities: the current state of knowledge and implications for health promotion research, policy and practice*. Paper presented at the 20th Anniversary Health Promotion Conference, NUI Galway, Galway.

Hennessy, M., Byrne, M., & Heary, C. (2016, May). *Preventing obesity during infancy: challenges and opportunities*. Paper presented at the Population Health Research and Health Services Research (PHR-HSR) Alliance Seminar, NUI Galway, Galway.

Poster presentations

Hennessy, M., Byrne, M., Laws, R., Mc Sharry, J., O'Malley, G., & Heary C. (2018, August). *Co-creating research priorities for childhood obesity prevention research: Uniting research, practice and policy*. Poster presented at the 32nd Annual Conference of the European Health Psychology Society: "Health Psychology Across the Lifespan: Uniting Research, Practice and Policy", NUI Galway, Galway.

Hennessy, M., Byrne, M., Laws, R., Mc Sharry, J., O'Malley, G., & Heary C. (2018, May). *Preventing childhood obesity: What are the priority areas for future research according to researchers, policymakers and practitioners?* Poster presented at the 6th Annual ASOI Conference 2018, RCSI, Dublin.

Hennessy, M., Byrne, M., Laws, R., Toomey, E., Tully, L., & Heary, C. (2017, August). *Exploring active ingredients in early-life health professional-delivered interventions to prevent childhood obesity: a systematic review*. Poster presented

at the 31st Annual Conference of the European Health Psychology Society: "Innovative ideas in Health Psychology", University of Padua, Italy.

Hennessy, M., Byrne, M., Toomey, E., Wolstenholme, H., & Heary, C. (2017, April). *Early Life Behavioural Interventions Delivered by Health Professionals to Prevent Overweight/Obesity: What Works, and Why?* Poster presented at the 15th World Congress on Public Health, Melbourne, Australia.

Hennessy, M., Byrne, M., Toomey, E., Wolstenholme, H., & Heary, C. (2017, March). *How can health professionals prevent childhood overweight/obesity during pregnancy and infancy? A systematic review of behaviour change strategies used in interventions*. Poster presented at the 14th Annual Psychology Health and Medicine Conference, RCSI, Dublin.

Hennessy, M., Byrne, M., Toomey, E., Wolstenholme, H., & Heary C. (2017, January). *Interventions delivered by health professionals from conception to age two to prevent childhood overweight/obesity: a systematic review of randomised controlled trials*. Poster presented at the SPHeRE Network 3rd Annual Conference. RCSI, Dublin.

Hennessy, M., Byrne, M., & Heary, C. (2016, April). *Informing the development of interventions to prevent childhood obesity*. Poster presented at the School of Psychology Research Day 2016, NUI Galway, Galway.

Blog

Hennessy, M. (2017, June 16) Childhood Obesity Prevention: Bringing POCKETS together [Blog post]. Retrieved from https://nuighealthpsychology.wordpress.com/2017/06/16/childhood-obesity-prevention-bringing-pockets-together/

Project updates

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Appendix 2 Additional work conducted during PhD

The following outputs were co-/authored by the PhD candidate during their doctoral studies.

Peer-reviewed journal articles

Toomey, E., Matvienko-Sikar, K., Doherty, E., Harrington, J., Hayes, C.B., Heary, C., Hennessy, M., Kelly, C., McHugh, S., McSharry, J., O'Halloran, J., Queally, M., Heffernan, T., Kearney, P.M. & Byrne, M. (2020). A collaborative approach to developing sustainable behaviour change interventions for childhood obesity prevention: Development of the Choosing Healthy Eating for Infant Health (CHErIsH) intervention and implementation strategy. *British Journal of Health Psychology*. https://doi.org/10.1111/bjhp.12407. doi: 10.1111/bjhp.12407

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Hennessy, M., & Share, M. (2017, November). *Influencing policy on nutritional health among families experiencing homelessness in Ireland*. Paper presented at the School of Psychology Research Strategy Committee In-house Impact Workshop, NUI Galway, Galway.

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Appendix 3 Supplementary material for Chapter 2

Study 1: Day 1 - Individual Worksheet 1 (Pink)

Identifying key areas for childhood obesity prevention-related research | Prevention Of Childhood obesity-Knowledge Exchange and TranSlation (POCKETS)

Date 4th May 2017

Name _____

Group No. _____

Please use this sheet to write down topics/questions you think are important to focus on in future research on the prevention of childhood obesity. Please list as many as you can think of. Use the back of the sheet if you need to.

PLEASE RETURN YOUR COMPLETED SHEET TO THE GROUP FACILITATOR AT THE END OF THE SESSION

HEALTH BEHAVIOUR CHANGE RESEARCH GROUP

Contd.

Please use this sheet to write down topics/questions you think are important to focus on in future research on the prevention of childhood obesity. Please list as many as you can think of.

Study 1: Day 1 - Individual Worksheet 2 (Blue)

HEALTH BEHAVIOUR CHANGE RESEARCH GROUP

Identifying key areas for childhood obesity prevention-related research | Prevention Of Childhood obesity-Knowledge Exchange and TranSlation (POCKETS)

Date 4th May 2017

Name _____

Group No. _____

From the list of topics/questions identified by each member of the group – as noted on the flipchart – please write down and rank the top 3 topics/questions you think are important to focus on in future research on the prevention of childhood obesity.

Please score your top choice as 3, your next choice as 2, and your last choice 1.

Topics/question	Score

PLEASE RETURN YOUR COMPLETED SHEET TO THE GROUP FACILITATOR DIRECTLY AT THE END OF THE SESSION

OÉ Gaillimh NUI Galway | HRB Health Research Board | SPHeRE Structured Population and Health-services Research Education | asoi Association for the Study of Obesity on the island of Ireland | IRISH RESEARCH COUNCIL An Chomhairle um Thaighde in Éirinn

Study 1: Day 1 - Group Worksheet (Yellow)

Identifying key areas for childhood obesity prevention-related research | Prevention Of Childhood obesity-Knowledge Exchange and TranSlation (POCKETS)

Date 4th May 2017 **Group No.** _____ **Facilitator Name:** _____

Topic/question	Individual scores (1-3) [P=Participant]										Total group score	Total group rank
	P 1	P2	P3	P4	P5	P6	P7	P8	P9	P10		

PLEASE RETURN THIS COMPLETED SHEET, ALONG WITH COMPLETED INDIVIDUAL WORKSHEETS 1 (PINK) AND 2 (BLUE) TO MARITA HENNESSY

Topic/question	Individual scores (1-3) [P=Participant]										Total group score	Total group rank
	P 1	P2	P3	P4	P5	P6	P7	P8	P9	P10		

Study 1: Day 2 - Individual Worksheet 3

Identifying key areas for childhood obesity prevention-related research | Prevention Of Childhood obesity-Knowledge Exchange and TranSlation (POCKETS)

Date 5th May 2017 **Name** _____

From the list of topics/questions identified – please write down and rank the top 5 topics/questions you think are important to focus on in future research on the prevention of childhood obesity.

Please score your top choice as 5, your next choice as 4, your next choice as 3, and so on.

Topics/question	Score

Round no. _____ **Group no.** _____

Study 3: Background Questionnaire

NUI Galway OÉ Gaillimh | HEALTH BEHAVIOUR CHANGE RESEARCH GROUP | HRB Health Research Board | SPHeRE Structured Population and Health-services Research Education

Parents' Views on Healthy Growth in Young Children
Background Questionnaire

All information collected in this questionnaire is completely anonymous and is only used to provide background information about parents taking part in the interviews. You will not be identifiable from your response.

A.1 Which of the following best describes your relationship to the child aged under 2?

- Mother (biological / adoptive) ☐
- Father (biological / adoptive) ☐
- Step-mother ☐
- Step-father ☐
- Other (please describe) _____ ☐

A.2 For each member of your household (excluding you) could you tell me the following:

Person no.	First name / initial	Sex (M/F)	Age last birthday		Relationship to you
			Years	Months	
1					
2					
3					
4					
5					
6					
7					
8					

A.3 Was your child/any of your children (if applicable) ever breastfed? Yes ☐ No ☐ [If no, please skip to A.6]

A.4 Was your child/any of your children (if applicable), exclusively breastfed? Exclusive breastfeeding means that the infant receives only breast-milk without any additional food or drink Yes ☐ No ☐

A.5 How long was your child (or youngest child) breastfed for?

a. Exclusively breastfed: _____weeks or _____months

a. Any breastfeeding: _____weeks or _____months

A.6 What is your height without shoes? _____feet _____inches OR Metres _____

A.7 What is your weight without clothes and shoes? _____stones _____lbs OR _____Kilograms

A.8 What is your age (years): <25 ☐ 25-30 ☐ 31-39 ☐ 40+ ☐

A.9 Were you born in Ireland?

Yes ☐ If yes, please skip to A.12

No ☐ ⇨ A.10 In which country were you born? _____

A.11 How long ago did you first come to live in Ireland?

- Within the last year ☐
- 1-5 years ago ☐
- 6-10 years ago ☐
- 11+ years ago ☐

A.12 What is your ethnic or cultural background?

White
- Irish ☐
- Irish Traveller ☐
- Any other White background ☐

Black or black Irish
- African ☐
- Any other Black background ☐

Asian or Asian Irish
- Chinese ☐
- Any other Asian background ☐

Other, including mixed background ☐

A.13 What is the highest level of education (full-time or part-time) which you have completed?

- Primary school or less ☐
- Some secondary school ☐
- Completed secondary school ☐
- Post-secondary school technical training ☐
- University degree ☐
- Postgraduate Certificate or Diploma ☐
- Postgraduate Degree (Masters or PhD) ☐

A.14 What of the following best describes you?

- Currently on maternity/paternity leave ☐
- Employee (including apprenticeship or Community Employment) ☐
- Self-employed ☐
- Student, full-time ☐
- On state training scheme/apprenticeship (e.g. SOLAS, Fáilte Ireland) ☐
- Unemployed ☐
- Unable to work due to sickness or disability ☐
- Home duties / looking after home or family ☐
- Other, please specify _____ ☐

Thank you for taking the time to complete this questionnaire

For office use only

Participant ID	Date	Researcher ID

Study 3: Study Advertisement – General

Are you the mother or father of a child aged two or under?

Would you like to take part in a study which is trying to find out about parents' views on healthy growth in children under the age of two years and how this could be best supported?

The study will involve one interview with a member of the study team which will last about an hour.

Interviews will be held at a time and place that suits you.

You will be asked about your experiences and opinions on healthy growth in young children. Your information will be kept confidential.

Taking part in the study is completely up to you. You can decide to withdraw at any point.

If you are interested in taking part, please contact the lead researcher:

Ms Marita Hennessy, SPHeRE Programme PhD Scholar
Telephone 089 245 9405
Email m.hennessy11@nuigalway.ie
Address GO55, AMBE, School of Psychology, National University of Ireland, Galway, Galway

NUI Galway OÉ Gaillimh | HEALTH BEHAVIOUR CHANGE RESEARCH GROUP | HRB Health Research Board | SPHeRE Structured Population and Health-services Research Education

Study 3: Study Advertisement – Fathers

Are you the father of a child aged two or under?

Would you like to take part in a study which is trying to find out about parents' views on healthy growth in children under the age of two years and how this could be best supported?

The study will involve one interview with a member of the study team which will last about an hour.

Interviews will be held at a time and place that suits you.

You will be asked about your experiences and opinions on healthy growth in young children. Your information will be kept confidential.

Taking part in the study is completely up to you. You can decide to withdraw at any point.

If you are interested in taking part, please contact the lead researcher:

Ms Marita Hennessy, SPHeRE Programme PhD Scholar
Telephone 089 245 9405
Email m.hennessy11@nuigalway.ie
Address GO55, AMBE, School of Psychology, National University of Ireland, Galway, Galway

NUI Galway OÉ Gaillimh | HEALTH BEHAVIOUR CHANGE RESEARCH GROUP | HRB Health Research Board | SPHeRE Structured Population and Health-services Research Education

Study 3: Interview Guide

Parents' views on healthy growth in young children
Parent Interview Guide

Study aim:

To elicit parents' views on obesity prevention and specifically health professional-delivered obesity prevention interventions targeting children under the age of two.

Study objectives

1. To explore perceptions of a good and/or appropriate size (healthy growth) for babies and toddlers up to the age of two
2. To explore parents' understanding of healthy growth and associated behaviours
3. To establish the perceived importance of weight in young children, how parents gauge it and if/how they think it can be managed
4. To explore parents' views about childhood obesity, interventions to prevent childhood obesity / promote healthy growth, and interventions delivered by health professionals in particular
5. To examine variations in all the above, if any, by socio-economic background and gender/parental role.

Briefing

- Thank you very much for agreeing to take part in the study, I really appreciate you giving up your time to talk with me.
- My name is Marita Hennessy and I am a PhD student within the Health Behaviour Change Research Group in the School of Psychology at NUI Galway.
- As described in the Participant Information Sheet, we are carrying out these interviews to get a better understanding of what parents think about healthy growth in young children and how this can be best supported. We want to use the information to inform the development of supports/programmes.
- I'm really interested to hear your views. There are no right or wrong answers.
- If at any time during the interview you do not wish to answer a question that's okay, just tell me and we will move on. [This may be particularly relevant if a child is present].
- I would like to record our conversation to allow me to give you my full attention during the interview. The recording will be typed out, but everything you say will be in strict confidence and reported anonymously (unless you disclose something that is identified as a risk to a child, in this case I must report this in line with child protection guidelines). This means that your name and any names or places you mention will be taken out and replaced, so that if someone read your interview they would not know who you are.

- If, at any stage, you wish to stop the audio recorder, or the interview, please let me know.
- Do you have any questions you would like to ask before we start?

A. Introduction

- Tell me a bit about yourself and your family (will have completed background survey so will have details) and your baby/toddler in particular
    - Baby's age
    - Any other children
    - Who else cares for the child/helps them with their child?

B. Importance of issue

- We hear a lot in the media nowadays about childhood obesity, what do you think about this issue?
- How do you know if a child aged under two is a healthy weight?
- Is it possible for a baby or toddler to be overweight?
    - What might the consequences of a child being overweight now, or for the future be, if any?
- How much do you think that an infant's weight needs to be monitored?
    - Are there things you can do to manage an infant's weight?
    - Is it possible to manage an infant's weight – to maintain a healthy weight or to manage it if it becomes an issue? If yes, how?

C. Understanding of behaviours associated with healthy growth

- What do think influences the size and growth of babies and toddlers?
    - [Open Q first => cue cards if not forthcoming]
    - Your weight when you became pregnant
    - The amount of weight you gain during your pregnancy?
    - If you smoke during pregnancy?
    - A baby's birth weight?
    - How quickly a baby gains weight during the first few months of life?
    - How and what you feed your baby (breastfeeding/formula feeding; when/how you introduce your baby to solid foods)?
    - How active or inactive a baby is?
    - How much sleep your baby gets?
    - Anything else?
- What do you think are the most important influences?

D. Experience - pregnancy

- Did anyone discuss your weight before you became pregnant with you? Can you tell me about this?
- Thinking about your pregnancy - was your weight gain and/or the weight of your baby discussed with you?

- When? By whom? Where?
- Did you raise the issue or did someone else?
- What did you think about this? [Probe various mandatory checks/visits].

E. General weight perceptions / Experience – post-partum

- Can you tell me about your baby's size at birth? What did you think about this?
- Describe your baby's growth during the first few months of life?
  - What are your thoughts about this?
- What do you think about your baby/toddler's weight now?
  - As compared to his/her siblings, cousins, other children?
  - Have you ever had any concerns about their weight?
  - Have you ever discussed it with anyone, or sought information/advice about it? If yes – who/where? Can you tell me about it?
- Did any health professionals monitor your baby's weight since they were born?
  - If so - Who? How often?
  - Did they plot this on a growth chart?
  - Did they explain what it meant? Did it make sense to you?
  - Did you get a copy of the record?
- Has anyone ever commented on the size of your baby/toddler?
  - If yes - Who? What did they say?
  - How did you respond/feel at the time?
  - What are your thoughts about it now?

F. Possible interventions

- Do you remember if any health professionals ever discussed any health messages/health-related behaviours with you while you were pregnant or since your baby was born?
  - [Open Q first => cue cards if not forthcoming]
  - The amount of weight you gained during your pregnancy
  - Your diet/what you ate during your pregnancy
  - How physically active you were during you r pregnancy
  - Feeding your baby – breastfeeding, formula feeding, introducing solid foods
  - Active play/tummy time with your baby
  - Time spent watching TV or on phones
  - Your baby's sleep] with you? Can you tell me a little bit more about this? Who? What? What did you think about this?
- Who are the main health professionals you have contact with regarding your child (since pregnancy)?
  - To what extent do you seek information/advice from them about your child's weight/growth?

    - Was the advice you got useful? Did you take it on board (why/why not)?
    - How would describe your relationship with them?
    - To what extent do you trust them?
    - How does this compare to other sources of information/advice (i.e. family, friends, social media)?
- What other practitioners do you see? Where else do you go for advice/information?
- What do you think works to encourage healthy growth?
    - How do you think we can encourage healthy growth in babies and toddlers?
    - Where did these ideas come from?
    - What would you find useful? / What have you found useful in the past?
- How/when do you think healthy growth in young children can be promoted, and who do you think can do that?

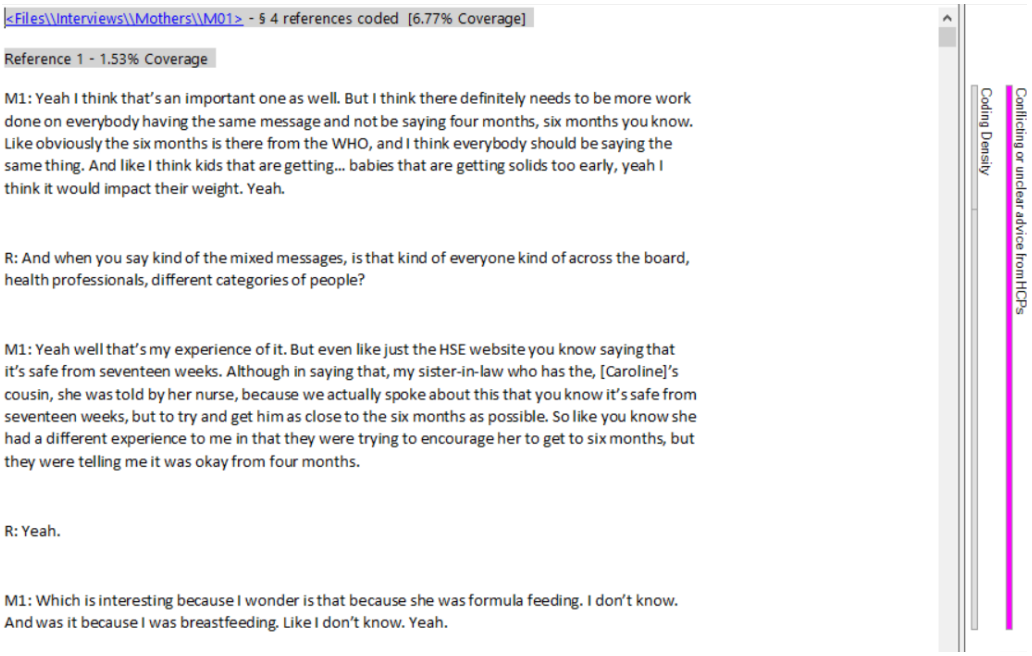
[Note: wording in this section to be adapted for interviews with fathers – e.g. 'your pregnancy' -> 'the pregnancy', 'with you' -> 'with you or your partner/the mother of your baby'.]

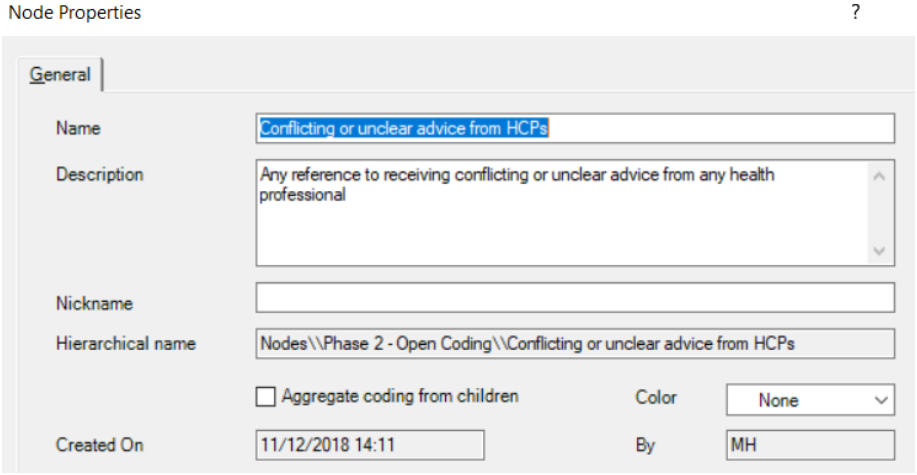
G. Summary / Close

- [Note to self: Reflect back a summary of what was asked during the interview and what they said]
- Was there anything I left out?
- Is there anything you would like to add?

Study 3: Excerpts from the Analysis Process in NVivo

Sample of coding





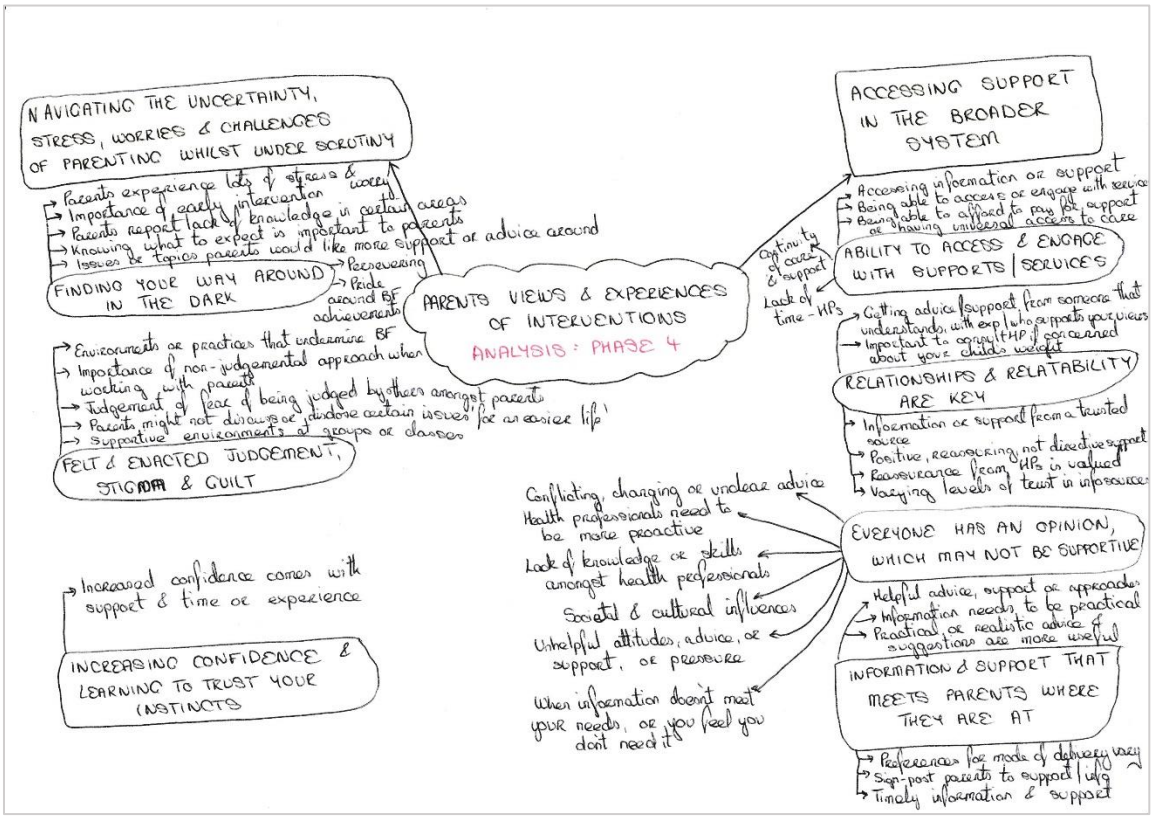
Theme development

Phase 3 - Developing Categories (Interventions)

Name	Files	References
Barriers	29	771
Facilitators	28	454
Information seeking	29	1826
Parents experience stress and worry and require or develop confidence or coping skills	29	735
What parents want in terms of information and support	29	643

Phase 4 - Developing Themes

Name	Files	References
Accessing support in the broader system	29	1443
Ability to access and engage with supports or services	29	272
Everyone has an opinion, which may not be supportive	28	469
Information and support that meets parents where they are at	28	297
Relationships and relatability are key	29	405
Navigating the uncertainty, stress, worries, and challenges of parenting whilst under scrutiny	29	1242
Felt and enacted judgement, stigma and guilt	28	438
Finding your way around in the dark	29	642
Increasing confidence and learning to trust your instincts	25	162



Study 1: Information Sheet

ASOI 2017: Participant Information for Day 1 Workshops

On Day 1 of the ASOI 2017 Annual Conference (Prevention of Childhood Obesity: POCKETS) we are hosting roundtable discussion workshops as part of a study to identify and prioritise knowledge gaps concerning obesity prevention and knowledge translation.

We would really appreciate your involvement in these workshops – it will allow us to harness the collective expertise of a diverse range of participants to set out directions for future research and knowledge translation.

Adopting a systematic, explicit and transparent approach to the prioritisation of health research priorities helps to ensure that:

- ✓ research with the greatest potential public health benefit is funded;
- ✓ funded research and outputs are policy-relevant;
- ✓ there is efficient and equitable use of limited resources.

We will publish the findings from the study and hope they will be of benefit those involved in obesity prevention research, policy, and practice.

To find out more about the study and what it involves please read the participant information below.

If you would like to participate in the study, we would be very grateful if you would indicate your consent by completing the online consent form: ASOI 2017 Day 1 Consent Form. This link is also available on the ASOI website (www.asoi.info) and on the online registration form for the conference (buytickets.at/asoi).

Identifying key areas for childhood obesity prevention-related research

Participant Information

Research team: Marita Hennessy, Dr Molly Byrne, Dr Grace O'Malley, Dr Caroline Heary

What is the purpose of this research?
This study aims to identify

1. Policy-relevant research gaps/priorities in childhood obesity prevention, by leveraging the collective expertise of a wide range of stakeholders including researchers, policymakers, clinicians, educators, and parents
2. Obstacles/barriers and facilitators to knowledge translation in childhood obesity prevention and opportunities to overcome or maximise them, accordingly.

The research is funded by the Irish Research Council and has been reviewed by the National University of Ireland, Galway (NUI Galway) Research Ethics Committee.

Who are the research team?
Marita Hennessy is a SPHeRE Programme PhD Scholar at the NUI Galway in the area of childhood obesity prevention. Drs Caroline Heary and Molly Byrne are Ms Hennessy's supervisors and research in the area of developmental/health psychology from NUI Galway. Dr Grace O'Malley is a senior physiotherapist in The Children's University, Temple Street, Dublin and is chair of the Association for the Study of Obesity on the island of Ireland.

Why have I been chosen?
You have been chosen because you have indicated an interest in registering to attend Day 1 of the ASOI 2017 Annual Conference - 'Prevention of Childhood Obesity: POCKETS'.

What do I have to do?
If you decide to take part in this study, you will participate in two roundtable discussion workshops as part of day 1 of the conference. During the facilitated workshops, you will be asked to: (1) identify and prioritise knowledge gaps in childhood obesity prevention; (2) identify obstacles/barriers and facilitators to knowledge translation in childhood obesity prevention and opportunities to overcome or maximise them, accordingly.

If you do not take part in the study, you can still attend the conference but not take part in the roundtable discussion workshops that form part of the study. In this instance, please note that there will be no alternative session running in parallel to the workshops for you to attend instead.

If you are interested in taking part, please complete the online consent form as per the instructions above.

What are the advantages and disadvantages of taking part?
There are no direct personal benefits to you. We hope, however, that the findings from the study will be of benefit those involved in obesity prevention research, policy, and practice by setting out directions for future research and knowledge translation. This study is unlikely to result in any risks, discomfort or distress to the research team or the participants.

Will my taking part in the study remain confidential?
Your participation in the study will not be anonymous as you will be taking part in roundtable discussion workshops during the ASOI 2017 Annual Conference. Your contributions, however, will not be attributed to you and so will be kept confidential in the final write-up. Your role and that of your organisation (if applicable) may appear in research reports and papers as this is sometimes required by journals. Your personal details (name, role, organisation, email) will be included on the workshop delegate list (and therefore publicly shared) if you consent to this. We will not release these details without your consent: you will be asked to indicate your agreement with the sharing of your details on the consent form.

What happens if I change my mind?
Taking part in this study is voluntary. It is up to you to decide whether to take part. You can withdraw without penalty at any time and without giving a reason.

What happens if something goes wrong?
If you have a concern about any aspect of this project, please speak to Marita Hennessy using the details below who will do her best to answer your query. If you remain unhappy, or wish to make a formal complaint, please contact Dr John Bogue, Head of School, Psychology, NUI Galway using the details below.

What will happen to the results of the research study?
The results will be published in scientific journals and at meetings. A summary of the findings will be sent to all participants and key stakeholders.

Where can I get more information?
If you would like any more information – or have any questions – about the study, or the event, please contact Marita Hennessy.

Contact details:

Name:	Marita Hennessy
Email:	m.hennessy11@nuigalway.ie
Address:	Room G055, AMBE, School of Psychology, NUI Galway, Galway
Name:	Dr John Bogue
Email:	john.bogue@nuigalway.ie
Address:	AMB1041, AMBE, School of Psychology, NUI Galway, Galway

Thank you for taking the time to read this information

Study 1: Consent Form

Identifying key areas for childhood obesity prevention-related research

Consent Form

Research team: Marita Hennessy, Dr Molly Byrne, Dr Grace O'Malley, Dr Caroline Heary

Purpose of study: This study aims to identify

1. Policy-relevant knowledge gaps and research priorities in childhood obesity prevention, by leveraging the collective expertise of a wide range of stakeholders including researchers, policymakers, clinicians, educators, and parents
2. Obstacles/barriers and facilitators to knowledge translation in childhood obesity prevention and opportunities to overcome or maximise them, accordingly.

If you are happy to take part in this research, then please read the following statements which you will be asked to indicate your agreement with on the online consent form, also available via www.asoi.info. If you have difficulty with the online version of the form, and wish to participate in the study, please complete this page and bring it with you to the conference.

	Yes	No
I confirm that I have read and understand the information for this study and have had the opportunity to ask questions	☐	☐
I understand that my participation is voluntary and that I am free to withdraw myself at any time without giving any reason and without any adverse consequences or penalty	☐	☐
I understand that my contributions on the day will not be confidential or anonymous (except for the private ranking of knowledge/research gaps), but that my contributions will be confidential and anonymous in the final write-up	☐	☐
I agree to the inclusion of my personal details (name, role, organisation, email address) on the workshop delegate list	☐	☐
I agree to the publication of my relevant background details (i.e. role, organisation), if required in research reports and papers, to contextualise the findings	☐	☐
I agree to take part in this research study	☐	☐

Participant name: _____ (Signature) _____ (Block capitals)

Date: _____

Contact details: Marita Hennessy
Email: m.hennessy11@nuigalway.ie
Address: Room G055, AMBE, School of Psychology, National University of Ireland Galway, Galway

Study 3: Sources of Information and Support

Parents' views on healthy growth in young children | Sources of information and support

Thank you for taking part in this study. You may feel like talking to someone about some of the issues that arose during the interview. We have put together details of some useful resources for you. Your GP or Public Health Nurse may be the first point of contact.

Caring for your baby – including information on feeding, activity and more

- Caring for your Baby and Child: HSE website https://www.hse.ie/eng/health/child/
- Booklets for 0-6 months, 6 months-2 years, and 2-5 years. Available from your Public Health Nurse or online at https://www.hse.ie/eng/health/child/cfyb/

Pregnancy

- Booklet 'Healthy eating for pregnancy' available in the publications section on www.healthpromotion.ie

Breastfeeding

- Information and breastfeeding and support groups available at https://www.breastfeeding.ie/
- Leaflet 'Breastfeeding - a good start in life', available in the publications section on www.healthpromotion.ie
- Booklet 'Breastfeeding and work', available in the publications section on www.healthpromotion.ie
- Cuidiú - The Irish Childbirth Trust provide support services in Antenatal and Birth Preparation, Breastfeeding, Postnatal and Parenthood. http://www.cuidiu-ict.ie/
- The La Leche League in Ireland is a voluntary organisation which provides information and support to women who want to breastfeed their babies. https://www.lalecheleagueireland.com/
- Friends of Breastfeeding works to ensure that women in Ireland achieve their desired breastfeeding experience. http://www.friendsofbreastfeeding.ie/wp/

Infant feeding

- Booklet 'How to prepare your baby's bottle' available from safefood or online http://www.safefood.eu/Publications/Consumer-information/How-to-prepare-your-baby-s-bottle.aspx

Introducing solid foods

- Booklet 'Introducing family meals', available in the publications section on www.healthpromotion.ie

Active play

- Booklet 'Active Play Every Day 0-3', available in the publications section on www.healthpromotion.ie

Your child's weight

- Your Child's Weight: Booklet available from safefood or online at http://www.safefood.eu/Publications/Consumer-information/Your-Child-s-Weight.aspx
- Booklet 'Eat Smart Move More-A Guide for Healthy Eating and Getting Active for Children', available in the publications section on www.healthpromotion.ie

Recipes

- '101 Square Meals' available from safefood or online at http://www.safefood.eu/Recipes/101-Square-Meals-(PDF).aspx

General parenting

- Parenting24Seven: http://www.tusla.ie/parenting-24-seven/0-5-years

Parent wellbeing

- The "baby blues" don't last for more than two weeks after giving birth. If your symptoms last longer or start later, you could have postnatal depression. Postnatal depression can start any time in the first year after giving birth. Please speak with your GP if you have feelings like this.

Study 3: Participant Information Leaflet (DL, folded)

What happens if you have any concerns?

If you have a concern about any aspect of this project, please speak to Marita Hennessy or Dr Caroline Heary using the details provided.

If you have any concerns about this study and wish to contact someone independent, and in confidence, you may contact the Chairperson of the NUI Galway Research Ethics Committee, c/o Office of the Vice President for Research, NUI Galway or email ethics@nuigalway.ie.

What will happen to the results of the research study?

Results of the study will be published in research journals and presented at conferences, but these published results will not identify you in any way: no names will be included in the report and any quotes from the interview will be anonymous. A summary of the findings will be sent to you, if you would like to receive them.

What do I do now?

If you are interested in taking part, please contact Marita Hennessy or Dr Caroline Heary. They will be able to answer any questions you have and make sure you understand the study information. You will be given as long as you need to decide whether to take part or not.

If you decide to take part in the study, please read and sign the consent form provided and return to Marita Hennessy, in person, or by post to the address provided.

You will be given a copy of the information sheet, and consent form after you sign it.

Contact details

Marita Hennessy
m.hennessy11@nuigalway.ie
089 245 9405

Dr Caroline Heary (PhD Supervisor)
caroline.heary@nuigalway.ie
091 495059

School of Psychology, National University of Ireland Galway, Galway

Thank you for taking the time to read this information

Parents' views on healthy growth in young children

Parent Information Sheet

SPHeRE Structured Population and Health-services Research Education

HRB Health Research Board

NUI Galway OÉ Gaillimh

Health Behaviour Change Research Group

What is the purpose of this study?

We would like to find out parents' views on healthy growth in children under the age of two and how this can be best supported.

The research is funded by the Health Research Board and has been reviewed by the National University of Ireland, Galway (NUI Galway) Research Ethics Committee.

Who is conducting the study?

We are a team of researchers within the School of Psychology at NUI Galway. Marita Hennessy is a SPHeRE Programme PhD Scholar in childhood obesity prevention. Drs Caroline Heary and Molly Byrne are Ms Hennessy's supervisors. Dr Rachel Laws from Deakin University in Australia is also involved in the project.

Why have I been chosen to take part in this study?

You have been chosen because you are a parent of a child aged under two years.

What would taking part involve?

If you decide to take part in this study, we will contact you to arrange an interview. The interview will be carried out face-to-face (or over the telephone if this is not possible) and be arranged at a time, and place, to suit you.

Before the interview starts you will be asked to complete a short background questionnaire about you and your family (e.g. age, education and occupation). During the interview, you will be asked about your thoughts and feelings about child growth, and how healthy child growth can be supported.

We are interested in hearing your thoughts and experiences on the following topics:

- Preventing childhood obesity
- Promoting healthy growth and related behaviours in infants
- Your understanding of obesity in young children
- If you think weight is important at this stage, if it is something that should be addressed, and if so, by who?

The interview will be conducted by Marita Hennessy and will take about an hour. With your permission, it will be audio-recorded.

What are the advantages and disadvantages of taking part?

You may not benefit personally. The results of the study will be used to provide guidance on the development of supports, programmes and services for parents. This may benefit parents and young children in the future.

This study is unlikely to result in any risks, discomfort or distress to you if you take part. Taking part in the study will involve giving of your time to take part in the interview.

Do I have to take part?

You do not have to take part and you can stop at any time without giving a reason. Nothing will happen to you if you decide not to take part.

Will my taking part in the study remain confidential?

With your permission, the interview will be audio-recorded to help us remember what was said. The recording will then be typed up. Your name and any names or places you mention, will be taken out and replaced with other names. The recording will be stored electronically in a password-protected file that only the research team can access. The typed record of your interview will be stored in a separate locked cabinet.

If during the interview the interviewer becomes concerned for the welfare or safety of a child or young person they will be required to report this to the Child Protection Officer at NUI Galway, in line with Children First: the National Guidance for the Protection and Welfare of Children.

What happens if I change my mind?

Taking part in this study is voluntary - it is up to you to decide whether to take part. You can withdraw without penalty at any time and without giving a reason.

Study 3: Consent Form

Parents' views on healthy growth in young children | Consent form

Purpose of study: This study aims to find out parents' views on healthy growth in children under the age of two and how this could be best supported.

If you are happy to take part in this research, then please read all seven statements below and tick the boxes if you agree with them. You will be given a copy of the consent form after you sign it.

I confirm that I have read and understand the information for this study	☐
I have had the opportunity to ask questions about this study and have them answered to my satisfaction	☐
I agree to take part in this study	☐
I understand that the interview will be audio-recorded and that no one but the research team will hear the recording	☐
I understand that my taking part is voluntary and that I am free to withdraw myself or my data at any time without giving any reason and without any negative impacts	☐
I give permission for anonymous quotes from the interview to be included in reports of the findings from the research	☐
I would like to receive a copy of the summary of the study findings	☐

If yes, please provide your:

Email address _____, OR

Postal address _____

_____	_____	_____
Name of Participant	Signature	Date
_____	_____	_____
Name of Person taking consent	Signature	Date

Contact details:
If you have any questions about any aspect of this study you may contact members of the study team:

Name	**Email**	**Telephone**
Marita Hennessy	m.hennessy11@nuigalway.ie	089 245 9405
Dr Caroline Heary	caroline.heary@nuigalway.ie	091 495059

Postal Address: School of Psychology, AMBE, National University of Ireland, Galway

Thank you for being part of this project

Appendix 4 Supplementary material (Table S5) for Chapter 4

Table S5 Intervention characteristics

Trial	Delivered by	Delivery time period	Mode of delivery	Intervention setting	Delivered during routine care	Intervention targets	Intervention intensity: Total intervention duration and any information on no. of contacts, timing and duration of contacts	Follow-up timepoint(s)	Outcome(s) – Significant impact[1]		
									Anthro (A)	Behavioural (B)	(A) AND (B)
Albernaz 2003 RCT	Lactation consultants (registered nurses)	Birth to 2 years only	Face-to-face visits (1 in the hospital & 7 home visits) with individual mothers. A hotline was open 24 h/d to request help and/or extra visits	1 visit in the hospital and 7 visits at home	No	Breastfeeding	Total intervention duration: 4 months No. of contacts: 8 minimum. Hotline open to request help/ extra visits. Timing & duration of contacts: 1st visit while mother still in hospital; home visits when infant aged 5, 15, 30, 45, 60, 90 & 120 days old. Duration of visits not specified	I-End: Child aged 120 days	X	✓	X
Baby Milk Trial: *Lakshman 2018 RCT	Research nurses	Birth to 2 years only	Face-to-face sessions, telephone contacts, and written materials	Face-to-face sessions took place in a specially designed research facility in Cambridge, Ely, Wisbech, Huntingdon, or if the participant preferred, at their home; telephone contacts	No	Infant feeding: bottle feeding; introduction to solids	Total intervention duration: 5.5 months No. of contacts: 5 Timing & duration of contacts: 3 x 30-45-minute face-to-face contacts (at baby's ages 2-12 weeks, 4-5 & 6-7 months) & 2 x 15-20-minute telephone contacts (at 2-3 months & 5-6 months) in addition to theory-based intervention leaflets (at 2 & 4 months)	I-End: Child aged 6 months I-FU (2): Child aged 12 months	✓	✓	✓
BBOFT+: *Eline 2016 cRCT	Youth Health Care nurses and physicians	Birth to 2 years only	Face-to-face individual advice and care during the regularly scheduled Youth Health Care visits	Youth Health Centre	Yes	Daily exercise/ outdoor playing, breakfast daily, few sweet drinks, minimal TV time, sleep [Infant/child]	Total intervention duration: 36 months *Only details / results for intervention delivery up to child aged 2 years included in this review due to scope* [Birth – 2 years=24 months] No. of contacts: 13-16 Timing & duration of contacts: 8-11 contacts in the 1st year, & 5 contacts	I-Mid: Child aged 15 months [Anthro only] I-Mid: Child aged 13/15 months [Behavioural only] [Note, I-End:	N/A (X: I-Mid)	N/A (✓: I-Mid)	N/A (X)

							in total in the 2nd & 3rd year of life. Duration of contacts not specified	Child aged 36 months. Out of scope of review so only outcomes within review scope included]			
BLISS: *Taylor 2017 RCT	Lactation consultant and trained researcher (dietitian)	Antenatal and birth to 2 years	Face-to-face individual sessions (& one group session before birth) and individual telephone calls (5 contacts with an international board certified lactation consultant from antenatal to 5 months, and 3 home visits from a research assistant trained in the BLISS approach at 5.5, 7, and 9 months of age	Home visits and telephone contacts. 5 contacts (3 face-to-face – where not specified – and 2 telephone). Three additional contacts (face-to-face) by a trained researcher	No	Infant feeding: introduction to solids	Total intervention duration: 11.5 months No. of contacts: 8 Timing & duration of contacts: 5 contacts (3 face-to-face & 2 telephone; 10-60 minutes each) antenatally (F2F) & at 1 (F2F) & 3-4 weeks (T) & 3-4 (F2F) & 5 months (T). Additional support could be requested. 3 additional contacts (face-to-face; 30-60 minutes each) when the infant was 5.5, 7 & 9 months of age	I-FU (1): Child aged 12 months I-FU (2): Child aged 24 months [Note, I-End: Child aged 9 months]	X	✓	X
*Carlsen 2013 RCT	International Board Certified Lactation Consultant	Birth to 2 years only	Telephone consultations	Telephone-based advisory support service. Participants recruited via Hvidovre Hospital, Copenhagen University, Denmark.	No	Breastfeeding	Total intervention duration: 6 months No. of contacts: 9 (minimum) Timing & duration of contacts: 3 contacts during the first month (initial contact within the first week); thereafter, participants were contacted every second week until 8 weeks postpartum &, thereafter, once monthly. Extra contacts were offered for specific difficulties. All	I-End: Child aged 6 months	X	✓	X

							women had the direct telephone number to the lactation consultant, & she was available 7 days/week. The 1st contact was set to last 20 minutes, whereas the duration of the following calls was 5–10 minutes				
EOIP: *De Vries 2015 cRCT	Nurses	Birth to 2 years only	Face-to-face, individual visits	One home visit plus regular visits at the Well Baby Clinic	Yes	Infant physical activity	Total intervention duration: 10.5 months No. of contacts: 5 Timing & duration of contacts: Home visit 2 weeks after birth & during regular visits at the Well Baby Clinic at 2, 4, 8 & 11 months of age	I-FU: Child aged 2.5y [Note, I-End: Child aged 11 months]	✓	X	X
*Ekstrom 2014 cRCT	Midwives and postnatal / child health nurses	Antenatal and birth to 2 years (unclear)	Not described in detail: face-to-face sessions in hospital; home visits	Antenatal centre, child health centre, home visit	Yes	Breastfeeding	Total intervention duration: Unclear – 13 months estimated (for this review; but could be 6 years & 3 months) No. of contacts: Unclear Timing & duration of contacts: Contact with a midwife approx. 8-11 times during pregnancy. Almost all women gave birth in a hospital, & care in the hospital was provided by midwives. The length of hospital stay was between 6 hours & 4 days, & a child health nurse made a home visit 7–10 days after the birth & remained in contact until the baby was old enough to start school at 6 years of age	I-End: Child aged 9 months	X	✓	X
ETOIG: *Parat 2019 RCT	Physician (pediatrician or endocrinologist), dietician, or a	Antenatal and birth to 2 years	Face-to-face group (x4) and individual (x2) sessions	Four French university hospitals	No	Maternal diet and/or physical activity; infant feeding	Total intervention duration: 27 weeks approx. No. of contacts: 6	I-FU: Child aged 2 years [Note, I-End: Infant aged 2	✓	X	X

	midwife						Timing & duration of contacts: 4 group sessions at ≤21, 28, 35 weeks of gestation & 2 months after delivery. 2 individual dietary counselling sessions at 26 & 30 gestational weeks. Initial interview took 60–90 minutes; others took 20-30 minutes	months]			
FeLIPO: *Rauh 2015 cRCT	Trained researchers who were nutritionists	Antenatal only	Two face-to-face individual counseling sessions	Gynaecological practices	No	Maternal nutrition behaviours; maternal physical activity behaviours	Total intervention duration: 10 weeks No. of contacts: 2 Timing & duration of contacts: Individual counselling modules at the 20th & 30th week of gestation, lasting up to 60 & 30 minutes, respectively	I-FU: Child aged 12 months [Note, I-End: 30th week of gestation]	X	NA	NA
***Froozani 1999** Quasi-RCT	Trained nutritionist	Birth to 2 years only	Face-to-face visits with a nutritionist	In the maternity ward of the hospital, with follow-ups in the hospital lactation clinic or at home	No	Breastfeeding	Total intervention duration: 4 months No. of contacts: 7 (minimum) Timing & duration of contacts: Contact during mothers' postpartum stay; contact on day of discharge. Follow-up visits in the lactation clinic or at the patient's home were conducted on day 10-15 after delivery, after 30 days, & at monthly intervals until the end of the 4th month. Mothers were encouraged to attend the clinic at any time if they were worried	I-End: Infant aged 4 months	✓	✓	✓
FYCS: *Bonuck 2014 RCT	Nutritionists	Birth to 2 years only	Face-to-face individual session, with written materials (flipchart and	WIC clinics (programme for low-income families). Delivered during routine WIC nutritional	Yes	Infant feeding: bottle feeding (bottle weaning)	Total intervention duration: 10-15 minutes No. of contacts: 1 Timing & duration of contacts: Delivered during one WIC nutrition	I-FU: 12 months (Child aged 24 months) [Note, I-End:	X	✓	X

			brochure) and a website	counseling visit			counselling session at child age 12 months. Typical WIC nutrition sessions last 10-15 minutes	Infant aged 12 months]			
Grow2Gether: *Fiks 2017 RCT	Psychologist	Antenatal and birth to 2 years	Online group activities and 2 in-person group meetings	Online group activities via Facebook. Location of in-person meetings not described	No	Infant feeding (including breastfeeding & introduction to solids); sleep; parenting	Total intervention duration: 11 months No. of contacts: 2 in-person contacts, plus online activities Timing & duration of contacts: Online group activities for 11 months (2 months prenatal until infant age 9 months) plus 2 in-person meetings (prenatally & at infant age 4 months)	I-End: 9 months (Infant aged 9 months) [Weight also measured at interim timepoints: T2=infant 2 months, T6=infant 6 months]	X	✓	X
Healthy Beginnings: *Wen 2015 RCT	Community (research) nurse	Antenatal and birth to 2 years	Face-to-face home visits (one home visit at the gestation age of 30–36 weeks and seven visits at 1, 3, 5, 9, 12, 15 and 24 months after birth), together with pro-active telephone support	Community-based home visiting intervention delivered in the most socially and economically disadvantaged areas of Sydney with telephone support	No	Infant feeding, breastfeeding, introduction to solids; physical activity	Total intervention duration: 2 years No. of contacts: 8 Timing & duration of contacts: 8 home visits: 1 at gestational age 30-36 weeks, & 7 visits at 1, 3, 5, 9, 12, 15 & 24 months after birth. Visits were approximately 1 hour in duration. Additional pro-active telephone support	I-End: Child aged 2 years I-FU (1): Child aged 3.5 years I-FU (2): Child aged 5 years	✓ (I-End only)	✓ (I-End only)	✓ (I-End only)
Healthy Moms: *Vesco 2016 RCT	Dietitian; behavioural interventionists	Antenatal only	Face-to-face individual dietary sessions and group sessions	Individual and group sessions conducted at the Center for Health Research	No	Healthy eating during pregnancy (mother)	Total intervention duration: 4-5 months No. of contacts: 18 Timing & duration of contacts: 2 individual counselling sessions (time/session not described) & 16 group sessions x 90 minutes	I-FU: Child aged 1 year [Note, I-End: Birth of baby]	✓	NA	NA
InFANT: *Campbell 2013 cRCT	Dietitian	Birth to 2 years only	Face-to-face group sessions	Delivered during the regular meeting time of the first-time parents' group – these groups are	No	Infant feeding, diet, physical activity, television viewing	Total intervention duration: 15 months No. of contacts: 6 Timing & duration of contacts: 6 x 2-hour	I-End: Infant aged 20 months	X	✓	X

				run within local government areas in Victoria, Australia, by Maternal and Child Health nurses			sessions at 3-month intervals				
INSIGHT: *Paul 2018 RCT	Research nurses	Birth to 2 years only	Mailed instructions (2 weeks); home visits (at child age 3 to 4, 16, 28, and 40 weeks); research centre visits (at 1 and 2 years); telephone contacts (at 18 and 30 months)	Home visits at child age 3 to 4, 16, 28, and 40 weeks. Research centre visits at 1 and 2 years. Telephone contacts at 18 and 30 months	No	Infant feeding; physical activity; sedentary behaviour; sleep; emotional regulation	Total intervention duration: 29.5 months No. of contacts: 9 Timing & duration of contacts: Mailed instructions at 2 weeks; home visits at child age 3 to 4, 16, 28, and 40 weeks; Research centre visits at 1 & 2 years; telephone contacts at 18 & 30 months	I-Mid (1): Infant aged 8 weeks [Behavioural only] I-Mid (2): Infant aged 16 weeks [Behavioural only] I-Mid (3): Infant aged 40 weeks [Behavioural only] I-Mid (4): Infant aged 44 weeks [Behavioural only] I-Mid (5): Infant aged 1 year [Anthro &Behavioural] I-Mid (6): Infant aged 1.5 years [Behavioural only] I-Mid (7): Child aged 2 years [Anthro only]	✓	✓	✓

								I-End: Child aged 30 months [Anthro only] I-FU: Child aged 36 months [Anthro only] I-End: Child aged 2.5 years [Behavioural only] I-FU (1): Child age 3 years [Anthro & Behavioural]			
ISS/KSS: ***Wake 2011** cRCT	Maternal and Child Health Nurses	Birth to 2 years only	Face-to-face individual consultation	Well-child check at Maternal & Child Health Centre	Yes	Sleep (infant)	Total intervention duration: Unclear – potentially 4 months No. of contacts: 2-3 Timing & duration of contacts: Delivered over 2-3 visits (initial visit 30-60 minutes during 8-month well-child check, subsequent visits 10-15 minutes)	I-End: Child aged 1 year [Behavioural only] I-FU: Child aged 6 years [Anthro & Behavioural]	NA, I-End; X, I-FU [=>NA, effectiveness assessment[1]]	X	X [=>NA, effectiveness assessment[1]]
ICEAGE: ***Jonsdottir 2014** RCT	Nurse who also was an International Board-Certified Lactation Consultant	Birth to 2 years only	Face-to-face and ability to 'contact' research team/ nurses	Health care centres	Unclear	Breastfeeding; complementary feeding	Total intervention duration: 2 months No. of contacts: 1 (minimum) Timing & duration of contacts: Face-to-face visit at the healthcare centre at child age 4 months. Ability to contact research team/nurses over the following 2 months	I-End: Infant aged 6 months I-FU (1): infant aged 18 months [Anthro only] I-FU (2): Child aged 29-38 months [Anthro only]	X	✓	X
***Kazemi 2011b**	Midwife (n=1)	Antenatal and birth to	Individual education /	Hospital at time of birth; unclear for	Unclear	Breastfeeding	Total intervention duration: 9 months	I-End: Infant aged 6	X	✓	X

RCT		2 years	support sessions	the remainder of the intervention			No. of contacts: Unclear Timing & duration of contacts: Not fully described. Sessions took place during the last trimester, at delivery, & during the 1st 6 months after birth	months			
MOMS: *French 2012 cRCT	Physicians, nurses, medical assistants	Birth to 2 years only	Face-to-face, individual well-child visits	Well-child visits	Yes	Maternal eating habits	Total intervention duration: 10 months No. of contacts:5 Timing & duration of contacts: Delivered at the 2-, 4-, 6-, 9-, & 12-month pediatric well-child visit: 1-2 minutes of more effective anticipatory guidance substituted for the guidance that was already being given	I-End: Child aged 12 months	X	✓	X
OOP: *French 2012 cRCT	Physicians, nurses, medical assistants	Birth to 2 years only	Face-to-face, individual well-child visits	Well-child visits	Yes	Infant feeding / introduction to solid foods	Total intervention duration: 10 months No. of contacts: 5 Timing & duration of contacts: Delivered at the 2-, 4-, 6-, 9-, & 12-month pediatric well-child visit: 1 to 2 minutes of more effective anticipatory guidance substituted for the guidance that was already being given	I-End: Child aged 12 months	X	✓	X
NELLI (Full RCT): *Kolu 2016 cRCT	Public Health Nurses	Antenatal only	Individual counselling sessions, plus group sessions	Primary health care maternity clinics	Yes	Maternal diet and physical activity	Total intervention duration: 29 weeks (maximum) No. of contacts: 5-6, plus 5 optional monthly meetings Timing & duration of contacts: 1 counselling session on physical activity at 8-12 weeks' gestation. 1 session for diet at 16-18 weeks' gestation (20–30 min), with 3-4 booster sessions (10–15 min each)	I-FU: Child aged 7 years [Note, I-End: 37 weeks' gestation]	X [=>NA, effectiveness assessment[1]]	NA	NA

							during other routine visits at 22–24, 32–34 & 36–37 weeks gestation. Optional monthly thematic meetings (n=5) on physical activity that each lasted 2 hours				
LIMIT: *Dodd 2018 RCT	Research dietician and trained research assistants	Antenatal only	Two dedicated individual face-to-face sessions with the research dietician (at trial entry, and 28 weeks); telephone call with trained research assistants at 22, 24, and 32 weeks, and a face–face visit at 36 weeks	3 public maternity hospitals	No	Maternal diet and physical activity	Total intervention duration: 16-26 weeks No. of contacts: 6 Timing & duration of contacts: 2 sessions with the research dietician (at trial entry, & 28 weeks) & contacts with trained research assistants via telephone at 22, 24, & 32 weeks, & a face–face visit at 36 weeks	I-FU: Child aged 6 months [Note, I-End: 36 weeks' gestation]	X	X	X
LiPO: *Tanvig 2015 RCT	Dieticians and physiotherapists	Antenatal only	Individual in-person sessions with a dietitian; group physical activity sessions (free gym membership for 6 months)	Odense University Hospital and Aarhus University Hospital, Denmark	Yes	Maternal dietary behaviours; maternal physical activity	Total intervention duration: 6 months No. of contacts: 32-36 Timing & duration of contacts: Dietary counselling sessions (30-60 minutes each) at 15, 20, 28, & 35 weeks' gestation. Physical activity classes 1 hour/week for 6 months. Group activities with physiotherapist after physical training 4–6 times in pregnancy	I-FU: Child aged 2.8 years	X	X	X
Minding the Baby: *Ordway 2018 RCT	Social worker; pediatric nurse	Antenatal and birth to 2 years	Face-to-face, individual home visits	Participants' homes (78%) versus an alternate place of convenience to the mother	No	Parenting behaviours	Total intervention duration: 27 months No. of contacts: 82 Timing & duration of contacts: Weekly home visits (typically 1 hour in duration) from the 3rd trimester of pregnancy	I-End: Child aged 24 months	✓	NA	NA

							until the child's 1st birthday & biweekly through the child's 2nd birthday				
NELLI (pilot-pregnancy): *Mustila 2012a cRCT	Maternity Health Care Nurses (i.e. Public Health Nurses)	Antenatal only	Individual in-person dietary and physical activity counselling sessions; group exercise sessions (optional)	Primary Health Care - Maternity Clinics	Yes	Maternal dietary behaviours; maternal physical activity	Total intervention duration: 29 weeks approx. No. of contacts: 5-6, plus 29 optional weekly exercise sessions Timing & duration of contacts: The visits were at 8-9, 16-18, 22-24, 32-34- & 36-37-weeks' gestation. The primary dietary counselling session lasted 20-30 minutes, & each of the boosters (x4) lasted 10-15 minutes. Participants in the intervention could participate in group exercise sessions once a week (60 minutes)	I-FU: Child aged 4 years	X [=>NA, effectiveness assessment[1]]	NA	NA
NELLI (pilot-postpartum): *Mustila 2012a cRCT	Maternity Health Care Nurses (i.e. Public Health Nurses)	Birth to 2 years only	Individual in-person dietary and physical activity counselling sessions; group exercise sessions (optional)	Primary Health Care - Child Health Clinics	Yes	Maternal dietary behaviours; maternal physical activity	Total intervention duration: 8 months approx. No. of contacts: 5, plus 32 optional weekly exercise sessions Timing & duration of contacts: Physical activity: 1 primary counselling session (allocated time 20–30 minutes) at the 2-month visit & 4 booster sessions (allocated time 10–15 minutes) at the 3, 5, 6 & 10-month visits. The participants in the intervention clinics had also an option to participate in group exercise sessions once a week (60 minutes). Dietary counselling: 1 primary	I-FU: Child aged 4 years	X [=>NA, effectiveness assessment[1]]	NA	NA

							counselling session (20–30 min) at the 3-month visit & 3 booster sessions (10 min), in addition to the physical activity boosters at the 5, 6 & 10-month visits				
*Neyzi 1991 Quasi-RCT	Dietitian	Birth to 2 years only	Face-to-face group session at the hospital, face-to-face individual home visits	Social-security obstetric hospital	No	Breastfeeding	Total intervention duration: 5-7 days No. of contacts: 2 Timing & duration of contacts: Group educational session after birth (2 videos for intervention group = 18 mins; 1 video for control group = 8 minutes), followed by 1 repeat session at home 5-7 days after delivery (20-30 minutes)	I-End: Child aged 1 week [Behavioural only] I-FU (1): Child aged 4 months [Anthro only] I-FU (2): Child aged 6 months [Behavioural only]	X	✓	X
NOURISH: *Daniels 2015 RCT	Dietitian; psychologist	Birth to 2 years only	Face-to-face group sessions (10-15 mothers/primary carers per group)	Child health clinics	No	Infant feeding: introduction to solids; child feeding	Total intervention duration: 12 months No. of contacts: 12 Timing & duration of contacts: 2 modules commencing when the children were aged 4-7 & 13-16 months, delivered as 6 group sessions of 1-2-hour duration over 12 weeks. 2nd module commenced 6 months after completion of 1st	I-End: Child aged 24 months I-FU (1): Child aged 3.5 years I-FU (2): Child aged 5 years	X	✓	X
POI-FAB: *Taylor 2018 RCT	FAB: Lactation consultant; Trained researchers (nurses, dietitians, and nutrition graduates); "Sport Otago" trust.	Antenatal and birth to 2 years	Face-to-face home visits (majority) and group sessions (antenatal contact plus group activity sessions with local "Sport Otago" trust)	Home visits (majority) and group sessions (3, 9, 18 months)	No	Infant feeding; infant physical activity; sedentary behaviour	Total intervention duration: 18 months & 3 weeks approx. No. of contacts: 11 Timing & duration of contacts: 8 home visits - 1 before birth (approx. 37 weeks' gestation; 30 minutes), then at 1-2 weeks, 3, 4, 7, 9, 12, & 21	I-Mid: Various [Behavioural only] I-End: Child aged 18 months I-FU (1): Child aged 24	X	✓	X

							months post-partum. 3 group physical activity sessions at 3, 9 & 18 months, approx. 1 hour long. The 4-month lactation consultant visit lasted 40 minutes; other home visits were approx. 30-45 minutes	months I-FU (2) Child aged 3.5 years I-FU (3): Child aged 5 years			
POI-Sleep: *Taylor 2018 RCT	Research Nurse	Antenatal and birth to 2 years	Face-to-face home visits (majority)	Home visits (majority) and group sessions (antenatal, 3, 9, 18 months)	No	Infant sleep	Total intervention duration: 25 months max. No. of contacts: 2 (minimum; no. of contacts for sleep treatment programme not specified) Timing & duration of contacts: 1 before birth (lasted about an hour) & then at 3 weeks, & a sleep treatment programme upon request (from 6-24 months)	I-Mid: Various [Behavioural only] I-End: Child aged 18 months I-FU (1): Child aged 24 months I-FU (2) Child aged 3.5 years I-FU (3): Child aged 5 years	X	✓	X
POI-FAB & Sleep: *Taylor 2018 RCT	FAB: Lactation consultant; Trained researchers (nurses, dietitians, and nutrition graduates); "Sport Otago" trust. Sleep: Research Nurse	Antenatal and birth to 2 years	Face-to-face home visits (majority) and group sessions (antenatal contacts plus group activity sessions with local "Sport Otago" trust)	Home visits (majority) and group sessions (antenatal, 3, 9, 18 months)	No	Infant feeding; infant physical activity; sedentary behaviour; sleep	Total intervention duration: 25 months (maximum) No. of contacts: 12 Timing & duration of contacts: *FAB:* 1 contact before birth (approx. 37 weeks' gestation) combining sleep antenatal contact also, then at 1-2 weeks, 3, 4, 7, 9, 12, & 21 months post-partum. Group physical activity sessions at 3, 9 & 18 months were approx. 1 hour long. The 4-month lactation consultant visit lasted 40 minutes. Participants could also	I-Mid: Various [Behavioural only] I-End: Child aged 18 months I-FU (1): Child aged 24 months I-FU (2) Child aged 3.5 years I-FU (3): Child aged 5 years	X	✓	X

							request additional support from the lactation consultant from antenatal to 6 months' postpartum *Sleep:* 1 extra contact as part of Sleep intervention at 3 weeks (merged with FAB contact at 3 weeks), and a sleep treatment programme upon request (from 6-24 months)				
PRIMROSE: ***Doring 2016a** cRCT	Nurses	Birth to 2 years only	Individual face-to-face sessions; group face-to-face consultation; telephone consultations	Individual consultation at home when child aged 8-9 months; group consultation at the Child Health Centre (CHC) at 11 months. Individual face-to-face sessions at the CHC when the child is 1.5 years, 2 years, 3 years, and 4 years old. Telephone consultations when the child is 2.5 and 3.5 years of age	Yes	Infant/child feeding; physical activity	Total intervention duration: 39 months (child aged 9-48 months). *Only details/results for intervention delivery up to child aged 2 years included in this review due to scope* [-> 9-24 months = 15 months] No. of contacts: 7-9 Timing & duration of contacts: Home visit when child aged 8-9 months; group consultation at CHC when child aged 11 months; individual consultations at CHC when child aged 1, 1.5, 2, 3 & 4 years. In addition, parents offered telephone consultations when child was 2.5 & 3.5 years of age	I-End: Infant aged 4 years [Note: Outside of scope of this review; only using results to age 24 months]	N/A (X: I-Mid)	N/A	NA
Pro Kind: ***Jungmann 2010** RCT	Midwife or by a tandem of midwife and a social pedagogue (social worker)	Antenatal and birth to 2 years	Face-to-face home visits	Home visits	No	Pregnancy: Maternal nicotine consumption, maternal usage of pregnancy check-ups, maternal physical exercise and diet. Postpartum: security for	Total intervention duration: 2.5 years No. of contacts: 65 approx. Timing & duration of contacts: Bi-weekly home visits over period of 2.5 years [no further details provided]	I-Mid: Infant aged 12 months [Note, I-End: 24 months]	N/A (X: I-Mid)	NA	NA

						children in the home; infant feeding and breastfeeding					
PROBIT (Italy): *Fornari 2018 cRCT	Paediatrician	Birth to 2 years only	Standardised educational intervention delivered at routine, face-to-face individual Well Visits	Well Visit clinics	Yes	Infant feeding (including breastfeeding and introduction to solids); active play	Total intervention duration: 2 years No. of contacts: Not described, other than intervention delivered at well visits for the first two years of life (0-2 years) Timing & duration of contacts: Not described	I-End: Child aged 2 years	X	N/A	N/A
PROBIT: *Martin 2017 cRCT	Physicians; obstetricians; paediatricians; nurses; midwives	Antenatal and birth to 2 years	Not described; implementation of the 10 steps of The Baby-Friendly Hospital Initiative (face-to-face; individual/group)	Belarusian maternity hospitals and affiliated polyclinics	Yes	Breastfeeding	Total intervention duration: Unclear – potentially 12 months No. of contacts: Not described Timing & duration of contacts: Not described	I-Mid: Child aged 1, 2, 3, 6, 9 months I-End: Child aged 12 months I-FU (1): Child aged 6.5 years [Anthro only] I-FU (2): Child aged 11.5 years I-FU (3): Child aged 16 years [Anthro only]	X	✓	X
ROLO: *Horan 2016b RCT	Dietitian	Antenatal only	In-person, group education session; follow-up email contact	Maternity Hospital	No	Maternal diet	Total intervention duration: 18 weeks No. of contacts: 3 (minimum) Timing & duration of contacts: 1 dietary education session (2h) in groups of 2-6 women when women were 15.7 (SD3.0) weeks' gestation. Research dietitian met with the patients at 28- &	I-FU (1): Child aged 6 months I-FU (2): Child aged 2 years [Note, I-End: 34 weeks' gestation]	X	NA	NA

							34-weeks' gestation. Additional low GI recipes emailed to participants during their pregnancy				
GLB: *Schroeder 2015 cRCT	Health care providers (pediatricians nurse practitioners, and clinic staff) during routine well-baby visits	Birth to 2 years only	Face-to-face interactions during routine well-baby clinic visits	Pediatric office during well-baby clinic visits	Yes	Infant/child feeding; physical activity	Total intervention duration: 23 months No. of contacts: 9 Timing & duration of contacts: Pediatric visits (approx. 5 mins each) at 1, 2, 4, 6, 9, 12, 15, 18, & 24 months of age	I-End: Child aged 24 months	X	✓	X
*Schwartz 2015 [Living with Grandmother] RCT	Various - team composed of two nurses, one nutritionist, and one pediatrician (3 were qualified lactation consultants)	Birth to 2 years only	Face-to-face sessions, and written materials (brochures)	Hospital maternity ward (1 session); mother's home (5 sessions)	Unclear	Breastfeeding; complementary feeding	Total intervention duration: 4 months No. of contacts: 6 Timing & duration of contacts: 5 counselling sessions on breastfeeding while in the hospital (24-72 hours after delivery) & at 7, 15, 30, & 60 days, & 1 session on complementary feeding at 120 days. Contact duration usually 1 hour	I-FU (1): Child aged 6 months [Behavioural only] I-FU (2): Child aged 12 months [Behavioural only] I-FU (3): Child aged 2 years [Behavioural only] I-FU (4): Child aged 4-7 years [Note, I-End: Child aged 4 months]	X	✓	X
*Schwartz 2015 [Not living with Grandmother] RCT	Various - team composed of two nurses, one nutritionist, and one pediatrician (3 were qualified lactation consultants)	Birth to 2 years only	Face-to-face sessions, and written materials (brochures)	Hospital maternity ward (1 session); mother's home (5 sessions)	Unclear	Breastfeeding; complementary feeding	Total intervention duration: 4 months No. of contacts: 6 Timing & duration of contacts: 5 counselling sessions on breastfeeding while in the hospital (24-72 hours after delivery) & at 7, 15, 30, & 60 days, & 1	I-FU (1): Child aged 6 months [Behavioural only] I-FU (2): Child aged 12 months	X	✓	X

							session on complementary feeding at 120 days. Contact duration usually 1 hour	[Behavioural only] I-FU (3): Child aged 2 years [Behavioural only] I-FU (4): Child aged 4-7 years [Note, I-End: Child aged 4 months]			
*Shah 2016 RCT	Pediatric resident or nurse practitioner	Birth to 2 years only	Group well-child care: the provision of well-child care to 4 to 8 infant/parent dyads	Yale New Haven Hospital Primary Care Centre, US	Yes	Not described, though assume focus on obesity prevention behaviours - infant feeding, active play / physical activity – as well as maternal / infant secure attachment and parental self-efficacy	Total intervention duration: 1 year No. of contacts: 8 Timing & duration of contacts: 8 x 90-minute sessions when the children were 2 weeks & 1, 2, 3, 4, 6, 9 & 12 months old	I-FU (1): Child aged 2 years [Anthro only] I-FU (2): Child aged 2.5 years [Anthro only] I-FU (3): Child aged 3 years [Note, I-End: Child aged 1 year]	X	X	X
SLIMTIME: *Paul 2011 [S/S] RCT	Research nurses	Birth to 2 years only	Face-to-face, individual home visit	Home visit	No	Infant sleep (and related behaviours)	Total intervention duration: 13-22 weeks No. of contacts: 2 Timing & duration of contacts: 1st home visit 2-3 weeks after birth; 2nd visit 4-6 months after birth when parents reported that their infant was starting to consume solid foods	I-End: Infant aged 4-6 months I-FU: Infant aged 1 year [Anthro only]	✓	X	X
SLIMTIME: *Paul 2011 [IS] RCT	Research nurses	Birth to 2 years only	Face-to-face, individual home visit	Home visit	No	Infant feeding (introduction of solids)	Total intervention duration: 13-22 weeks No. of contacts: 2 Timing & duration of	I-End: Infant aged 4-6 months	X	✓	X

							contacts: 1st home visit between 2–3 weeks after birth; 2nd visit 4-6 months after birth when parents reported that their infant was starting to consume solid foods & parents following a child feeding regime for 4 weeks afterward	I-FU: Infant aged 1 year [Anthro only]			
SLIMTIME: *Paul 2011 [S/S and IS] RCT	Research nurses	Birth to 2 years only	Face-to-face, individual home visit	Home visit	No	Infant sleep; infant feeding (introduction of solids)	Total intervention duration: 13-22 weeks No. of contacts: 4 Timing & duration of contacts: "Soothe/Sleep" intervention: 1st home visit 2-3 weeks after birth; 2nd visit 4-6 months after birth. "Introduction of Solids": 1st home visit 2–3 weeks after birth; 2nd visit 4-6 months after birth when parents reported that their infant was starting to consume solid foods & parents following a child feeding regime for 4 weeks afterward	I-End: infant aged 4-6 months I-FU: Infant aged 1 year [Anthro only]	✓	X	X
Starting Early: *Gross 2016 RCT	Registered Dietitian / Certified Lactation Counsellor	Antenatal and birth to 2 years	Face-to-face individual nutrition counseling, and parenting support groups	Primary care prenatal and pediatric clinics and the postpartum ward of a large urban public hospital and an affiliated satellite neighbourhood health centre	Partly	Infant feeding: breastfeeding; introduction to solid foods	Total intervention duration: 36 months. *Only details/results for intervention delivery up to child aged 2 years included in this review due to scope* [*For this review -> 3rd trimester to child age 24 months = 27 months*] No. of contacts: 15 Timing & duration of contacts: 15 lessons, from pregnancy through child age 3 years: 1) Individual counselling with a Registered Dietitian / Certified Lactation Counsellor during the 3rd	I-Mid: Infant aged 3 months I-End: Infant aged 10 months [Anthro only] I-FU: Infant aged 18 months [Anthro only]	✓	NA (✓ mid intervention)	NA

							trimester of pregnancy & peri-partum for breastfeeding support (n=2); 2) nutritionist led parenting/nutrition support groups at every well child health care visit (n=13) starting at 1 month old until 3 years old child aged 1, 2, 4, 6, 9, 12, 15, 18, 21, 24, 27, 30, & 33 months]. Each contact duration was approx. 45-60 minutes				
STRIP: *Niinikoski 2007 RCT	Paediatrician; dietitian; nurse	Birth to 2 years only	Face-to-face individual family counselling	Well Baby Clinics	In part (intervention group has extra visits that are not part of routine care)	Infant and child feeding/eating; breastfeeding	Total intervention duration: 29 months (Child aged 7 months to 36 months). *Only details/results for intervention delivery up to child aged 2 years included in this review due to scope* [-> 7 months to 24 months =17 months] No. of contacts: 10 Timing & duration of contacts: Visits when children were 7, 8, 10, 13, 15, 18, 21, 24, 30*, & 36* months of age [Controls: visits when children were 7, 13, 18, 24, 30*, & 36* months of age.] Contacts lasted 20-45 minutes	I-Mid: 24 months Note: I-End: Child aged 36 months]	X	✓	N/A

Abbreviations: cRCT: cluster Randomised Controlled Trial; I-End: Intervention End. I-Mid: Mid-Intervention Delivery. I-FU: Intervention Follow-Up. NA: Not assessed. N/A: Not applicable (Trial ongoing/trial delivered beyond first 1,000 days/results not available); RCT: Randomised Controlled Trial

Note: [1]Cut-off for timing of outcome assessment defined as within 12 months of follow-up of the intervention endpoint for this review (i.e. child aged two years, plus maximum 12 months follow-up)

Appendix 5 Supplementary material for Chapter 6

Additional File 1: Standards for Reporting Qualitative Research (SRQR) Checklist

No.	Topic	Item	Manuscript page no.
Title and abstract			
S1	Title	Concise description of the nature and topic of the study identifying the study as qualitative or indicating the approach (e.g., ethnography, grounded theory) or data collection methods (e.g., interview, focus group) is recommended	1
S2	Abstract	Summary of key elements of the study using the abstract format of the intended publication; typically includes objective, methods, results, and conclusions	1
Introduction			
S3	Problem formulation	Description and significance of the problem/phenomenon studied; review of relevant theory and empirical work; problem statement	2
S4	Purpose or research question	Purpose of the study and specific objectives or questions	2
Methods			
S5	Qualitative approach and research paradigm	Qualitative approach (e.g., ethnography, grounded theory, case study, phenomenology, narrative research) and guiding theory if appropriate; identifying the research paradigm (e.g., positivist, constructivist/interpretivist) is also recommended	3
S6	Researcher characteristics and reflexivity	Researchers' characteristics that may influence the research, including personal attributes, qualifications/experience, relationship with participants, assumptions, or presuppositions; potential or actual interaction between researchers' characteristics and the research questions, approach, methods, results, or transferability	3
S7	Context	Setting/site and salient contextual factors; rationale[a]	3

S8	Sampling strategy	How and why research participants, documents, or events were selected; criteria for deciding when no further sampling was necessary (e.g., sampling saturation); rationale[a]	3-4
S9	Ethical issues pertaining to human subjects	Documentation of approval by an appropriate ethics review board and participant consent, or explanation for lack thereof; other confidentiality and data security issues	3-4
S10	Data collection methods	Types of data collected; details of data collection procedures including (as appropriate) start and stop dates of data collection and analysis, iterative process, triangulation of sources/methods, and modification of procedures in response to evolving study findings; rationale[a]	3-4
S11	Data collection instruments and technologies	Description of instruments (e.g., interview guides, questionnaires) and devices (e.g., audio recorders) used for data collection; if/how the instrument(s) changed over the course of the study	3-4
S12	Units of study	Number and relevant characteristics of participants, documents, or events included in the study; level of participation (could be reported in results)	4-5
S13	Data processing	Methods for processing data prior to and during analysis, including transcription, data entry, data management and security, verification of data integrity, data coding, and anonymization / deidentification of excerpts	4
S14	Data analysis	Process by which inferences, themes, etc., were identified and developed, including researchers involved in data analysis; usually references a specific paradigm or approach; rationale[a]	4
S15	Techniques to enhance trustworthiness	Techniques to enhance trustworthiness and credibility of data analysis (e.g., member checking, audit trail, triangulation); rationale[a]	4
Results/Findings			
S16	Synthesis and interpretation	Main findings (e.g., interpretations, inferences, and themes); might include development of a theory or model, or integration with prior research or theory	4-13

S17	Links to empirical data	Evidence (e.g., quotes, field notes, text excerpts, photographs) to substantiate analytic findings	4-13
Discussion			
S18	Integration with prior work, implications, transferability, and contribution(s) to the field	Short summary of main findings; explanation of how findings and conclusions connect to, support, elaborate on, or challenge conclusions of earlier scholarship; discussion of scope of application/generalizability; identification of unique contribution(s) to scholarship in a discipline or field	13-16
S19	Limitations	Trustworthiness and limitations of findings	15
Other			
S20	Conflicts of interest	Potential sources of influence or perceived influence on study conduct and conclusions; how these were managed	16
S21	Funding	Sources of funding and other support; role of funders in data collection, interpretation, and reporting	16

[a]The rationale should briefly discuss the justification for choosing that theory, approach, method, or technique rather than other options available, the assumptions and limitations implicit in those choices, and how those choices influence study conclusions and transferability. As appropriate, the rationale for several items might be discussed together.

Additional File 2: Maternal and infant care in Ireland

Women in Ireland are entitled to maternity care under the Maternity and Infant Scheme which provides an agreed programme of care to all expectant mothers who are ordinarily resident in Ireland (Health Service Executive, 2018e). This service is provided by a family doctor (GP) of their choosing and a hospital obstetrician (Table S1).

Table S1 Maternal and child health services available to women in Ireland

Service type	Description
Consultant led service	Service provided in a maternity hospital/unit by a multidisciplinary team led by a consultant obstetrician (18.1% of live births in 2016 (Healthcare Pricing Office, 2018)[a])
Combined care	Under the Maternity and Infant Care Scheme, care is shared between the GP and the hospital / DOMINO services. (81.6% of live births in 2016 (Healthcare Pricing Office, 2018))
Midwife-led units[a]	Available to low risk women, where the service is co-located with a consultant-led unit. The service is planned, managed, coordinated and delivered by midwives and covers the antenatal, intrapartum and postnatal periods. Care is delivered in the community and in an alongside midwife-led unit.
DOMINO (Domiciliary In and Out)[a]	Service generally provided by a team of hospital based community midwives who care for women throughout pregnancy, birth and during the postnatal period. Antenatal appointments can take place either in the hospital or in a community setting. The woman generally transfers home within 12-24 hours after the birth. The community midwife continues to look after mother and baby for the first few days at home. 2,297 DOMINO births were recorded in 2014, accounting for 3.35% of total births.
Early Transfer Home Scheme[a]	A scheme available in a number of hospitals to facilitate mothers who wish to leave hospital within a few hours after giving birth. Postnatal care is provided by a team of community midwives in the woman's home.

Home births[a]	The National Maternity Hospital and University Hospital Waterford offer a very limited home birth service to low risk women. In addition, the HSE facilitates a home birth service through self-employed community midwives (SECM). Approximately 20 SECM have signed Memoranda of Understanding (MOU) with the HSE to provide planned home birth services to eligible women. SECMs are bound by the terms of the MOU and are indemnified under the Clinical Indemnity Scheme operated by the State Claims Agency. The SECM is the primary carer for the woman throughout her pregnancy and for up to 14 days postnatally. Home births account for approximately 0.2% of births in Ireland.

Source: (Department of Health, 2016a)

[a]Deliveries under hospital schemes (such as domino, early transfer home, planned community midwives, and midwifery-led units) are treated as hospital births as the current birth notification form does not differentiate between different hospital schemes].

Postnatal care is provided to all women; however the care is provided in different settings and for a different duration, depending on the model of care. For women birthing in hospitals, postnatal care is provided within the hospital setting. The average length of hospital stay is dictated by the type and complexity of the delivery. The average postnatal length of stay in Irish maternity hospitals/units was 3.4 days in 2016 (Healthcare Pricing Office, 2018). Women who receive their care in midwifery led units, the DOMINO or Early Transfer Home services, receive postnatal care for the first few days at home. This care is provided as an outreach service by hospital midwives. However, in the main, postnatal care is provided by public health nurses (PHNs) who visit mother and baby at home soon after their discharge from hospital. PHNs visit all mothers and their infants within 72 hours of hospital discharge. They have a key role in supporting child health, families and new babies, screening for postnatal depression, providing breast feeding support and checking the baby's development, amongst other services. Women who avail of the Maternity and Infant Care Scheme attend their GP for the 6 week postnatal check, and bring their baby to the GP for a 2 week and 6 week check. All infants are entitled to free GP care under the Under 6s GP Visit Card Scheme, which includes free GP assessments at age 2 and 5.

Table S2 No. of contacts under the Universal Child Health and Wellbeing Programme from pregnancy to a child's second birthday

Timeline	Maternity and Infant Scheme		GP – child only		HSE Child Health, Screening and Surveillance Service
	Hospital	GP[d]	Immunisa-tions	Under 6s GP contract	
Antenatal					
Before 12 weeks		1			
Before 20 weeks	1				
24 weeks		1			
28 weeks	1 (1st pregnancy)	1 (except in case of 1st pregnancy)			
30 weeks		1			
32 weeks	1				
34 weeks		1			
36 weeks	1				
37 weeks		1			
38 weeks	1				
39 weeks		1			
40 weeks	1				
Postnatal					
Birth	1 [a,b,c]				
Primary visit within 72 hours					1 [b,c]
2 weeks		1			
6 weeks		1 (mother & baby)			
2 months			1		
3 months					1
4 months			1		
6 months			1		
7-9 months					1
12 months			1		
13 months			1		
18-24 months					1
24 months				1	
Total (25)	**6/7**	**8/9**	**5**	**1**	**4**

Notes: [a] Neonatal Examination and Hearing Screening. [b] Newborn Blood Spot Screening can be done in hospital or by PHN. [c] BCG. [d] If a woman has a significant illness, e.g. diabetes or hypertension, she may have up to 5 additional visits to the GP.

Additional File 3: Interview guide

Parents' views on healthy growth in young children
Parent Interview Guide

Study aim:

To elicit parents' views on obesity prevention and specifically health professional-delivered obesity prevention interventions targeting children under the age of two.

Study objectives

1. To explore perceptions of a good and/or appropriate size (healthy growth) for babies and toddlers up to the age of two
2. To explore parents' understanding of healthy growth and associated behaviours
3. To establish the perceived importance of weight in young children, how parents gauge it and if/how they think it can be managed
4. To explore parents' views about childhood obesity, interventions to prevent childhood obesity / promote healthy growth, and interventions delivered by health professionals in particular
5. To examine variations in all the above, if any, by socio-economic background and gender/parental role.

Briefing

- Thank you very much for agreeing to take part in the study, I really appreciate you giving up your time to talk with me.
- My name is Marita Hennessy and I am a PhD student within the Health Behaviour Change Research Group in the School of Psychology at NUI Galway.
- As described in the Participant Information Sheet, we are carrying out these interviews to get a better understanding of what parents think about healthy growth in young children and how this can be best supported. We want to use the information to inform the development of supports/programmes.
- I'm really interested to hear your views. There are no right or wrong answers.
- If at any time during the interview you do not wish to answer a question that's okay, just tell me and we will move on. [This may be particularly relevant if a child is present].
- I would like to record our conversation to allow me to give you my full attention during the interview. The recording will be typed out, but everything you say will be in strict confidence and reported anonymously (unless you disclose something that is identified as a risk to a child, in this case I must report this in line with child protection guidelines). This means that your name and any names or places you mention will be taken out and replaced, so that if someone read your interview they would not know who you are.
- If, at any stage, you wish to stop the audio recorder, or the interview, please let me know.
- Do you have any questions you would like to ask before we start?

A. Introduction

- Tell me a bit about yourself and your family (will have completed background survey so will have details) and your baby/toddler in particular
    - Baby's age
    - Any other children
    - Who else cares for the child/helps them with their child?

B. Importance of issue

- We hear a lot in the media nowadays about childhood obesity, what do you think about this issue?
- How do you know if a child aged under two is a healthy weight?
- Is it possible for a baby or toddler to be overweight?
    - What might the consequences of a child being overweight now, or for the future be, if any?
- How much do you think that an infant's weight needs to be monitored?
    - Are there things you can do to manage an infant's weight?
    - Is it possible to manage an infant's weight – to maintain a healthy weight or to manage it if it becomes an issue? If yes, how?

C. Understanding of behaviours associated with healthy growth

- What do think influences the size and growth of babies and toddlers?
    - [Open Q first => cue cards if not forthcoming]
    - Your weight when you became pregnant
    - The amount of weight you gain during your pregnancy?
    - If you smoke during pregnancy?
    - A baby's birth weight?
    - How quickly a baby gains weight during the first few months of life?
    - How and what you feed your baby (breastfeeding/formula feeding; when/how you introduce your baby to solid foods)?
    - How active or inactive a baby is?
    - How much sleep your baby gets?
    - Anything else?
- What do you think are the most important influences?

D. Experience - pregnancy

- Did anyone discuss your weight before you became pregnant with you? Can you tell me about this?
- Thinking about your pregnancy - was your weight gain and/or the weight of your baby discussed with you?
    - When? By whom? Where?
    - Did you raise the issue or did someone else?
    - What did you think about this? [Probe various mandatory checks/visits].

E. General weight perceptions / Experience – post-partum

- Can you tell me about your baby's size at birth? What did you think about this?
- Describe your baby's growth during the first few months of life?
    - What are your thoughts about this?
- What do you think about your baby/toddler's weight now?
    - As compared to his/her siblings, cousins, other children?
    - Have you ever had any concerns about their weight?
    - Have you ever discussed it with anyone, or sought information/advice about it? If yes – who/where? Can you tell me about it?
- Did any health professionals monitor your baby's weight since they were born?
    - If so - Who? How often?
    - Did they plot this on a growth chart?
    - Did they explain what it meant? Did it make sense to you?
    - Did you get a copy of the record?
- Has anyone ever commented on the size of your baby/toddler?
    - If yes - Who? What did they say?
    - How did you respond/feel at the time?
    - What are your thoughts about it now?

F. Possible interventions

- Do you remember if any health professionals ever discussed any health messages/health-related behaviours with you while you were pregnant or since your baby was born?
    - [Open Q first => cue cards if not forthcoming]
    - The amount of weight you gained during your pregnancy
    - Your diet/what you ate during your pregnancy
    - How physically active you were during you r pregnancy
    - Feeding your baby – breastfeeding, formula feeding, introducing solid foods
    - Active play/tummy time with your baby
    - Time spent watching TV or on phones
    - Your baby's sleep] with you? Can you tell me a little bit more about this? Who? What? What did you think about this?
- Who are the main health professionals you have contact with regarding your child (since pregnancy)?
    - To what extent do you seek information/advice from them about your child's weight/growth?
    - Was the advice you got useful? Did you take it on board (why/why not)?
    - How would describe your relationship with them?
    - To what extent do you trust them?

    - How does this compare to other sources of information/advice (i.e. family, friends, social media)?
- What other practitioners do you see? Where else do you go for advice/information?
- What do you think works to encourage healthy growth?
    - How do you think we can encourage healthy growth in babies and toddlers?
    - Where did these ideas come from?
    - What would you find useful? / What have you found useful in the past?
- How/when do you think healthy growth in young children can be promoted, and who do you think can do that?

[Note: wording in this section to be adapted for interviews with fathers – e.g. 'your pregnancy' -> 'the pregnancy', 'with you' -> 'with you or your partner/the mother of your baby'.]

G. Summary / Close

- [Note to self: Reflect back a summary of what was asked during the interview and what they said]
- Was there anything I left out?
- Is there anything you would like to add?

Additional File 4: Information and support - sources and topics

Parents had a range of sources of information and support during the first 1,000 days, with health professionals, peers/family, online sources ('Dr Google', specific websites, online forums, email updates), fathers and 'own research' being the most common. Participants described a range of interactions with various health professionals, including GPs, midwives, PHNs, lactation consultants, and to a lesser extent obstetricians, pediatricians, and practice nurses. When asked, and prompted if necessary, about discussions with health professionals around child growth-related behaviours, parents primarily recalled those around infant and child feeding.

Few participants recalled any advice received around preconception issues, smoking during pregnancy, or screen-time. Discussions about a mother's diet during pregnancy seemed infrequent and varied, if they happened at all. Sources of information included midwives (at booking visits), GPs, and antenatal classes. The focus of discussions seemed to be on food safety issues and what a woman could/couldn't eat during pregnancy rather than 'healthy eating' per se. Many participants recalled discussions, however brief, about physical activity during pregnancy – with midwives and physios at antenatal classes, at booking visits and at GP visits. While information at antenatal classes seemed to focus on benefits of activity in preparation for birth, discussions with GPs centred more on asking women if they were active and encouraging them to be/maintain a certain level of exercise. Some participants noted that they had to ask their GP for advice around pregnancy physical activity and if they could maintain their pre-pregnancy levels.

There were mixed reports of discussions around gestational weight gain. Some participants reported being monitored (particularly those with an issue, e.g. gestational diabetes) by midwives/obstetricians in hospitals and/or GPs, with (e.g. told it was normal) or without discussion, while others reported that it was not discussed at all. Even when women were weighed, sometimes this was only at the initial booking visit, whereas others were weighed throughout.

Participants discussed a wide range of sources of information/support when it came to infant/child feeding topics such as breastfeeding, bottle-feeding, introducing solids (including baby led weaning). These included antenatal classes (breastfeeding), PHNs (all topics), midwives/hospital nurses and doulas (breastfeeding), with GPs mentioned to a lesser extent. Few mentioned doing 'weaning'-specific breastfeeding classes while four also mentioned doing workshops. Websites, online forums and books/booklets (e.g. those provided by PHN) were also popular.

Infant sleep discussions were mentioned by some – often with negative reactions. Some participants reporting feeling frustrated if they were asked if their baby was sleeping. PHNs - and to a lesser extent lactation consultants, GPs and antenatal classes (with one using a sleep consultant) – were referenced most in this regard. Often discussions focused on sleep in the context of breastfeeding/safe sleep, with co-sleeping being controversial.

The majority of participants spoke about receiving information/advice around active play or tummy time (primarily the latter) from PHNs though hospital midwives, physiotherapists at discharge/postnatal class, GPs, lactation consultants, antenatal classes, and family/peers were mentioned by a small number of participants.