DOCTOR OF PHILOSOPHY

Exploring parental attitudes and practices during complementary feeding

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Award date:
2020

Awarding institution:
Queen's University Belfast

Exploring parental attitudes and practices during complementary feeding

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February 2020

This thesis is submitted for the degree of Doctor of Philosophy

Acknowledgments

I would like to thank the Department for Education, Northern Ireland for funding my project and giving me a great opportunity to advance my research skills and my academic knowledge in my area of interest.

I am deeply grateful to my supervisors Prof Moira Dean and Prof Michelle McKinley for their constant support, feedback and encouragement. Their help has made this journey as smooth and effortless as possible and I feel very fortunate for conducting research under their guidance.

My sincere appreciation also goes to Dr Virginia Allen-Walker, Miss Louise Tully, Dr Caroline McGirr and Prof Jayne Woodside who have greatly contributed to various stages of this project by sharing useful insights and tips. It has been a pleasure working alongside them.

I would like to extend my acknowledgements to all parents who kindly supported my research by taking part in my qualitative project and online survey and provided me with their information and their personal experiences with feeding their child.

I couldn't forget my friends and fellow PhD candidates in the Institute for Global Food Security: Mairead Campbell, Michaela Crummy, Rebecca Hall, Stephanie Heaney and Shirin Macias. It has been great sharing experiences, concerns and motivation with them during the course of our projects.

Contributions

Chapter 2: A systematic review of qualitative evidence.

My contribution entails:

- Determining inclusion and exclusion criteria, drafting key words and conceptualising the online search strategy
- Performing search on online literature databases and hand-searching reference lists
- Title, abstract and full text screening of selected studies
- Data extraction, analysis and synthesis
- Writing the manuscript

Assistance was received with: refining the search strategy for individual online databases; independent abstract screening

Chapter 3: A qualitative exploration.

My contribution entails:

- Drafting questions and incorporating them to the existing topic guide of a wider SafeFood project
- Contacting gatekeepers, recruiting study participants and determining their eligibility
- Facilitating discussions for the majority of focus groups
- Checking professional transcripts for accuracy
- Coding and producing themes
- Writing the manuscript

External help was useful with: drafting the Ethics application; drafting questionnaires for eligibility and demographics; giving initial directions for recruitment approaches; transcribing recordings of focus groups; recruitment and moderating some of the focus groups; analysis of descriptive information and thematic analysis (determining inter-rater reliability)

Chapter 4 & 5: An online survey.

My contribution entails:

- Design of the questionnaire (paper and online) and of recruitment material
- Running pilots
- Engagement with gatekeepers and advertising the call for participation
- Data processing and statistical analysis
- Writing the manuscripts

Assistance included: obtaining log-in details of Qualtrics account; further dissemination of participation call, optimisation of the statistical analysis

Research dissemination

Publications

Published, Open Access

Spyreli E, McKinley MC, Allen-Walker V, Tully L, Woodside JV, Kelly C, Dean M. "The One Time You Have Control over What They Eat": A Qualitative Exploration of Mothers' Practices to Establish Healthy Eating Behaviours during Weaning. Nutrients. 2019 Mar;11(3):562.

Under review

Spyreli E, McKinley MC, Dean M. Parental considerations during complementary feeding in upper-middle- and high-income countries: a systematic review of qualitative evidence. (submitted to peer-reviewed journal on 10 Feb 2020)

Spyreli E, McKinley MC, Dean M. Predictors of dietary quality during weaning in a UK sample of mothers; findings from an online survey. (submitted to peer-reviewed journal on 13 Feb 2020)

Conference presentations

Spyreli E, McKinley MC, Dean M. Weaning and the parameters affecting the decision-making process in developed countries: a systematic review. Oral presentation, 'Sustainable and Healthy Lifestyles: Policy, Pedagogy and Practice' - Conference of the International Federation for Home Economics, Sligo, 2017.

Spyreli E. The importance of food variety in weaning; A qualitative exploration of mothers' perceptions in Northern Ireland. Oral presentation, Nutrition Society Postgraduate Conference, Belfast, 2018.

Spyreli E. Why do parents deviate from the guidelines on the age of weaning? Findings from a systematic review of qualitative evidence. Oral presentation, Nutrition Society Postgraduate Conference, Coleraine, 2019.

Spyreli E, McKinley MC, Dean M. Taste experiences and food exposure in weaning age: a qualitative exploration of maternal perceptions, attitudes and practices. Poster presentation, Annual Meeting of the European Society for Paediatric Gastroenterology Hepatology and Nutrition (ESPGHAN), Geneva, 2018.

Spyreli E, McKinley MC, Allen-Walker V, Tully L, Woodside JV, Kelly C, Dean M. Challenges and opportunities to establishing healthy eating behaviours during weaning: a qualitative exploration. Poster presentation, Annual Meeting of the International Society of Behavioral Nutrition and Physical Activity (ISBNPA), Prague, 2019.

Spyreli E, McKinley MC, Dean M. Why do parents in developed countries find it difficult to adhere to the WHO guidelines for complementary feeding? A systematic review of qualitative studies. Poster presentation, European Nutrition Conference, Federation of European Nutrition Societies (FENS), Dublin, 2019.

Awards received during this project

Nutrition Society Travel Grant to attend the annual meeting of ESPGHAN, Geneva, 2018

Centre of Excellence studentship award to collaborate with Innovation Lab, NI for four months (May-Aug 2018)

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Abstract

Background

Children's introduction and transition to a mixed diet is gradual and covers the first 18-24 months of life. In the UK, all parents have the opportunity to access information on complementary feeding (also referred to as weaning) through the health services. Parental adherence to the weaning guidelines however, has been assessed to be unsatisfactory on a national level. A big challenge therefore for researchers working in the field of complementary feeding is to understand the factors that influence parents' decisions regarding weaning and target those that are associated with the level of compliance to the weaning guidelines.

Aim and objectives

This project aims to increase understanding of the factors that influence parents' feeding behaviours and attitudes during the complementary feeding period in high-income countries, particularly in the United Kingdom.

Methods

Three studies were undertaken to achieve the overall aim:

1) Using a framework approach, a systematic review synthesised qualitative evidence available from four electronic databases in relation to weaning practices of parents in developed countries with a child younger than 3 years.

2) A qualitative study gathered data from eight focus groups consisting of 37 mothers from Northern Ireland with a healthy child in weaning age. Using inductive thematic analysis opportunities to establish healthy eating habits during complementary feeding, and relevant challenges were explored.

3) An online survey collected data from 466 mothers and 30 fathers living in the UK with a healthy child up to the age of 18 months. This study investigated the factors associated with the timing of introduction of solid foods and the quality of weaning diet.

Results

Qualitative data revealed a high maternal perceived value for food diversity during complementary feeding. Modelling healthy foods, using covert approaches to feed, and offering repeated exposure to foods were some practices that mothers engaged in to establish healthy eating behaviours; having a limited understanding of food variety and using distractions during feeding were some of the challenges faced by mothers. Cross-sectional data demonstrated that a diet of high quality was provided. Maternal feeding self-efficacy

and relying on the NHS guidelines to start weaning were independently correlated with the dietary quality provided. Weaning from 6 months was strongly predicted by reliance on the NHS recommendation; it was also positively associated to distress infant temperament and negatively associated to perceived social support.

Conclusions

This work discussed factors that shape parental weaning practices. It highlighted prevalent baby and maternal cues to initiate weaning, mothers' views on the WHO recommendation for the age of weaning and the main drivers of choosing weaning foods. The project additionally addressed the perceived value of the advice from health providers and grandmothers, mothers' suggestions for improved weaning education and experiences of baby-led weaning. The nature of fathers' role during weaning and their under-representation in relevant research was discussed.

Mothers encouraged their children to develop a preference for healthier foods through modelling and repeated exposure. While a high perceived value for food variety was demonstrated, the definition of a diverse weaning diet and the methods to provide it were poorly understood. Using distractions whilst offering food and being flexible about where the feeding takes place were practical strategies used to reduce feeding-related stress.

Mothers demonstrated good adherence to the UK complementary feeding recommendations and a good ability to offer a nutritious weaning diet. Maternal self-efficacy in feeding a child and reliance on the official feeding recommendations to initiate weaning were predictive of dietary quality during weaning. Aspects of children's temperament may influence the timing of introduction and the type of complementary foods.

Recommendations

An effective weaning education should be provided to parents with the most up-to-date official recommendations and enable them access to easy-to-understand education material, whilst taking into consideration the diversity of cultural and religious backgrounds. Areas to focus on include infant signs of readiness to receive solids, health implications of early weaning, and the age marking the appropriate inclusion of various complementary foods. Additionally, misconceptions around food exposure and food variety are common and health practitioners need to be aware of them. Mothers' perceptions around their own eating behaviours, such as food neophobia, should also be addressed as part of the guidance on complementary feeding. Emphasis should also be placed on strengthening mothers' confidence in feeding by equipping them with ways to promote the consumption of healthy foods and to restrict intake of high-fat and high-sugar snacks.

Chapter 1: Introduction

1.1 Definition of complementary feeding and risk of chronic disease

1.1.1 What is complementary feeding?

Complementary feeding is defined as the introduction of any foods other than milk (breastmilk or formula milk) into an infant's diet (1-3). It is also referred to as baby weaning, since an infant is weaned from an exclusively milk-based diet to foods. Many paediatric and dietetic associations worldwide are in line with this definition, but there is a slight difference with the one proposed by the World Health Organization (WHO), which considers formula milk a complementary food (4). Complementary foods can have a solid, semi-solid or liquid consistency, but are often referred to as solid foods, and can be offered as spoon feeds, finger foods or drinks. Complementary feeding is a process that covers an extended period of time (up to 18-24 months) with the gradual reduction of breast-feeding (or formula-feeding) in frequency and volume of milk, which eventually leads to a dietary pattern customary in the infant's family (5).

The European Food Safety Authority (EFSA) suggests the introduction of nutrient-rich complementary foods from the age of 6 months, as exclusive breast-feeding alone cannot fully meet a healthy infant's need for energy, protein and most vitamins and minerals. This is particularly crucial for infant stores in iron and zinc which start to diminish from 6 months increasing the risk for a deficiency and compromising optimal growth (6,7). Aside from meeting child's nutritional requirements, the introduction of complementary foods offers exposure to new and exciting tastes and textures providing the experiences which will set the foundation for future diet habits (8). It is well-reported that infants have a biological drive towards foods that are calorie-dense which is demonstrated by an innate preference towards sweet foods and an aversion to bitter foods that might be poisonous or toxic (9,10). Early likes and dislikes are shaped by these innate preferences, but are also modifiable (11).

1.1.2 Timing of introduction of complementary foods and risk of chronic disease

The timing of introduction to solid food and the types of first foods offered, along with their potential link with the risk of various chronic diseases has drawn great research interest in recent years. Indicatively, the literature on the timing of weaning and the risk of obesity and overweight in the European population has grown by 54 publications in the last two decades. In September 2019 the EFSA Panel on Nutrition, Novel Foods and Food Allergens systematically reviewed and pooled the available global evidence, based on its quality, in order to suggest an appropriate age for the introduction of solid foods (12). All the available randomised control trials, prospective and retrospective observational studies were

considered before the panel concluded that there is no evidence to support that early weaning (as defined before 4 months) is associated with an increased hazard of developing obesity or overweight, symptomatic food allergy, or developing type 1 diabetes later in life, when compared to later weaning (6 months onwards). Additionally, the panel updated its last scientific opinion from 2009 and now suggests that there is no differential effect between the introduction of gluten at 4 months compared with 6 months of age and the hazard of developing coeliac disease up to 3 years of age. However, these conclusions were reached without taking into consideration the effect of breastfeeding versus formula milk on the above health outcomes.

1.2 Guidelines and recommendations on complementary feeding

1.2.1 Official guidelines

In the UK, the Department of Health recommends that parents of full-term infants should introduce complementary foods to their children's diet when they are around 6 months old (13). This is because baby milk provides the energy and nutrients babies need until that time and delaying the introduction of solids to 6 months gives the baby time to develop so they can safely accept solid foods. Signs of developmental readiness include infants staying in sitting position and holding their head steady; coordinating eyes, hands and mouth so they can look at the food, pick it up and put it in their mouth by themselves; and able to swallow food, rather than spitting it back out. When the above signs appear together from around 6 months of age, they mark the beginning of safe weaning. When it comes to choosing the first complementary foods, parents are advised to offer a variety of flavours and textures, and as their children progress through solid foods, to include iron-rich foods (animal and plant-based) at each meal. They are advised to avoid giving any salty foods, as salt excretion maybe sub-optimally managed by the child's not-fully developed kidneys (14), and should abstain from giving sugar- or honey-containing foods and drinks, as they can cause tooth decay (15). The list of foods to avoid also include choking hazards like whole nuts, as well as potential sources of threatening bacteria such as mould-ripened soft cheeses, raw and lightly cooked eggs and raw fish. In addition, UK official weaning guidelines advise parents on portion sizes and frequency of meals, on a feeding environment with no distractions, food safety and hygiene when preparing and storing food, as well as vitamin supplements.

All the above guidelines are in alignment with the WHO weaning recommendations and were published following an expert consultation and a thorough review of the available research evidence in 2001 (16). Since then the European Society of Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN) has published two position statements with the latest

in 2017 providing an update on new evidence regarding the appropriateness of introducing various solid foods and the recommended timing (2). Institutions in European countries have adopted the guidelines in the ESPGHAN position paper, but slight differences exist in certain areas. For instance, given the lack of evidence against introducing solid foods prior to 6 months, parents in a number of European countries are advised to wean between 4 and 6 months (e.g. Ireland) (17), as opposed to 6 months, as recommended in the UK and other countries (5,13). The timing of introducing cow's milk is also a source of disagreement; ESPGHAN recommends the delay of introduction after the first year of life due to the nutritional content of cow's milk being high in protein but low in iron. However, European countries such as Denmark and Sweden advise in favour of introducing cow's milk from ten months (18). Recommendations in relation to the introduction of reduced-fat milk products can also vary; UK guidance advises parents to delay the introduction of low-fat milk products after two years (and only as part of varied diet), in Ireland after two to three years, whereas Finland after one year. Such differences may be a source of confusion for new parents; particularly in neighbouring countries where inconsistencies in weaning recommendations are easily flagged (e.g. Ireland and UK).

1.2.2 Nutrition education through health services

In the UK, the primary care pathway in the first two years might differ slightly depending on the area of residence, but generally, parents' primary point of contact and designated source of weaning advice is health visitors. They are qualified nurses or midwives who have undergone further training to undertake the role. Health visitors meet regularly with parents to monitor child development, provide information on wellbeing and parenting skills including feeding practices during the first years (19). *Sure Start* is an additional service available to new parents, which with the support of midwives or health visitors offers parenting programmes including courses in relation to healthcare and nutrition (20). For special medical cases e.g. growth faltering or obesity, fad eating and feeding problems, or other nutrition-related medical conditions, parents are referred to secondary care where they can see a paediatric dietitian (21). Low income families can also benefit by the *Healthy Start* scheme. The scheme provides vouchers for free baby milk, fresh fruit and vegetables to young children and pregnant women, and vitamin supplements (22).

1.2.3 Research recommendations

The official weaning guidelines are supported and complemented by a growing body of research, which has generated additional recommendations that can help parents foster long-lasting healthy eating behaviours that start at weaning. A comprehensive review by

Nicklaus concludes that food acceptance can be facilitated by the timing of introducing solid foods (23). More specifically, parents are encouraged to try introducing all family foods by the age of two years, as this marks the end of a time window that favours acceptance (particularly of vegetables). In addition, repeated exposure to a new food and exposure to a variety of foods have been acknowledged as key determinants of acceptance of new and not-so-liked foods. The value of giving a child multiple opportunities to taste a food (8-10 times) and of offering variety from one day to the next has been a consistent message of literature to date. These recommendations provide parents with practical tips that could make day-to-day feeding easier and may be incorporated in future official guidelines.

Recent literature highlights the importance of responsive feeding and encourages parents to: allow the child to guide the feeding process; respond to hunger and satiety cues; avoid coercive feeding; and establish positive parent-child interactions during mealtimes (24-26). Studies reveal that infants up to 6 months can self-regulate their food intake (i.e. adjusting the quantity eaten according to the energy density of this food) (27,28), but this ability seems to diminish with age, in particular when it is not consistently met with an appropriate maternal response (26). The decrease in caloric compensation ability seen in children around the age of 1 can be modulated by mothers' feeding practices and in particular the feeding pace. As Burgailleres and colleagues conclude, mothers who allow more time for their infant to process bigger amounts of food offered can enable their infant to self-regulate better. The importance of responsive feeding is already addressed by the UK and European guidelines (2,13).

Guidelines in the UK also suggest that parents should not heavily rely on commercial complementary foods, as the frequent consumption of these foods may inhibit a smooth transition to the variety of family foods (13). It is currently unclear whether the consumption of home-made weaning foods holds benefits over manufactured baby foods, as the limited number of studies that exist in this subject convey mixed results. A systematic review that looked at the nutritional content of baby foods manufactured in the UK classifies two thirds of the available products as sweet foods (with added fruit sugars) and warns that the frequent exposure to them may contribute to children's low acceptance of non-sweet foods (29). Additionally, the consumption of home-made complementary foods among 6-month-old infants in the ALSPAC cohort was associated with greater variety of fruit and vegetables in 7 years of age (30). On the other hand, the superiority of a home-made diet is largely dependent on its appropriateness and whether the foods that are made available to infants are in line with the weaning recommendations. Indicatively, in a telephone survey with low-

income parents living in the US, the diet of infants that were fed with manufactured foods was characterised by a greater variety of fruit and vegetables (including green leafy vegetables) compared to children who consumed foods prepared at home (31). In this way, commercial baby foods may contribute to dietary variety during infancy for parents whose cooking skills and nutritional knowledge may be limiting factors for offering a wide range of foods.

Additionally, it appears that infant feeding holds great importance for the oral motor development. A review by Neiva et al warns that weaning too early may be responsible for structural alterations in speech organs and can cause disruption to the proper development of oral functions such as swallowing and speaking (32). It is worth noting however, that 'early weaning' in this review refers to early termination of breastfeeding (timeline is not specified), as opposed to the untimely introduction of foods, with children who have been bottle-fed being on a higher risk of presenting speech- and language-related pathology. At the same time, development of certain oral functions is dependent on the textures offered (33). In this way, children who are exposed to a variety of different tastes from 6 months have a wide range of oral-motor experiences and are better prepared to cope with more difficult textures later in infancy (34). Parents are also advised of the importance of timely progression from purees to lumps. Researchers in the ALSPAC cohort concluded that infants that are introduced to lumpy food textures later than nine months are more likely to present feeding difficulties and be less accepting of a variety of family foods (30,35).

1.2.4 Potential reasons for confusion

Given the number and the complexity of the weaning recommendations, it is possible that parents might be left in a state of confusion. A few of the recommendations are age-specific (e.g. introduction of lumps before the 8th month) and vary across countries as previously explained. Also, in the years following the publication of the infant feeding guidelines in the UK access to and the use of the internet has risen massively. An abundance of information, including health- and nutrition-related information, has since been made easily available, something that has had a detrimental effect on the reliability of online resources (36). This has been particularly notable with the information on infant feeding, as shown by a systematic analysis aimed to assess the quality and comprehensiveness of infant feeding information available on Australian websites (37). Quality was measured by the Health-Related Website Evaluation Form (HRWEF) that assess, among others, the content, accuracy and reliability of web-based health information (38). The study revealed that the information on most websites (27 out of 44) was of poor quality based on their final HRWEF score.

Regarding the content of the information, it was shown that only two websites covered all topics of the Australian infant feeding guidelines and that the information provided was accurate. Even though this might not be exactly the case for UK websites, the study by Taki et al demonstrates that infant feeding information available online is not always evidence-based and sufficient.

1.3 Current parental complementary feeding practices in the UK

1.3.1 Survey data on feeding behaviours

In the current environment where there is an abundance of weaning information with varying levels of accuracy, there is a mismatch between what parents are being recommended to do by health professionals and what they do during complementary feeding. In the UK, the 2011 Diet and Nutrition Survey of Infants and Young Children (DNSIYC) provided data on food consumption of a nationally presentative sample of 2,683 children aged between 4 and 18 months (39). An investigation focusing on the energy and dietary intake of a nationally representative sample showed that the feeding behaviours that favour overweight also compromised nutritional quality and diversity. They found that the energy intake of 65% of children below one year and of 88% of children between 12-18 months exceeded the age- and gender-specific estimated average requirement (EAR), where only 50% of the population is expected to have requirements exceeding the EAR. In relation to the frequency of consumption of energy-dense and nutrient-poor foods among infants between 10 and 12 months, results found that: 41% consumed sugar-containing foods and confectionery; 15% sugar-sweetened soft drinks; 26% low-calorie soft drinks; and 28% not-infant-specific savoury snacks. On the other hand, the reported variety of protein- and iron-rich foods was lower than ideal with only 47% of 10-12month-olds eating fish and fish-containing dishes and just 51% of them eating red or white meat. A total of 32% of parents taking part in the survey also reported giving follow-on formula to children aged 4-6 months, even though it is not recommended for children younger than 6 months. This indicates that parents are either not getting sufficient advice on infant feeding or that they are not aware of the benefits of adhering to the feeding recommendations; or the risks of not doing so; or a combination of all of them.

1.4 Interventions to date to improve weaning practices

The period of complementary feeding offers a window of opportunity to establish long-lasting healthy eating habits. Food preferences and behaviours formed in early years persist through the lifespan (40), and rapid growth during infancy may have a persisting effect on body composition through childhood (41). Several randomised control trials (RCTs) have

been designed to promote healthy feeding behaviours during the first two years of life. A few examples of well-designed interventions with large samples and good retention rates are mentioned here (42-46). Three of them employed an anticipatory guidance approach whereby parents are informed about food-related behaviours they can expect from their children and ways to manage these behaviours (42-44). Two of them included educational material on recommended feeding practices delivered by a trained health professional (45,46). Even though no significant intervention effect was observed for growth trajectories and the risk of overweight for any of these studies, the interventions had a positive significant effect on several feeding behaviours.

An intervention by Campbell et al with 542 infants aimed to build parental knowledge and skills regarding infant feeding by adopting the anticipatory guidance framework (42). At 2-year follow-up children in the intervention group were offered sweet snacks less frequently when compared to the comparative group, but there was no significant effect on other parameters of children's diet (e.g. fruit and vegetables, total energy intake). Similarly, an American RCT assessed the dietary intake of 232 infants following infant feeding advice in the form of educational brochures that led to reduced exposure to sweetened drinks (42,46). The American INSIGHT trial employed an education curriculum focusing, among others, on responsive feeding, parent food modelling and appropriate infant foods and portion sizes. A significantly higher food variety was seen among children in the intervention group, but only among formula-fed children and not those who had been breast-fed (45). French et al reported that mothers who received brief anticipatory advice on infant feeding gave more fruits and less juice compared to those in control at 1-year follow-up (44). Finally, the Australian NOURISH trial with a sample of 698 first-time mothers reported increased maternal use of feeding practices protective against obesity (e.g. responsive feeding, absence of controlling feeding) which was an aspect of the guidance module used and one of the primary outcomes (43); no information was collected on children's food consumption and eating patterns however. Overall, although results from interventions are mixed and reported outcomes differ across studies, their findings suggest that parental feeding practices can be modifiable.

1.5 Research gap, project aim and objectives

However, further work would be essential to advance existing knowledge on effective strategies that health providers can adopt to improve complementary feeding practices. Research is needed to identify the underlying factors that contribute to the formation of parents' feeding practices and influence their adherence to weaning guidelines. This would

enable the design and implementation of effective and financially-sustainable interventions that in turn could be incorporated as part of primary care and nutrition education for new parents.

Thus, this project aimed to gain a deep understanding of the factors that influence parents' feeding behaviours and attitudes during the complementary feeding period in high-income countries, particularly in the United Kingdom. This will be achieved by undertaking the following studies:

1. a systematic review of the existing qualitative literature to synthesise all the factors that are taken into consideration by parents during complementary feeding in developed countries;
2. a qualitative study to gain a better understanding of parental experiences of weaning a child with a particular focus on the factors that favour establishing a healthy relationship to food in infancy and those that impede it;
3. an online survey to assess the dietary quality and diversity during the complementary feeding period and the association with parental and infant characteristics.

The first study will be described in Chapter 2, the second in Chapter 3 and the final study will be addressed in Chapter 4 and 5. It is worth considering that even though improving complementary feeding behaviours poses a global challenge, the priorities of weaning interventions in lower-income countries are largely diverging form those in higher-income ones (47-49). This thesis will focus entirely on parental considerations during complementary feeding practices in developed countries. Additionally, as per the definitions given by the European Food Safety Authority, this thesis defines 'infants' as children until the age of one year and 'young children' as children between the age of 1 and three years (12). Also the scope of this thesis is within the domain of weaning for full-term healthy infants. There is a number of additional consideration when studying the introduction of solid foods in pre-term infants.

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Chapter 2: A systematic review of qualitative evidence on parental considerations during complementary feeding in upper-middle- and high-income countries

2.1 Introduction

2.1.1 Physiological maturation during infancy

Infancy is characterised by rapid physical growth and neurological development which result in high energy and nutrient demands (1). Important body systems linked with food intake and absorption mature during the first year of life. Development of the gastrointestinal system enables normal luminal digestion and mucosal absorption of micro- and macronutrients from solid foods (1). Additionally, maturation of renal function is necessary for maintaining fluid and electrolyte balance and for removing toxic end products of metabolism (2). Neurological development also takes place at a fast pace during infancy; the brain doubles in size (3) and infants gradually acquire speech, language and visual and gross motor skills (4). The completion of all the above processes is required for a safe and effective progression from a milk-only diet to a diet including solid foods (5). The introduction of solid foods in infancy is also known as baby weaning or complementary feeding, since milk feeds are complemented by non-milk foods (6).

2.1.2 Weaning recommendations around the world

In 2001 the World Health Organisation (WHO) published a comprehensive systematic review to establish an optimal age of introducing complementary foods (7). The evidence drawn from this review and an international expert consultation informed the development of a novel set of recommendations on infant feeding according to which the appropriate timing to introduce solids in an infant's diet was established to be 6 months of age (8). Additionally, in these recommendations WHO introduces the concept of responsive feeding, encourages the maintenance of breastfeeding for the first two years and advises on the quantity and types of weaning foods, and appropriate meal frequency. Parents and caregivers are advised by WHO to avoid giving drinks with low nutrient value, such as tea, coffee and sugary drinks. Cow's milk is not recommended as a main drink before the first 12 months.

Several national bodies have updated their infant feeding guidelines in line with those by WHO. Countries such as the UK, Sweden, Australia and New Zealand have adopted the 6-

month guideline (9-12), whereas there are countries that recommend that complementary feeding start between 4 and 6 months, like USA, Belgium, Denmark and Spain (10,13). Some of the recommendations published in European countries make a distinction between breastfed and formula-fed infants and suggest weaning at the age of 4-6 months only for bottle-fed children; examples of such countries are Norway and Ireland (10,14). Apart from slight inconsistencies in relation to the recommended weaning age, guidance on the time of introducing cow's milk also vary between national associations. Health professionals in Canada advise parents and caregivers to delay introduction of cow's milk until nine months of age, as opposed to the European and WHO guidelines that recommend introducing cow's milk after the first year (8,15).

2.1.3 Current parental feeding practices around the world

National data from around the world suggest that the timing of complementary feeding shows considerable variation between upper-middle- and high-income countries and often deviates greatly from the recommendations. National Chinese data from 2008 showed that only 43.3% of children aged 6–9 months were introduced to solids with the remaining being on a milk-based diet (16). Studies with rural populations further validate this evidence and conclude that Chinese infants are weaned too early or too late, and foods are often nutritionally inadequate and unsafe (17-19). In Brazil, a prospective study which assessed feeding practices and dietary intake of healthy infants in three municipalities showed that the median weaning age was four months and concluded that insufficient dietary intake in young infants was very frequent (45% presented with iron deficiency) (20). Introducing solid foods too early is prevalent in European countries too. In Ireland the prevalence of infants introduced early to complementary foods (<17weeks) was 15.5% (21) in 2008. In Italy, 34% of infants had been weaned before the 4th month of age (22) and in Germany 16% by the 3rd month (23). In America, the Feeding Infants and Toddler Survey offers an insight of the population's weaning practices and early weaning rates (before 4 months), albeit improved since 2002, were still common practice in 2008 (reduced from 26% to 10%) (24). In South Africa, it has been reported that the proportion of infants transitioned to a solid diet before four months ranges from 56-73% between various provinces (25-27). Additionally, frequent consumption of carbonated drinks has been observed among the children aged 6-12 months along with low intakes of foods high in iron and omega-3 fatty acids (26).

2.1.4 Value of qualitative research on complementary feeding

Infant feeding is one of the main causes of stress and anxiety for new parents, and problems occurring during feeding can become a psychological burden for them (28). At the same time,

there is low compliance with the WHO recommendations for the timing of weaning or the appropriate weaning foods. In an effort to understand the potential contributors to this issue, a large body of evidence exists on identifying the determinants of early weaning and inappropriate practices (21,29-31). Aside from surveys and other quantitative techniques, soaring interest has focused on utilising qualitative research approaches to investigate the underlying reasons of individuals choosing certain eating behaviours (32). Particularly in relation to complementary feeding, the usefulness of qualitative methodologies lies in providing evidence in how and why parents in the developed world shape their feeding practices. Casting a view in the existing qualitative literature on weaning will be helpful to gain insights into the circumstances under which parents form their infant feeding perceptions and practices.

2.1.5 Objective

The objective of this paper is to systematically review the existing qualitative literature in order to synthesise all the factors that are taken into consideration by parents or caregivers in relation to baby weaning practices in upper-middle- and high-income countries.

2.2 Methodology

2.2.1 Protocol and Registration

A protocol for this review exists in the registry of PROSPERO (registration ID: CRD42017067091).

2.2.2 Eligibility criteria

The selection of the reviewed studies was based on the following inclusion criteria:

- Participants: parents or primary caregivers of healthy infants (from birth to 3 years of age).
- Study design: studies of qualitative methodology as well as mixed-method studies with a significant qualitative component.
- Setting: studies that interviewed participants residing in developed countries at the time the study took place. Developed countries were 'upper-middle-income' and 'high-income' economies as per the World Bank Classification. Even though selection based on this system runs the risk of including countries with food insecure areas, it was still considered appropriate, as it is consistent with previous research in developed countries.

Studies with any of the following characteristics were excluded from the present review:

- Participants: parents or primary caregivers of pre-term or small-for-gestational-age infants or infants with health conditions affecting their ability to feed,

swallow or digest. Studies including children up to 3 years of age and older were excluded, unless they reported results separately for different age groups. Additionally, studies which explored a non-parent perspective (health care professionals or policy makers).

- Study design: studies which followed a non-qualitative methodology. Additionally, qualitative research about weaning specifically related to a weaning intervention.
- Objective: qualitative research that doesn't discuss the process of weaning and/or is related to an intervention.
- Setting: studies set in developing countries ('low-income' and 'lower-middle-income' economies on the World Bank Classification). Challenges observed in developing countries regarding infant feeding and weaning in developing countries represent unique and distinct challenges that require separate focus (such as high rates of undernutrition, insufficient health information services, high rates of parental illiteracy, household food insecurity and limited access to clean water).
- Breastfeeding: studies that solely explored intentions, knowledge and behaviours regarding breastfeeding or cessation of breastfeeding (with no reference to solid food introduction).
- Year of publication: studies that were published or completed data collection before 2001 (prior to publication of WHO infant feeding guidelines) (33).

2.2.3 Information Sources

The following electronic databases were searched for this review: PubMed, EMBASE, Scopus, Web of Science (Core Collection). A search was last conducted on 28 Mar 2019 to update the search results and ensure that the papers retrieved from all databases were published in the same reference period (January 2001 – 28 Mar 2019).

The reference lists of all included studies were hand-searched for additional papers that meet the inclusion criteria. In a few cases where a full text could not be retrieved in English the authors of these papers were contacted to confirm that a paper in English didn't exist.

2.2.4 Search

The following terms were used for the initial search in PubMed. The same set of terms was used for all the other databases after appropriate adjustment for database-specific operators.

Table 2.A Keywords used in search of electronic databases

1.	weaning NOT ventilation
2.	infant feed*
3.	complementary food*
4.	complementary feed*
5.	"solid food introduction"
6.	**1.** OR **2.** OR **3.** OR **4.** OR **5.**
7.	"information sources"
8.	knowledge
9.	attitude*
10.	practice*
11.	**7.** OR **8.** OR **9.** OR **10.**
12.	**6.** AND **11.**

All databases allowed for filtering for year of publication. The current recommendations on complementary feeding were published by the World Health Organisation (WHO) in 2001 (33). Therefore, all papers published earlier than January 2001 were removed from the search results. An additional limit was applied to include only studies with humans (only applicable on PubMed and EMBASE). No limit was applied for language of publication.

2.2.5 Study Selection

All search results were imported from each database to Refworks citation management software (online version, ProQuest, Michigan, USA). They were then exported into a unified Excel spreadsheet. All duplicate records (between and within databases) were identified and removed. Titles were screened and the records with irrelevant titles were removed. An additional independent researcher reviewed all abstracts of the remaining records against the eligibility criteria. Disagreements due to simple oversights were resolved easily by discussion between the reviewers and there was no need to consult an additional member of the research team.

For the studies that appeared to meet the inclusion criteria and a definite decision could not be made based on their abstract alone, the full paper was obtained for detailed assessment against the inclusion criteria. The reason(s) for exclusion was (were) documented for each study that was screened on a full-text basis.

2.2.6 Data collection and synthesis

This is a narrative review, so no specific software package was used as it would in quantitative approaches e.g. meta-analyses. The information that was obtained and integrated in this review included key characteristics and reported outcomes of the included papers. Study characteristics were extracted according to a template including reference details (leading author and year of publication), country/location, eligibility criteria and sampling approach, number and age of participants, data collection method and type of analysis.

In relation to study findings, a 'framework synthesis' was applied in this review. Similarly to the method outlined by Barnett-Pate & Thomas (34), an initial framework, i.e. a list of outcomes of interest, was conceived following review of the background literature and discussions within the team. After selection of relevant studies and during careful consideration of the available data, additional outcomes of interest emerged and incorporated into the initial framework. However, during this process the newly-emerging findings were prioritised based on the frequency they occurred within the selected literature; findings that sparsely appeared in the data were not presented in this review. This approach has been given the term 'qualitative meta-summary' by Sandelowski & Barroso (35).

There was no need to contact the authors of the original papers, as the data reported in the included papers were sufficient for the scope of this review.

2.2.7 Quality assessment in individual studies

The 'Standards for Reporting Qualitative Research' tool (SRQR) was used to assess the quality of the included studies (36). The SRQR checklist includes 21 criteria and provides a critical appraisal of the design and reporting of findings for each of the eligible papers.

The SRQR scoring was utilised to underline areas of methodological rigor and clarity of reporting, as well as key elements that were inadequately reported. In this way, the quality assessment of the selected studies could enable comparisons among them and inform qualitative researchers of common omissions. Studies were not excluded based on the quality assessment and their scores were not taken into consideration during data synthesis.

2.3 Results

2.3.1 Study selection

Figure 2.A provides a flowchart of the selection process based on the inclusion/exclusion criteria according to the PRISMA protocol (37). Thirty-seven studies were eligible and considered for this review. A description of each of these studies can be found in Appendix 1, Table 0.A. Additionally, a list of all studies that were reviewed on a full-text basis and were not included is provided in Appendix 1, Table 0.B, along with the reason for exclusion.

2.3.2 Quality assessment of included studies

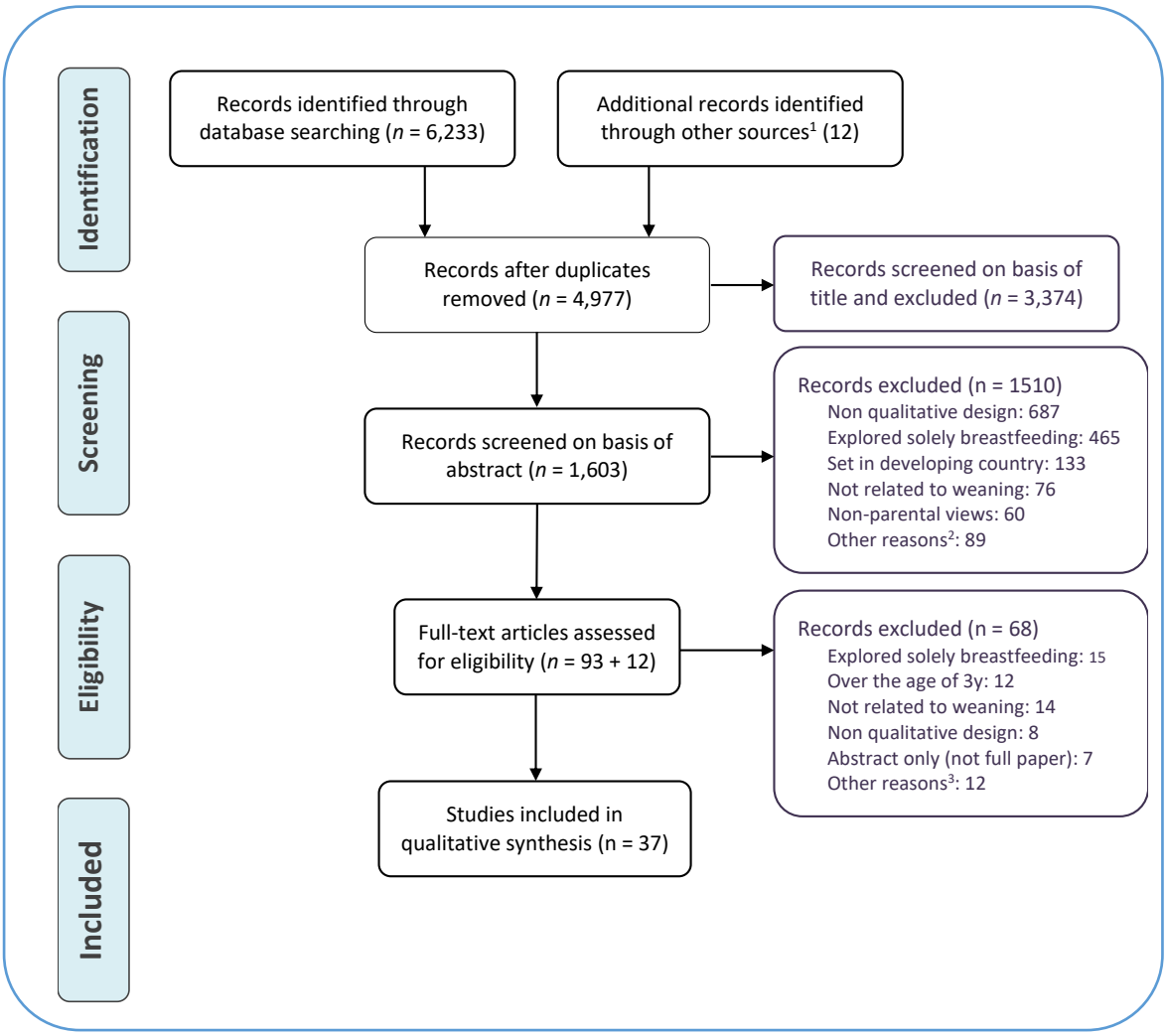
The Standards for Reporting Qualitative Research checklist (SRQR) was used to critically appraise the quality of the included studies (36). All the manuscripts were carefully evaluated against the 21 items of the checklist by the author. The lowest score was 6/21 and the highest was 20/21. Four studies (11% of all studies) scored between 5-10, twenty-five (67%) scored 10-15 and eight scored 15-20 (22%) (Fig 2.B).

All included studies sufficiently reported the problem formulation and the research question within their introduction section. All but one (38) adequately covered their results and their interpretation. The data analysis process was not well reported in three studies. Links to empirical data (e.g. quotes) and source of funding were reported in 89% of studies (33/37).

Fragmented information was available within the included papers for a number of areas: the title, the units of study and integration with prior work. Regarding the title, even though all studies described the topic in the title, the authors often gave insufficient information on the methodological approach that was followed i.e. qualitative. Omissions about the units of study mostly were due to lack of information on the level of participation in each study (e.g. the number of participants that didn't complete the data collection and why). Finally, in the twenty-two studies there was insufficient integration with prior work and inadequate descriptions of the transferability of studies' conclusions and contribution to the field.

The most frequently omitted information was regarding authors' conflict of interest (not available in 20 papers), followed by techniques enhancing credibility (not provided in 9 papers) and finally limitations of the study (not provided in 6 papers). A detailed comparison of the studies against the SRQR checklist is provided in Appendix 1, Table 0.C.

Figure 2.A PRISMA flowchart of study selection

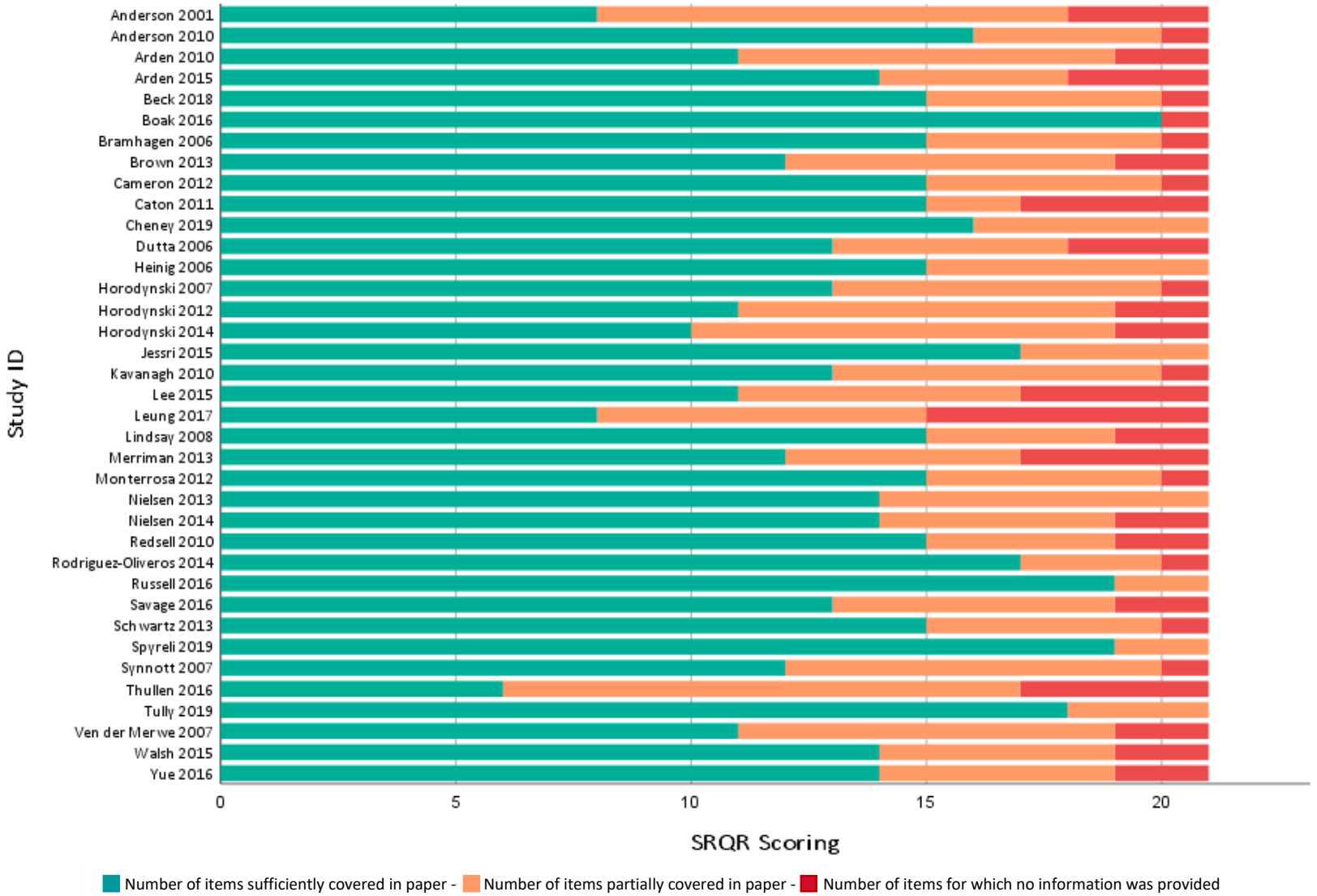


[1] The additional records were assessed through the full-text screening stage, hence full-text screening included 93 + 8 records

[2] Other reasons for exclusion include: title only (no abstract) (*n*=59); pre-term/small-for-gestational-age/hospitalised infants (*n*=22); over the age of 3y (*n*=6); and data collection before 2001 (*n*=2)

[3] Other reasons for exclusion include: full text not available in English (*n*=5); data collection before 2001 (*n*=2); non-parental views (*n*=2); set in a developing country (*n*=1); health status (*n*=2)

Figure 2.B Scoring of individual studies according to the 'Standards of Reporting Qualitative Research' assessment tool.



2.3.3 Study Findings

When considering the available outcomes and how they were inter-related, three main themes emerged. As shown in Figure 2.C, Theme 1 had three sub-themes related to the timing of weaning (prompts for the introduction of solids, knowledge of and attitudes to WHO weaning guidelines, feeding practices that deviate from WHO guidelines on timing of weaning); Theme 2 had four sub-themes related to type of foods chosen during weaning (factors influencing choice of foods, perceptions of commercial infant foods, strategies to establish healthy eating habits, feeding practices that deviate from the WHO guidelines on type of weaning foods); and Theme 3 had four further sub-themes that were related to both timing of introduction and type of foods (views on sources of weaning advice, feedback for improved weaning education, experiences of baby-led weaning (BLW) mothers and fathers' role during weaning). The themes were addressed across the literature with the majority of included papers discussing all themes. The frequency with which the sub-themes were reported is summarised in Table 0.D (Appendix 1).

2.3.3.1 Theme 1: Timing of introduction of solid foods

1) Prompts for the introduction of solid foods

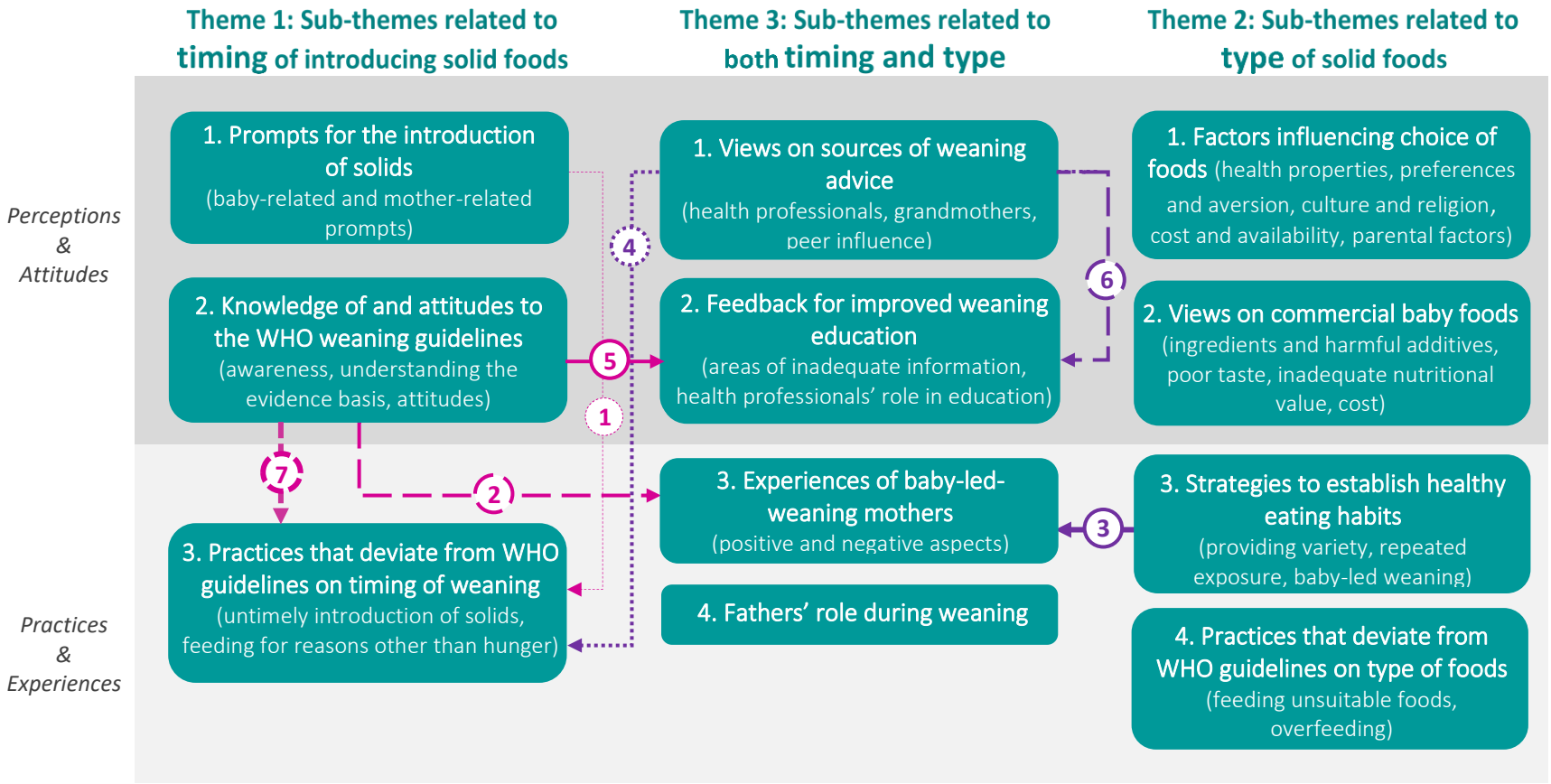
Twenty-two papers included in the systematic review discussed a number of factors associated with introducing solid foods in infancy, which had to do with the infant or the mother. Each of these are described in more detail below.

Baby-related prompts. Mothers discussed how cues from their babies guided them to start weaning. These cues included: perceived hunger, perceived interest in food, changes in weight and physical cues indicating their infant's readiness for solids.

The idea that infants were no longer satisfied by a milk-only diet was often cited by mothers and fathers as a compelling cue to give the baby's first solid foods (38-53). Signs that indicated hunger were crying, fast and increased consumption of milk, and waking through the night. In some cases, the feeling of obligation to attend to baby's hunger led parents to introduce solids early (38,42,46-49). For some parents, the perception that a diet with solid foods reduced hunger, and prolonged satiety and sleep justified the decision to introduce earlier than recommended by medical professionals and guidelines.

Excitement triggered by the sight of food was reported as another sign of baby's readiness for solids (39-42,44,49,51-57). Parents described that their baby was reaching out for food and grabbing it from their plates, which encouraged them to initiate weaning. Baby's desire for mum's food was quoted as a sign for readiness in all three studies that interviewed baby-led weaning (BLW) mothers (54-56).

Figure 2.C Themes and sub-themes emerging from systematic review of qualitative research of weaning: sub-themes classified as those related to theme one (timing of introduction of solid foods), those related to theme two (type of foods introduced during weaning)



1. Parents may be responding to baby's cues or their personal circumstances with introducing solids prior to the timing recommended by the guidelines. **2**. BLW mothers demonstrated better awareness of the WHO 6-month recommendation and a greater effort to follow it. **3**. Mothers reported feeling encouraged to follow BLW, as they believed it would help their child develop the ability to make healthy food choices. **4**. Receiving conflicting messages about feeding was rationale for not following weaning guidance. **5**. Mothers felt that easy-to-understand information about when to start feeding solids, about the benefits of waiting and the harmful effects of early introduction was lacking. **6**. There was a desire for culturally-appropriate feeding advice that covers all areas of weaning equally for both multiparous and first-time mothers. **7**. Poor adherence to the WHO 6-month recommendation and untimely weaning was prevalent in the included studies.

Baby's weight was discussed in eight studies in relation to the timing of introduction of solid foods (39,41,42,45,46,52,53,58). In these studies, the purpose of weaning was to sustain a steady growth rate. In this way, babies whose weight picked up in the first months of life were perceived to need solid foods earlier than their lighter peers (39,52). On the other hand, mothers felt compelled to introduce solids because they were concerned about their baby's slow weight gain (41,42,46,53,58).

Mothers explained that a number of physical characteristics signified physiological maturation for a smooth transition to a mixed diet (39,41-43,49,54,55,57). Relevant milestones included: losing the tongue thrust (41), being able to sit up (41-43,55), good hand-eye coordination (41,55), and teething (39,57).

Mother-related prompts. Even though the process of weaning was predominately described in the literature as infant-led, certain mother-related considerations contributed to the decision to introduce complementary foods (39,41,52,53,58,59). Some of these considerations were practical and involved the mothers returning to work after maternity leave (41,52,59). Solids were introduced into baby's diet so that they could be fed by other people, such as fathers or day carers, and so that they would not solely relying on mum's breastmilk. Additionally, some mums shared that they were excited to see their children eat family foods (39,53).

One study highlighted that breastfeeding in public was felt to be shameful for Middle Eastern mothers who lived in Canada (58) and feeding the baby solid foods when they were in public was seen as a practical solution.

2) Knowledge of and attitudes towards WHO guidelines on timing of weaning

Parental views on the WHO recommendations on complementary feeding was an important theme across papers in this review. The most frequently discussed aspect of the guidelines was in relation to the recommended age for weaning; less emphasis was placed on the type of foods to avoid or introduce throughout the weaning age. Studies reported on parental awareness of the recommendations for the timing of introducing solids, their understanding of the background and rationale, as well as their attitudes towards the guidelines.

Awareness of the recommended weaning age. Findings from the selected studies reflected good awareness of the guidance on the timing of introducing solid foods (39,43,48,51,53-55). Participants in these studies were mainly from the UK, USA and Australia and varied in demographic characteristics (with some of the studies having recruited mothers with low educational attainment and entitled to benefits and some having interviewed affluent mothers with a university degree). The recommended weaning age varied slightly based on

location; in some countries parents are recommended to introduce after 4 months (as recommended by the American Association of Pediatrics in USA), whereas in others the WHO recommendation of 6 months was followed. In contrast, Yue et al revealed poor awareness of the 6-month recommendation among a sample of Chinese mothers who believed that 1 year is an appropriate age to initiate solids foods in a baby's diet (60).

Understanding the evidence basis of guidelines. Despite mothers' awareness of the recommended age for complementary feeding, there were gaps in understanding of the evidence that led to the current guidelines. Specifically, mothers revealed an uncertainty about the health implications of early weaning (39,48), and about the need for reviewing and updating the guidelines (52,61). This was more evident among parents with older children who had weaned them before the new evidence emerged. Participants in studies by Van der Merwe and Walsh, however, seemed knowledgeable that early weaning had been associated with risk of obesity and allergy (53,62).

Attitudes towards the guidelines for the appropriate age for complementary feeding. A wide range of views was expressed regarding the usefulness of the WHO guidelines on the appropriate timing of weaning (39,41,43,47-56,61,63). There were mothers who questioned their credibility and disregarded them, those who were sceptical but still considered them as a guide, and those who expressed an effort and desire to follow them. Some of the reasons of dissatisfaction quoted by mothers were that current guidelines are perceived as too rigid, that they put unrealistic restrictions on mums and that babies develop differently. Thus the one-size-fits-all approach of the guidelines is not applicable. In some cases, feelings of guilt were described by the participants when they did not comply with the recommendation on timing of weaning (39,53).

It became evident that adherence to, and trust of, the guidelines were related to parents' experiences with their current or older children (if they had). Participants who had fed a child before based on older guidelines were particularly sceptical about the rationale of the current guidelines and were less likely to follow them (39,51,52,61). On the contrary, a positive attitude towards the official recommendations was expressed by mothers who followed a baby-led style of weaning (54-56). BLW mums considered the 6-month recommendation best practice and reported that it was the primary cue to introduce a mixed diet. Guidelines were generally acknowledged and considered as a helpful guide for mothers to start their babies on solids, but mums' felt that their ability to recognize babies' signs of readiness ultimately determined the timing of weaning.

3) Feeding practices that deviate from the WHO guidelines on timing of weaning

In the included studies mothers described weaning practices that deviate from the WHO infant feeding guidelines in relation to an appropriate weaning age. These were untimely introduction of complementary foods and feeding for reasons other than hunger.

Untimely introduction of solids. Eleven studies reported untimely introduction of solid foods which predominately occurred prior to six months and contrary to the WHO recommendation (42-44,46,49,53,58-60,62,64). In some cases, mothers admitted that weaning happened earlier than 4 months postpartum (42,44,46,49). The reasons that were quoted to contribute to early weaning were: 1) misconceptions in defining solid foods and the belief that adding soft, semi-liquid foods, such as cereal in milk, doesn't mark weaning (42,43,62); 2) the belief that milk alone cannot nourish 4-month old infants and satisfy their needs (44); and 3) building up children's acceptance to solid foods, so they can be fed by other people (59). The opposite trend is presented in a study set in rural China, where milk-feeding for a year was reported to be standard practice (60).

Feeding for reasons other than hunger. As emerged in the qualitative literature, mealtimes didn't solely aim to nourish, but also to modify behaviours. Feeding was a strategy occasionally employed by both mothers and fathers to settle an upset or crying baby (39,40,42,48). Seeing baby content after a feed justified this strategy and encouraged parents to utilise it again in the future. Providing food was also perceived to help infant sleep longer and with no interruptions (39,43,59,63,65).

2.3.3.2 Theme 2: Type of solid foods introduced during weaning

1) Factors that influence the choice of foods

More than half of the included studies discussed a number of different factors taken into consideration by parents to determine the type of complementary foods they fed their children. These factors related to: the actual and perceived health properties of the food; infants' own food preferences and aversions; cultural and religious beliefs about food; food cost and availability; and parental factors.

Actual and perceived health properties of the food. Providing a healthy diet was voiced to be a priority in most studies that addressed the factors that influence the choice of complementary foods (39,44,46-48,50-55,57,59-61,63,64,66-70). Parents shared a desire to provide a balanced diet with foods from all groups that will secure a sufficient intake of nutrients. Encouraging fruit and vegetable consumption was often voiced as the foundation of providing a healthy diet. Foods were often labelled as 'healthy' based on their nutrient content (vitamins, protein, fibre) or after comparison with other foods (e.g. banana versus chocolate bar, apple versus a lollipop) (51,67). A preference for organic foods was expressed

by parents in a number of studies (47,50-52,61,63,69). Buying organic produce was often seen as the pinnacle of the effort in providing a diet of superior quality, even though some of them admitted that its cost was considerably higher than foods conventionally sourced.

Parents also felt that a good nutrition included limiting the exposure to foods that due to their nutritional content were perceived 'unhealthy' e.g. processed, calorific snacks high in salt, sugar and fat such as cakes, cookies, chocolate and chips (50,54,63,66,69). Child getting accustomed and even 'addicted' to these foods' taste and choosing them over healthier foods was quoted as one of the reasons for avoiding giving them (50,66). Parents also discussed weaning as an opportunity for wider changes in the household. They often admitted making poor dietary choices and eating meals high in salt and sugar, but wanted to adopt healthier eating habits in order to increase the quality of the family diet and make it more suitable for the child's nutritional needs.

Five of the included studies discussed avoidance of foods that were thought to be unsuitable during weaning, because parents felt that their child's gastrointestinal system was not mature enough to process them (pulses, meat, eggs, some types of vegetables, spices) (44,50,57,59,66). Beck and Yue reported that parents waited for children to reach 12 months, or even longer, before introducing meat, as they believed their infants could not digest it. Additionally, some foods were perceived to be linked to an increased risk of developing allergy; such foods included dairy, nuts, eggs, meat, fish and exotic fruit (50,53,59).

Gaps in parental understanding of what healthy diet means were evident, but also in the nutritional content of foods and in the nutrient-health links. In some cases, individual foods have been arbitrarily linked to healthy growth and absence of illness due to their nutritional content (57,59,68). For example, participants in the study by Dutta et al associated foods with 'building nerves' and 'helping with bones'. In Monterrosa et al vegetables were perceived to 'help with learning', and in Rodriguez et al chicken was perceived to prevent 'illnesses'.

Baby's preferences and aversions. Even from infancy, parents observed that their children had distinct likes and dislikes to certain tastes and foods which guided the choice of complementary foods given (39,52,54,57,59,60,63,66-68,70). Rodriguez and Yue report that parents might have even prioritised offering foods that baby was thought to like over others that were considered to be more nutritious. Mothers explained that infants' preferences determined the choice of complementary foods in two ways: baby was presented with a number of foods and was given the freedom to choose which ones to eat (54); or mothers discontinuing offering foods that infants rejected and giving alternatives (52,59,60,66,67).

Cultural and religious beliefs. Culture played an important role in the way that women viewed foods and determined which ones were appropriate to introduce to their infants' diet (45,46,50,57-59,62,66,67,71). The studies that address the influence of the socio-cultural norms on choice of weaning foods can be further split into two categories: studies that explore the values of mothers who come from and reside in places where culture is strongly linked to dietary choices (46,50,57,59,62,66,67); and the studies that interviewed women who immigrated but maintained their cultural and religious beliefs associated with food (45,58,71). Traditional foods automatically featured in the diet of the weaning infant: meat broths for Latino families (66), steamed foods for Chinese (71), gruel for Brazilian (i.e. a milk-based food containing rice or maize) (46) and porridge made from bread flour and water ('meelbol') for mothers in urban and rural areas of South Africa (62). Jessri et al discussed how Islamic beliefs encourage the consumption of certain foods, some of which are not recommended during infancy i.e. herbal infusions and sugar-sweetened desserts (58). Muslim mums also highlighted that only halal foods were suitable for the infant.

Food cost and availability. Cost was identified as a barrier to providing a nutritionally complete, balanced nutrition during weaning (47,50,51,57,58,60,67,68). In particular for low-income families the price of some foods allowed the purchase of fresh fruit, vegetables and of meat less frequently than desired. Due to the reported high cost and perishability of these foods parents described replacing them by cheaper alternatives of poorer nutritional quality; or offering them less frequently than ideally (e.g. daily); or leaving them only for the infant to consume. The cost of nutritional supplements was an additional financial burden for families with limited budget (58). Participants who lived in remote rural areas also admitted being faced with limited accessibility to fresh food (47,67).

Parental factors (risk aversion, skills). Additional considerations that guided the decision on the type of first foods given were food consistency and texture, parents' own food preferences, time available and cooking skills and resources (39,44,47,50-52,55,57-59,67,69,70,72).

Foods with a soft texture were considered appropriate for infants, whereas parents discussed how hard foods, or foods with seeds raised concerns of choking and were, therefore, avoided (39,50,57,59).

The discourse in studies indicated that food choices were influenced by what mothers saw as tasty or by their awareness of the current consumer health trends e.g. seeking organic food products. Mothers discussed how infants are exposed to samples of parents' food which are chosen based on the parents' personal preferences (44,50,55,57,67,69). Similarly,

mothers admitted that foods they disliked were not available at home and hence were not provided to children (59,70).

Parents felt that their return to work or need to take care of the other children in the family meant that time-consuming meal preparation often gave way to convenience meals (51,52,67,72). Limited confidence in cooking and lack of cooking equipment were also quoted to impact choice of weaning foods (47,58,59,67,68).

2) Perceptions of commercial baby foods

Maternal views on ready-made weaning foods were apparent in some studies. A general preference for home-made foods over ready-prepared baby foods emerged from the studies included. A mistrust of the baby food industry was voiced by some mums which partly stemmed from the fact that mums noticed some of the products marketed for infants were labelled as suitable from 4 months which contradicts the formal 6-month recommendation for weaning and further contributed to mothers' confusion over what age to start weaning (51-53).

Furthermore, parents noted that although commercial infant foods offered a practical back-up option for a mother's hectic schedule, they were perceived to contain potentially harmful additives, to be inferior in terms of flavour and nutritional quality, and to be costly.

Additives and harmful ingredients. A common idea about ready-prepared or convenience baby foods was that they underwent processing, were not freshly prepared and hence contained artificial additives that could be dangerous for infant's health (59,66-69). There was also uncertainty if they were void from ingredients that should be avoided during infancy e.g. salt, sugar (51,59,61).

Poor taste. There was also the belief that ready-made infant foods lacked taste (50,51,61,62). In the relevant studies women described how their baby didn't enjoy the food from jars and rejected them. Some mothers felt that these products gave babies a false taste of food and prevented them developing a liking for home-made foods (62).

Inadequate nutritional value. The nutritional content of commercial and home-made foods was another consideration when deciding between the two (51,52,59,61,63,68). Mixed feelings were expressed on this issue with a portion of participants underlining the superiority of family meals in terms of their nutritional quality (59,61,63,68) whereas others were confident that commercial baby foods were designed to provide all the necessary nutrients to an infant (51,52).

Cost. Discussion across four studies indicated that parents felt it was more economical to make their own baby foods at home than to buy those on the market (58,62,67,68). In one

study in financially overburdened households, ready-to-eat infant foods were described as unaffordable (62).

3) Parental strategies to establish healthy dietary behaviours

Parents talked about their weaning practices and the impact they perceived these to have on their children's future food patterns. The positive effects of offering a variety of foods, the repeated exposure to foods, baby-led weaning, and modelling are described below.

Providing variety of foods. The importance of providing a diverse diet during complementary feeding was acknowledged in many of the included studies (39,41,50,55,57,61,63,67,69,70). Mothers were mindful that their weaning practices would have a lasting effect on their children's eating behaviours and that ensuring food variety would have a number of short- and long-term benefits including: nutritional adequacy (70), improving acceptance of foods in infancy and later in life (55,57,61), and preventing picky eating habits in the future (63,69,70). Particularly in terms of avoiding picky eating, mothers highlighted that weaning offers a great window of opportunity for infants to explore different foods and flavours (50,69). They also highlighted that children who grow up to be adventurous with food enjoy their food more and felt that this often originated from the mothers' own experiences with fussy eating (67,70).

Repeated exposure to foods. In a number of studies, women discussed how their infants' acceptance of unfamiliar foods grew over time through their repeated exposure to them (50,61,66,67,70). Mothers were aware that by offering children the same foods frequently would be an effective way of promoting intake of unfamiliar foods, as consistently reported in literature (73). This feeding strategy is facilitated through the process of familiarisation (74) and learned safety (i.e. when food ingestion is not followed by a distinct negative consequence such as gastrointestinal discomfort) (75).

Mothers recounted practical suggestions related to re-offering the disliked foods like presenting it again in a few days, hiding it within dishes, or giving it side by side with a previously liked food. Repeated exposure was mainly used with foods of high nutritional value and vegetables were the most frequently quoted (50,61).

Baby-led weaning (BLW). Five studies discussed the baby-led approach of weaning as another method to foster healthy eating habits in the future, three of which exclusively recruited BLW mothers (41,53-56). Through this approach, it was envisaged that children would develop an ability to make healthy food choices through life. Participants explained how BLW would encourage their children to develop good appetite control, lower their chances of becoming a fussy-eater and improved the experience of family meals. Moreover,

babies that were weaned this way were observed to be in charge of the feeding process and this was perceived to hold benefits for their development.

Modelling. Albeit less frequently reported, modelling was another technique to encourage healthy eating behaviours (51,61,70). Mothers considered themselves role models for their children and used this quality in an effort to shape good food habits. According to them this was achieved by sharing meals with their infant whereby they ate foods they would like them to consume (e.g. vegetables) and abstaining from unsuitable foods (e.g. sweets).

4) Feeding practices that deviate from the WHO guidelines on the type of complementary foods

This section describes participants' practices that didn't comply with the recommendations in relation to the type of weaning foods.

Feeding foods unsuitable for infancy. Offering foods that are not recommended by the WHO and national guidelines was discussed in some of the selected studies (57,58,62,64,65). These foods included sugar-sweetened drinks and sweet and savoury snacks. Mothers claimed that feeding unsuitable foods was often reinforced by older women such as grandmothers (64) or by cultural norms (58).

Overfeeding / not being attentive to satiety cues. Parents described letting their children determine the amount of food given by being attentive for signals indicating when they're full (48,66,76). However, coercive feeding techniques or feeding according to schedule was utilised by some parents who felt that a certain amount of food had to be consumed to ensure their child is well-nourished (40,42,48,66,76).

2.3.3.3 Theme 3: Factors that influence both timing of weaning and type of weaning foods

1) Views on the available sources of weaning advice

Sources that influenced parents' weaning practices were extensively quoted in the included studies. Advice coming from 'important others' (healthcare professionals, grandmothers, peers) was described as a prompt to start weaning and also a guide to the choice of complementary foods offered to their children.

Healthcare Professionals. This category included a range of professions who give postpartum feeding advice ranging from paediatricians to nurses (European countries), health visitors (UK) and staff who work for the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) (USA). They were the most frequently discussed source of information about timing (39-41,49,54,56,61,71), and type of weaning (38,42,64).

In nine studies, medical professionals were discussed in a positive light and parents recognised that their decision to start weaning was based on their advice

(39,41,42,51,53,56,57,61,71). Health providers were viewed as experts in the area due to their experience and knowledge of latest relevant research (40,43,67).

However, in eleven studies the information from healthcare professionals was met with scepticism, particularly when it was not consistent with official recommendations (38,40-44,47-49,52,54). Three UK studies reported parental disapproval of health visitors' instruction to wean earlier than six months due to slow or quick weight gain (41,47,54), and in four studies mothers talked about paediatricians suggesting starting solids early to deal with a diagnosed acid reflux (41,43,44,49). Additionally, two separate samples of mothers and fathers agreed that advice from medical staff who hadn't experienced parenthood was less valued than those with children (40,52).

The level of adherence or scepticism towards advice from healthcare staff varied substantially across studies and depended on the nature of the contact with health professionals, parents' ethnic background (42,43), as well as the number of children participants had. For instance, Yue et al explored a setting where caregivers expressed mistrust for the advice of medical professionals, but had limited opportunities to consult them on weaning, as some of them lived in remote areas with difficult access to the village with a doctor and due to the absence of a routine postnatal care pathway (60). According to the findings of two American studies with low-income participants, Spanish-speaking mothers adhered more to medical advice compared to English-speaking, and Caucasian more than Black. Finally, a sample of Danish mothers indicated that parents who had previous experience of weaning a child were less willing to consult with a health provider (63).

Grandmothers. Parents in many studies expressed trust for their mothers' feeding advice and found it helpful (38,43,44,46,52,58,60,61,64,65,76). Mothers-in-law were also influential, though to a lesser extent, and as Kavanagh suggests, only for participants who viewed their mother-in-law as a 'motherly figure' (39,40,44,48,64,69). In some cases, grandmothers were a preferred source of advice over health care professionals. A reason quoted for this trust was grandmothers' own experience with weaning and raising children of their own (44,61,64,65). In two studies with low-income Latina and Brazilian mothers, participants admitted they felt obligated to follow the advice from senior family members out of respect for them (46,64). Teenage mums and women living in a different country from their home country relied heavily on their mothers' advice which shaped their weaning practices (45,58,65).

On the other hand, parents reported that the advice from their mothers often came without being requested. It was agreed that grandmothers were not informed on the change of

recommended timing of weaning and therefore, their advice was considered outdated (40,41,48,51,52). It was often pointed out that grandmothers applied pressure for an early introduction of solids (38,39,48,53,64,69), and offered or encouraged foods that were not suitable for infants e.g. chocolate and ice-cream (38,47,58,64,67,69).

Peer influence. Friends and peers acted as important influences during weaning and contributed both positively and negatively to parents' feeding decisions (38,40-44,47,48,50,52,53,56,58,60,61,65,67,76). Both mums and dads highlighted that recent experience with weaning an infant qualified them as credible sources of advice (40,53,67). Some of the reasons that peer advice was useful included: the ease of getting in touch with them; their advice came from actual experience rather than knowledge of the recommendations; relatability due to positively resolving a similar situation. It was recognised, however, that the influence of peers sometimes manifested as peer pressure to introduce solids early (41,47,53). Drawing on other mothers' experiences through face-to-face groups or online forums and social media was frequently quoted and in certain cases, they were described as a source of practical information on previously underexplored areas such as BLW (56) and choking (52).

Receiving external advice was very often expressed as vague, ambiguous, contradictory and confusing (38,41,44,48-53,58,60,67,76). The number of available sources of information made it difficult for parents to filter out the unreliable information. Parents confessed that following the suggestion that suited them was a way to deal with conflicting messages (60,76). Alternatively, they chose to stick to the sources they trusted the most (44,67). Receiving conflicting messages was quoted as a rationale for not adhering to infant feeding guidelines (41,49,53). In general, parents who had experience of weaning other children felt they were less influenced by external weaning advice or had a better ability to gauge if the advice was correct (40,43,51,53,60).

2) Feedback from mothers for improved weaning education

In several studies, parents voiced opinions on the guidance they received regarding weaning their children and improvements were suggested for areas where parents felt there were deficits in provision of information and/or support for weaning. They also shared their feedback on health care professionals' approach to providing information on weaning. Further details on parents' feedback on weaning advice are described below.

Suggested areas of inadequate information. Several qualitative studies reported areas of disapproval of the current opportunities for weaning education and of the delivery of the information. In these studies, mothers pointed out that early weaning is prevalent, as they

felt there is no effective education on the implications of early weaning on health and benefits of waiting until six months to start (38,41,43). Particularly with regard to allergies, it was felt that more information was required on the specific foods that are associated with increased risk of allergies (43,52,65).

Participants in Boak et al and Horodynski et al highlighted a gap between being advised on the weaning guidelines and translating them into every-day practice, and expressed the desire for easy-to-understand information on feeding (65,67). Other areas where more information was required included the appropriate frequency and size of infant's daily meals (38,43,50,62), as new mothers found it difficult to conceptualise the amount of solid foods that would replace milk feeds. An all-Ireland study highlighted the lack of understanding of the benefits of vitamin D supplementation and awareness of current recommendations in this area (52).

Health care professionals' role in weaning education. There was great variance in parents' thoughts on how effective contact with health professionals can be achieved during weaning. The ability to establish good rapport was seen as an essential quality that health professionals that deal with parents should have. Participants explained that health care staff need to inspire trust and respect, and to avoid passing any sort of judgement (47,52,65). A sample of women in the UK expressed a need for healthcare professionals to be direct and explicit when describing the health risks associated with weaning practices (47). A disagreement with the one-size-fits-all approach occasionally employed by professionals was expressed in an American study (49), while mothers in Canada highlighted and condemned the disparities in the content of weaning information given regarding timing and type of solid foods between first-time and multiparous mothers (58).

Interesting feedback on health professionals' approach was voiced by parents whose beliefs were strongly influenced by their culture (58,65). In a study that explored perceptions of a Native American community caregivers stressed the importance of receiving information that is sensitive and appropriate to their cultural heritage (65). Similarly, Middle-eastern mothers living in Canada disapproved of the delivery of weaning advice that doesn't consider their cultural identity and religion, and of the lack of available education material in their language; both situations were described as major barriers to adhere to the recommendations on complementary feeding (58).

3) Experiences of baby-led-weaning mothers

Three studies set out to explore perceptions and attitudes of mothers who employed an exclusively baby-led approach to weaning (54-56). The approach influenced the age that

solid foods were introduced, as all three studies on this topic reported that the WHO guideline was an important guide for BLW mothers and prompted them to introduce solids from 6 months. At the same time, some mothers explained that their decision to wean was based on the guidelines in conjunction with signs that their infant was developmentally ready to self-feed, such as sitting up unsupported, grasping food and bringing it to mouth (54,55). Moreover, the decision to follow BLW gave children control over what they eat and hence, had an impact on the choice of weaning foods. The studies, two from the UK (54,55) and one from New Zealand (56), dealt with the advantages of the method, as well as the practical difficulties.

Positive experiences. Good appetite and portion control was described by mothers as one of the advantages over traditional weaning methods. According to BLW mums, their children developed the ability to recognise their own signals of hunger and satiety, and demonstrated good control of the amount of food needed to satisfy their hunger (54,55). Mums discussed that this then made them feel relaxed, as the method released them from the stress of having to closely monitor their infant's portion sizes.

Mums in the BLW studies viewed spoon-feeding as a forceful process that was associated with a certain level of pressure, whereas BLW was viewed as a more liberal and fun way of eating (54,55). Infant's experience with food was more pleasurable and mothers' experience with feeding less stressful. BLW was described as a more enjoyable way to get an infant acquainted with food. It was also viewed as conducive to infants actively taking part in family mealtimes and overall made eating a more pleasant experience for them as they ate with their parents (55,56).

Finally, some mothers who used BLW explained that the approach saved money and time, as infants have whatever the family eats with no need for particular adaptations such as preparation of purees (55,56).

Negative aspects of BLW. Along with the positive aspects of baby-led weaning, women identified a number of challenges to overcome. BLW proved to be not suitable for all times and occasions. The method was linked with increased mealtime mess due to food being 'dropped', 'spread' and 'squashed' on surfaces (54-56). However, mothers discussed that mess was gradually reduced as infant motor skills improved.

Although some mothers described BLW as economical, others described the method as wasteful due to the mess made and this could discourage mothers from offering expensive foods (55). Allowing infants to have control over the food consumed was not always

discussed positively as some mothers indicated being unable to measure the amount eaten caused them to be concerned about whether their child's food intake was adequate (54).

Finally, mothers admitted that the risk of choking was an aspect of baby-led weaning that might put parents off. Mothers shared that at the initial stages of weaning they would be wary when any gagging occurred and were uncertain about which foods would be appropriate (55,56). However, only a small minority reported dealing with individual cases of choking that were managed easily and mums reported that fear of choking reduced as they gained familiarity with feeding.

4) Fathers' role during weaning

Two of the included studies set out to explored fathers' role in relation to complementary feeding (40,72). Anderson and colleagues recruited exclusively male participants and Thullen recruited couples with both males and females being present during each couple's interview. Two additional studies included fathers in their sample (69,76).

In general, fathers' role was described to be supportive to a great extent. Mothers were mainly responsible for feeding and took decisions regarding the timing of weaning and the types of food to introduce in infant's diet. They introduced ideas which were then discussed with their male partners who would validate them or research them further.

Both parents had the desire of providing their child with a healthy and nutritious diet; dyads in the study by Thullen et al pointed out, however, that fathers had a more relaxed approach to feeding, as they reported to be less concerned about choking or feeding their child foods that mothers would consider not appropriate for infants (69,72). Overfeeding was also employed by a sample of fathers who admitted to feed under pressure despite infant's satiety cues (40).

2.4 Discussion

This paper systematically reviewed 37 qualitative studies and aimed to synthesize all the factors that parents and caregivers of children below 3 years take into consideration during weaning in developed countries. The included studies were diverse regarding design and quality, but together they provide unique insights into parental perceptions, experiences and practices during complementary feeding.

The findings of this review were grouped into 3 overarching themes: 1) factors that relate to the age of introduction of solids foods; 2) those that relate to the type of first solid foods; and 3) those that relate to both age of introduction and type. Important findings of this review include: prevalent baby- and mother-driven cues to initiate weaning; mothers' views on the WHO recommendation for the age of weaning; the main factors that drive the choice

of complementary foods; the value of the advice received from health professionals and grandmothers regarding timing of weaning and type of weaning foods; mothers' suggestions for improved weaning education; experiences of baby-led weaning; and the nature of fathers' role during weaning. The findings are discussed in detail below.

2.4.1 Factors in relation to the age of introduction of solids

2.4.1.1 Perceived baby hunger as a prevalent prompt for the introduction of solid foods

Studies included in this systematic review indicated that the factors and circumstances that mark the introduction of complementary foods have been extensively reported; these were categorised, for the purpose of this review, into baby- and mother-related factors. Perceived hunger, often displayed by disrupted sleep, was a compelling prompt for mothers to introduce solids to their infants' diet. These signs can be mistakenly perceived by parents who might think that milk alone fails to nourish their babies and to satisfy their hunger which keeps them awake (39,40,42,44,48,49,53). This has been previously reported in two previous papers that systematically reviewed and synthesized the qualitative evidence on weaning practices (77,78). Contrary to common maternal beliefs, an observational study has shown that increasing the calorific content of infants' diet by offering more milk or by commencing complementary foods does not improve disrupted sleep (79). Additionally, it was apparent in this systematic review that infant's developmental cues of readiness for solids were not discussed to the same extent as the perceived hunger cue. Consistent with this observation from qualitative research, the most prevalent reason for introducing solid foods in the UK Diet and Nutrition Survey for Infants and Young Children, a cross-sectional survey, was the perception that the baby is no longer satisfied with milk feeds (52%) (80). A reason that was quoted less frequently was that the baby was able to sit up and hold food in his/her hand (29%). In the UK and Europe, official guidance warns mothers that hunger (actual or perceived) and interest in food alone do not mark an appropriate timing for weaning. The guidance encourages mothers to focus on their babies' signs of physiological maturation (gastrointestinal and neurological) before mothers introduce them (5,81).

An important cultural insight into prompts for introduction of solids came from a study of Middle Eastern women in Canada (58). In this study, commencing solids was a way for mothers to deal with the shame associated with breastfeeding their baby in public. Maternal experiences of shame during breastfeeding in public due to violation of female modesty have been described before in qualitative studies in the UK and Australia (82,83); however not as a reason for early introduction of solid foods.

The qualitative literature, as reviewed in this paper and in the review by Harrison et al (77), has also demonstrated that having a heavy infant can encourage early introduction of solids, which is in agreement with data from a longitudinal study by Rogers & Blisset (84).

2.4.1.2 Other baby-driven factors that influence the timing of weaning

A few factors influencing the timing of introduction of solids have emerged from the quantitative literature but were not addressed in the qualitative studies included in this systematic review. Recent research has focused on infant temperament as a potential contributing factor to the timing of introduction of solid foods, but with no conclusive evidence so far (84-86). In this study, although not explicitly discussed, mothers did talk about every baby being different indicating awareness of baby's personality. Additionally, previous research has found a relationship between symptoms of maternal postnatal depression and early weaning, but not here.

2.4.1.3 Uncertainty regarding the WHO recommendations on timing of weaning

A significant body of qualitative evidence (15 studies) exists in relation to parental beliefs and attitudes towards the WHO recommendations on the appropriate age for complementary feeding in developed countries. Although there was good awareness of the WHO guidelines, there was scepticism as to whether introducing solids from the age of 6 months is best practice (39,41,43,47,49,52,61). As formerly demonstrated by the systematic reviews on this topic (77,78), among mothers there was a general feeling that the WHO guidelines on the timing of weaning are rigid and that they don't have application to all infants, since "every baby is different" in terms of growth and development rate (39,41,48-50,52,61). There was a substantial gap in maternal knowledge of the evidence that formed the basis of the relevant guidelines and the health risks related to early weaning, which seem to reinforce the general dismissal of the recommended timing for weaning (39,53). Understanding the implications of untimely introduction of solids, as revealed by Nielsen (63), motivated mothers to adhere to the weaning recommendations and this was in contrast to participants in other studies who demonstrated a poor understanding of the contraindications of early introduction of solids (39,41,53).

Poor compliance to the WHO 6-month recommendation is also illustrated by national survey data in the US, Australia and UK. In a nationally representative sample from the American National Survey of Early Childhood Health (NSECH), 19% of women introduced solids before the 4th month and 62% before the 6th month (87). The 2010 Australian Infant Feeding Survey, revealed that in total 35% of infants had received solids by four months and 92% of infants had received their first solids before 6 months of age (88). In the UK according to the

data from the Infant Feeding Survey, 30% of mothers had introduced solids by four months and three-quarters of them by the time their baby was five months old (89).

2.4.2 Factors in relation to the type of first solid foods

2.4.2.1 Choice of weaning foods made primarily based on their effects on baby's health

Foods' nutritional content and their impact on infant's health were the most influential factors when choosing weaning foods. In relation to foods' nutritional and health properties, mothers were aware of the 5-a-day message and gave priority to offering fruit and vegetables daily (48,50,51,54,55,57,61,63,66). In addition, an increased perception of trust for the organic products, as opposed to non-organic, often guided the purchase of weaning foods (47,50-52,61,63,69). Placing emphasis on offering fruit and vegetables, as well as organic foods was seen as an important determinant of choice of complementary foods in previous systematic reviews in this topic (77,78). Although the high price of these products was an obvious disadvantage, parents were willing to pay it thinking that they are securing the best possible diet for their children. In contrast to the beliefs of many parents, the latest systematic review on the nutritional quality of organic foods by Dangour and colleagues concluded that currently there is no evidence suggesting significant differences in the nutrient content between organic and conventionally produced food (90). Moreover, both organic and non-organic foods are subject to certain safety requirements (in the EU subject to Commission Regulation No 178/2002) (91) and neither of them should be placed in the market if they could pose a health risk.

Among the factors that influenced the type of complementary foods offered, parents discussed their concerns about the consumption of certain foods during weaning (such as foods linked with allergies) and exclusion of these foods from the baby's diet. These concerns were often passed down from older family members or were established on an empirical basis. Parents also addressed fear for allergies as a reason to avoid a number of foods. Food avoidance can restrict nutritional variety and compromise quality. In the most recent UK Infant Feeding Survey, 12% and 11% of mums with an infant aged between 8 and 10 months reported that they avoided giving to their children any eggs or dairy products respectively due to fear of allergy (89), showing that there may be a need for more advice on food allergy and food transitioning during infancy.

2.4.3 Factors in relation to both age of introduction and type of solid foods

2.4.3.1 Healthcare professionals and grandmothers as primary sources of weaning advice

A number of sources provide advice on when and how to wean a child; grandmothers and health care staff were the two sources of weaning advice that triggered most discussion

across the studies. An abundance of information was provided by these sources. Women from societies and cultures with great respect for traditions and the older generations, as well as teenage mums put a lot of trust and so may be heavily influenced by advice from grandmothers. However, such advice may be outdated and diverging from the WHO recommendations (early weaning) (40,41,52,61,64). Similarly, pressure from older family members including participants' own mothers to introduce solids early and to offer unsuitable foods has been discussed by the systematic reviews that previously dealt with parental weaning practices (77,78).

Views on the information gathered from medical professionals were also polarised; sometimes it was discussed as helpful and well-backed-up, but other times as confusing and unhelpful. The differing parental trust in medical professionals' advice, which could be partly explained by the fact that countries around the world have very different approaches in providing infant feeding guidance through the health care staff (e.g. UK provided by health visitors, Sweden by CHS nurse, America by WIC staff). Another contributing factor might be the different opportunities and levels of pressure that medical staff have to remain up-to-date with current evidence on infant feeding. As it was seen in this review, advice from health professionals was better received when it was incorporated into a routine postpartum care pathway and through scheduled visits (like in Sweden as described by Synnott et al (51)) relative to other settings where caregivers had limited opportunities to visit a paediatrician and seek their advice on complementary feeding (60). The delivery of weaning education that fails to take mothers' culture and religion into consideration was discussed as a source of discontent and as an obstacle to complying to the complementary feeding recommendations (58,65).

2.4.3.2 Parental feedback on Infant Feeding Education

This review also highlights areas of weaning about which mothers felt that more and better information could be provided to them by health care professionals. One major area was the lack of practical information to guide mothers through the number and size of meals that complement milk feeds (38,43,50,62). A number of official guidance documents around the world provide a detailed overview of the recommended amounts of complementary foods and frequency of meals for the first stages of weaning, such as the US Special Supplemental Nutrition Program, the Australian Dietary Guidelines and the latest South African Food-Based Dietary Guidelines (11,13,92). Overall, there are educating resources worldwide providing information on the recommended frequency and amount of solid foods during infancy, but it is possible that quality, accessibility of language and cultural tailoring of such resources is

a limiting factor. Additionally, the WHO guidelines also stress the importance of responsive feeding, where mothers need to be attentive of their baby's hunger and satiety cues, which can save them the time and stress of preparing and serving certain portions for every feeding occasion. Responsive feeding is characterised by recognition of child's appetite cues, positive parent-child mealtime interactions, encouragement of self-feeding and limiting force-feeding or food restriction (93,94). Mastering all these skills as well as the food preparation requires a high level of confidence by mothers and interventions aiming to build on maternal confidence should be culturally tailored and provide appropriate cognitive-behavioural strategies.

2.4.3.3 Reduced maternal stress over feeding, better infant appetite control and greater compliance to the 6-month recommendation with BLW

Three of the relevant studies in this review dealt exclusively with parents who adopted a baby-led weaning style (54-56), while an additional study included a reference to it (53). BLW is an approach of introducing infants to solids that has gained popularity in the recent years and therefore the literature that deals with it, both qualitative and quantitative, is still relatively scarce. In the present systematic review, parents talked about a number of positive effects of weaning through a baby-led approach, including decreased stress about controlling the amounts of food and making mealtimes more enjoyable for mothers (54-56). The baby-led approach has been previously associated with lower levels of food fussiness and greater meal enjoyment (95,96).

Additionally, parents felt that the infant would develop better appetite control and ability to regulate their food intake which would, in turn, help maintain a healthy weight later in life (54,55). Indicatively, mothers in the study by Brown & Lee noticed that their children after consuming a food portion that was smaller than the usual would compensate with a greater intake of milk. Studies examining the effect of baby-led weaning on satiety responsiveness present mixed results. A longitudinal study examined differences in child-eating behaviour in 18-24 months for infants weaned through a baby-led or a spoon-feeding approach while controlling for breastfeeding. Infants weaned using a baby-led approach were significantly more satiety-responsive and less likely to be overweight compared to infants weaned with a traditional approach (97). However, the BLISS study, the only randomised control trial existing in the field of BLW demonstrates lower satiety responsiveness in BLW children at 24 months in comparison with their spoon-fed peers and no differences in the risk of overweight at the same age (96). Hence further research is warranted to determine whether a baby-led

approach to weaning holds benefits in satiety responsiveness and appetite control over spoon-feeding.

A slight difference became apparent in the present review between BLW and spoon-feeding parents in terms of their attitudes towards the WHO guidelines for the timing of weaning. Followers of BLW displayed a more positive disposition towards the recommendation on when to introduce solids (54,55). For them, the 6-month guideline served as best practice and adherence to it was important. Books and online resources serve as helpful guides for BLW mothers considering that BLW is still a novel approach to weaning and health professionals might have limited or no tips for an appropriate nutritional intake and quality for these mothers (54-56).

Since an ever-increasing number of parents follow a baby-led approach during weaning, questions have emerged regarding the benefits and risks associated with it. A recent systematic review has looked at the observation and intervention studies published to date in relation to BLW and aimed to answer the main questions addressing the safety as well as energy and nutrient adequacy of the method (98). Due to the limited volume of available literature and its methodological limitations, it was concluded that more robust evidence is needed to establish the safety and appropriateness of the method.

2.4.3.4 Fathers' supporting role during complementary feeding

Even though the present review aimed to explore the qualitative literature on parental experiences of both genders, it was observed that mothers represent the vast majority of research participants. Five studies included in this review gathered data from males (16% of all included studies), from which two studies had the inclusion of fathers as necessary eligibility criterion, while the remaining three recruited both females and males; the numbers of male participants were however negligible compare to the female. Only one study recruited exclusively fathers (3% of all studies).

Fathers played an assisting role during weaning whilst allowing their female partners to lead in the decision-making process regarding timing of weaning and type of weaning foods (40,72). The quantitative literature that looked at both parents' feeding practices also suggests that mothers and fathers have distinct interaction with children regarding food (99,100). Fathers are less likely to monitor children's food intake and apply restrictions on food compared to mothers who reported higher levels or responsibility for child feeding. In general, literature on fathers' feeding practices is sparse, focusing only on children and not on infancy. However, mealtime interactions between fathers and children are important and that fathers can be influential role models of dietary behaviours, as the following findings

demonstrate (101-103). According to data from the US National Survey of Family Growth and for children under the age of 5, more than 96% of fathers who live with their children share a meal with them every day or several times a week (101). Additionally, as highlighted by previous studies, fathers' intake in foods such as fruit, vegetable and sweet snacks and beverages could predict children's consumption for these foods (102,103).

As noted previously, the findings of this review are primarily derived from maternal data. Fathers' underrepresentation in research has been highlighted in the past by a systematic review by Davison and colleagues which quantified paternal involvement in studies about childhood obesity-related behaviours, including diet. Results indicated that fathers represented only 17% of participants across all eligible studies, while only 10% of studies reported father-specific data, and only 1% of studies included exclusively fathers (104).

2.4.4 Critical appraisal of included studies

Apart from reviewing and synthesizing the current qualitative literature in the area of weaning, this review also provides a critical appraisal of the relevant papers. The SRQR tool was found particularly useful for this purpose (36). The great majority of the included studies scored highly (within the third quartile - between 50-75%). Authors of the included qualitative literature described sufficiently the problem/phenomenon studied and its significance, and they clearly formulated the purpose of their research and the specific objectives. The main findings of their work were elaborated and interpreted thoroughly. On the other hand, areas lacking information included the limitations of findings and authors' conflicts of interest. Reporting on the limitations enables reviewers and other researchers to critically appraise the trustworthiness of study findings; as for including a declaration of competing interests, it clarifies whether there are potential sources of influence on study conduct and conclusions. Inclusion of these elements is therefore important and contributes to the clarity and completeness of reporting. Overall, adhering to standards of reporting, can be helpful for authors of qualitative studies, in order to increase the quality of their manuscript, make the conclusions of their studies easily understood and disseminate them successfully.

2.4.5 Strengths and Limitations of the review

The process of undertaking this systematic review was characterised by transparency and scientific rigour. The authors undertook the following steps in order to achieve this: four large electronic databases were searched alongside a manual search of reference lists; a set of well-researched search terms were identified; a list with the eligibility criteria was established and a protocol of the review was published online before the literature search

was done; and the abstract screening was done independently by two researchers. Furthermore, this review took into account the 27-item checklist of the PRISMA guidance and the relevant flow diagram to ensure the clear presentation of the design, conduct and findings of this review (37). Ultimately, systematic reviews of qualitative evidence provide a unique exploration of parental weaning practices and the factors influencing them which is not elicited by purely quantitative techniques, whereby lies the usefulness of synthesizing the evidence of qualitative methodologies.

A number of limitations should be considered when reading this review. Like in all systematic reviews of qualitative evidence, the final synthesis is prone to vary between researchers and to be driven by their individual research priorities and background (105). In order to deal with this, great care went to achieve a methodical interpretation and aggregation of study findings, and the use of an explicit protocol offered transparency to this process. Additionally, alongside the first author, two additional reviewers monitored the synthesis process and offered guidance.

Currently, the majority of qualitative research on parental attitudes and practices during weaning comes from the UK, USA and Australia. Hence, the views of parents living in other upper-middle- and high-income countries, particularly in Europe and Asia, were underrepresented limiting the generalizability of the findings of this systematic review. Moreover, the information available on the socioeconomic and family status of studies' participants was limited. As a result, it was difficult to differentiate between weaning experiences of parents living in distinct social and family circumstances.

The selected papers provided insights about parents' experiences during the initiation of weaning and about the types of first foods, and not so much about the later stages of weaning and transitioning through foods and textures. Furthermore, the set of themes on introducing the first solid foods, which is presented in the results of this paper, is not exhaustive. Given the rich qualitative data provided by the selected studies, the authors of this systematic review tried to offer a wide range of the essential themes exploring the topic.

The quality appraisal of the included studies revealed a number of insufficiently reported areas with regard to presenting their findings. Hence, the strength of the recommendations made in this paper might have been compromised by the studies of poorer quality.

One also needs to consider that the participants in the included studies were made aware of the research objective before consenting and as a result, it is possible that they formed an idea of the topics they wanted to bring forward in advance of the interview. Knowing that they participate in a study on weaning experiences, parents may respond to questions with

the experiences they think that the researcher wants to hear, as opposed to what they were instructed to respond. Furthermore, parents may attempt to influence the researchers' understanding of an event or situation during weaning based on their own perceptions e.g. information obtained by healthcare professionals on weaning, or the adoption of baby-led weaning as an advantageous method. Additionally, feeding practices may be falsely self-reported if parents feel that they're being evaluated by the researcher. For instance, parents may disguise their poor compliance with feeding guidelines, which can become a barrier to an in-depth exploration of the underlying factors of poor compliance with the guidelines.

This is not the first study that set out to systematically review the qualitative literature on weaning practices. Two previous systematic reviews by Harrison et al and Matvienko-Sikar et al have explored perceptions of and experiences during complementary feeding (77,78). The present paper however provides an updated review of the evidence, as a few new studies have been published after the search performed by the most recent review (52,64,66,70). In addition, the studies included by previous systematic reviews interviewed parents with children younger than 2 years old, whereas the present review incorporated data from parents with children up to the age of 3 provided they discussed complementary feeding. This decision was based on the premise that weaning is an important milestone in a child's life and hence parents are able to recall former feeding practices. This systematic review also provides an in-depth exploration of topics that were not previously addressed. These included the experiences of baby-led-weaning mothers, the paternal involvement in weaning, as well as a comprehensive overview of all the factors that influence choice of complementary foods. Consequently, the additional studies that were incorporated in the present review contributed to a more comprehensive synthesis of the factors in relation to parental feeding practices.

2.4.6 Recommendations for weaning education

This review indicates a number of factors that can be barriers to forming positive weaning practices and therefore are pertinent to education on complementary feeding. Some of these factors include poor understanding of the complementary feeding guidelines and increased trust in non-reliable sources of advice and should be addressed as part of weaning education. As these barriers often interact with each other, as shown in this paper, health practitioners who deliver the education should target them simultaneously in order to modify complex parental feeding behaviours. The content of weaning information should be up-to-date and its language easy to understand and culturally tailored. Attention needs to be drawn to vulnerable groups of parents (teenage mums or mothers living away from their

home country) who, due to their personal circumstances, are more prone to seek and take on board advice that is not evidence based. Including fathers and other family members in weaning education (e.g. grandmothers) is important, as it can reduce information inconsistencies and increase mothers' feeling of being supported and confidence in child feeding.

Misconceptions on the appropriate timing of weaning are prevalent, as well as types of weaning foods. Prior to introducing complementary solid foods, parents should be made aware of infant signs of physiological maturation to receive solids and should be encouraged to commence weaning when these are present. Parents should also be familiarised with potential health implications of early weaning; this includes the risk of food allergies with instructions on specific foods and when to introduce them based on family history. The WHO and national weaning guidelines should be addressed and their applicability should be discussed with flexibility and without disregarding parents' own priorities and baby's prompts as previously mentioned.

Even though there is limited evidence suggesting that baby-led weaning may encourage positive outcomes, the approach gains popularity and, as indicated by the findings of this systematic review, might encourage adherence to the guidelines regarding timing of weaning. The contribution of healthcare professionals is crucial, as they can discuss the nutritional benefits and challenges of BLW and provide parents with relevant and accurate information to introduce solid foods in a safe and effective manner. This can motivate them to feel confident about using this approach and helping them to refrain from consulting with sources of mis-information.

2.4.7 Conclusions

This systematic review aimed to provide a comprehensive report on factors that parents take into consideration during baby weaning by gathering and reviewing the available qualitative evidence in upper-middle- and high-income countries. Its findings offer valuable information for researchers involved in the design of interventions to improve parental adherence to the complementary feeding recommendations. Three themes emerged from the literature which included factors that relate to the timing of weaning, factors that relate to the type of weaning foods and factors that relate to both. This classification can prove particularly useful to guide interventions that seek to employ specific strategies in order to address early weaning or feeding non-recommended complementary foods.

Across the qualitative studies included, parents often reported early introduction of solid foods and the main reason for this was interpreting baby cues as prompts for readiness for

solid foods. Parents reported to have a poor understanding of the evidence base of the WHO 6-month recommendation, which was perceived to be too rigid. The choice of complementary foods was mainly based on the perceived health properties of foods, though there was often uncertainty as to which foods need to be avoided at what stage. The limited father-derived data revealed that their contribution is currently overlooked in infant feeding research.

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Chapter 3: "The one time you have control over what they eat": A qualitative exploration of mothers' practices to establish healthy eating behaviours during weaning

3.1 Introduction

Weaning is an important milestone in an infant's development. It marks the transition from a milk-only diet to the consumption of family foods and it is also known as complementary feeding (1). Nutrition has a dominant role in a child's development during this time period for a number of reasons. Primarily, weaning is a period of rapid growth; as a result, the infant's nutrient needs increase and stores acquired through *in-utero* life gradually deplete (2). Additionally, diet and growth during weaning seem to have a programming effect for health outcomes later in life, as previous research demonstrates. With particular respect to adiposity, studies highlight that infants that have a rapid weight gain are more likely to become overweight or obese children and adults (3-5). Moreover, the post-natal period is critical for brain development with environmental factors, including food, influencing both structural and functional aspects of the brain (6). Taste experiences early in life can also affect later food preferences and thus food related behaviours (7,8).

Even though the first foods are eaten during weaning, the first flavour experiences occur earlier in life. Humans come to contact with smell and taste initially in the womb (9). The first exposure to food is through the mother's diet during pregnancy and, hence, children' first preferences can be shaped by her food choices. Further exposure to foods after birth is through breast milk; an infant is more likely to show preference for foods which their mothers consumed often when breastfeeding (10,11). Moreover, humans innately prefer foods that taste sweet and hold an aversion towards those that taste bitter (12-14). Similarly, for infants with no prior exposure to food (or milk), naturally sweet foods would elicit a better hedonic response in comparison to bitter or sour foods. Taking this inherent aversion into consideration, along with the fact that several nutritious foods taste bitter (e.g. green vegetables), health professionals advise that repeated exposure to these foods and serving them alongside sweet foods can encourage consumption in infancy (15,16).

Even in early infancy, children communicate enjoyment and refusal after exposure to a food. Responses can be expressed through head orientation and facial expressions (hedonic or

non-hedonic). As far as facial expressions are concerned, a number of facial expressions have been associated with distinct tastes. Steiner and colleagues first described features displayed in faces of neonates after various sensory stimuli: lip thinning and lip licking with sweet taste; eyes closing and nose wrinkling with sour; and upper-lip elevating and gaping with bitter (17). A number of well-designed experimental studies assessed mothers' judgement of their infants' liking to certain foods based on their facial responses (15,18,19). Qualitative data would also be useful in providing an insight in parents' thought process and practices in response to infants' facial expressions, but currently such data is lacking.

The Department of Health, in accordance with the World Health Organisation, advises that from six months a variety of complementary foods should be introduced alongside continued breastfeeding and/or breast milk substitutes (20,21). Current parental practices in the UK however deviate from the recommendation in terms of providing a wide selection of appropriate complementary foods, as shown by the latest Diet and Nutrition Survey for Infants and Young Children (DNSIYC) (22). 34% of the parents with a child aged 7-9 months avoided giving all meat/poultry/fish/seafood and the main reason was that these foods were not cooked in the household. Additionally, 9% of parents with a child in the same age group avoided giving fresh fruit and 7% salad vegetables (lettuce-tomato-cucumber).

Weaning can be an emotive and challenging time for parents, as they have a special role in helping their children shape their dietary behaviour through their feeding practices. The factors and conditions that form parental feeding practices are yet to be fully understood; doing so can help target any problematic weaning practices and modify them. To address this gap, this study set out to use qualitative methodology to gain a better understanding of parental experiences of weaning a child and more specifically to explore the factors and conditions that favour establishing a healthy relationship to food in infancy and those that impede it. It is hoped that ultimately, findings of this study will inform future interventions that provide nutritional education in the complementary feeding period.

3.2 Methodology

3.2.1 Study design and Ethics

A qualitative study, using a semi-structured topic guide, was conducted with focus groups as the mode of data collection. This study formed part of a larger study across the island of Ireland exploring parental experiences of weaning and use of guidelines (23). The focus of the present study was to identify mothers' perceptions on acquisition of taste preferences and on the importance of food variety and their attitudes towards food exposure and shaping the feeding environment in weaning. This paper focuses exclusively on the introduction of

solid foods as opposed to milk feeding and the terms 'weaning' and 'complementary feeding' will be used interchangeably.

Focus groups were selected as the data collection approach over alternative ones (e.g. individual interviews) due to their dynamic nature; they foster a group interaction which in turn can provide better insights into participants' beliefs and experiences. Group members find themselves influenced by their co-speakers' comments, respond with their ideas and make comparisons. In this way focus groups automatically highlight issues of consensus and diversity, something that doesn't occur in individual interviews. Additionally, conducting focus groups saves time; groups produce data from a certain number of participants faster than individual interviews (24).

Ethical approval for the study was obtained by the School of Medicine, Dentistry and Biomedical Sciences Research Ethics Committee, Queen's University Belfast. After being briefed on the study, participants consented to take part by signing a form that confirmed voluntary participation, confidentiality and data protection.

3.2.2 Participant selection

Eligible participants were adult parents and legal guardians of healthy infants aged between 3 and 14 months who were able to read and converse in English. Participants from all genders were eligible. Even though weaning is not recommended till the 6th month, parents with children in a younger age were also included, as they might be already thinking of introducing solids and thus, can talk about their intentions. Prematurely born children, children with diagnosed allergies and intolerances and any medical condition that affects the ability to feed, swallow or digest were excluded from participating. Eligibility in the study was assessed with a screening questionnaire that was administered during recruitment. The sample size was to be determined by the interviewers when data saturation would be reached.

Recruitment in the study utilised a purposive, snowball sampling technique and targeted community organisations in Northern Ireland that already engaged with the target population. The research team identified parent – toddler groups, community centres that offer programmes to young women and Sure Start centres, and established contact with the people who run them (gatekeepers). Sure Start centres are UK Government initiatives that provide help and advice on child and family health and parenting. Recruitment took place in the greater Belfast area and two areas outside Belfast (Armagh and Antrim), Northern Ireland, in order to capture the views of participants from urban as well as rural environments.

A first contact with gatekeepers was attempted; first via email and, if there was no response, via a phone call. A quick overview of the study was given and, provided that the gatekeepers deemed recruitment in their organisation feasible and worthwhile, a visit from the research team was organised. The purpose of the visit was to describe the study and invite mothers to take part. Mothers were also encouraged to disseminate the call for participation to peers who might be interested. The screening questionnaires were completed by any mothers who expressed an interest in participating. Questionnaires were collected from the mothers and were reviewed for eligibility by the research team when they returned to the University. In some cases, the study was advertised on the Facebook page of community organisations and interested participants contacted the research team for further information, in which case the screening questionnaire was completed over the phone with them. Participant inclusion/exclusion was determined and communicated to all those that showed an interest in participating.

To maximise participation in the study, women were encouraged to bring their infants (or older children) with them to the focus group if they didn't have childcare arrangements. All participants were also given a 'One-4-all' gift card worth £20 as a token of appreciation for their time and contribution, as well as educational material on weaning (25). They were also given the option to be reimbursed for their travel expenses to and from the focus groups.

3.2.3 Data collection

Data collection took place in the organisations where participants were recruited from, as they were familiar and convenient for the participants. Focus groups were also organised when the usual parent groups would take place so that participants didn't need to make special arrangements to attend. A reminder text was sent the day before the focus group was due to take place.

Data were collected through focus groups which had the form of semi-structured conversations with open-ended, discussion-stimulating questions. The questions had been carefully considered by the research team in order to efficiently address the specific objectives of this project. Moreover, a review of the qualitative literature on weaning was performed to ensure the choice of under-explored themes in the topic guide.

Images were also used to stimulate conversation where it didn't occur naturally and to further elicit participants' views. The images had been published in a study assessing fruit and vegetable acceptance in infancy (15) and permission was obtained to use during the focus groups. The images presented illustrated common components of responses to sour

and bitter taste: A) brow raising, B) brow lowering, C) tightly closed eyes, D) nose wrinkling with lip pursing, E) upper-lip raise and F) mouth gaping.

The topic guide was piloted with the first focus group (attendees in it were included in the overall study sample) to assess clarity of questions and flow from one topic to the next. Minor adaptations on wording were made to the discussion guide as a result of the pilot (Table 3.A). The person who facilitated the discussions encouraged everyone's contribution and probed when it was felt that the participants did not elaborate enough on a topic. Also prompts such as the following were used to ensure interaction between group participants: "*does anyone else have any similar experiences?*", "*Any other views or comments on …?*", "*Do you all agree with these ideas on …? Is there anyone that thinks otherwise?*". When new ideas arose that were not part of the guide, the facilitator deviated from the script and probed accordingly.

Two researchers were present at all focus groups: ES (doctoral researcher and dietitian) and VAW (postdoctoral researcher and health psychologist); one facilitated the discussions and one took notes of participants' discussions and their non-verbal responses to them. The two researchers, both trained in focus group facilitation and data collection techniques, facilitated equal numbers of focus groups alternating between each other for every group.

All conversations were audio recorded with two digital recorders. Before commencing with the topic guide, the facilitator gave a brief introduction reminding the participants of the audio recorders and the need to talk clearly and loud enough, the informal nature of the group discussions and study confidentiality. As an ice-breaker, attendees introduced themselves and mentioned their infants' name and age. An additional brief questionnaire was administered at the beginning of the session to record demographic characteristics and infant feeding information. When mothers had more than one children at the time of the focus group, they were asked to talk about their youngest child.

Data collection ran in tandem with recruitment which started at the beginning of March 2017 and continued until the beginning of July 2017. The recordings were transcribed verbatim by a professional transcribing company and then proof-read by both facilitators to ensure accuracy. Participants were anonymised and given a unique study ID which consisted of the number of the focus group and their participant number represented as "Participant [focus group number]_[participant number]".

Table 3.A Outline of the Focus Group Topic Guide

Purpose / Topic	Questions / sub questions
Ice breaker	We can start with an introduction. Could you say your name and how old your infant is?
Key question on forming taste preferences - strategies and timing	How do you think that our likes and dislikes for foods are acquired? Can you think of an example drawn from yourselves or your children? Do you think that the type of foods that infants have and when they have them affects in any way their likes and dislikes and how? Yes – What do you do in order to shape your infant's likes? Can you give me a few examples from your everyday experiences with your infants now or previous children?
Key question on food acceptance, exposure to novel foods	Have you ever come across cases where your infant didn't like the foods you gave them? Yes – How did they express it? What kind of food(s) was/were they? Have you given your infant same foods again? *Show Figure* The children in the pictures have just been fed. How do you interpret the children' facial expressions? Have you seen these expressions on your infant? Which ones and how do they affect your feeding plan?
Key question on food variety, feeding environment	How important do you think is for an infant to eat different types of foods? How can parents introduce food variety into their children's diet? Add one at a time? Give a new food on its own or combined with familiar foods? Can you tell me a bit about the environment that you feed your infant in? Where does the feeding normally take place? Who else is there?
Ending question	Is there anything else you would like to add about weaning, especially to do with all the topics we discussed previously ?

3.2.4 Data analysis

All transcripts were imported and processed in NVivo 12 Pro software (QSR International Pty Ltd, Doncaster, Victoria, Australia). All data were coded by ES, previously trained on the steps of qualitative data analysis. Having Braun and Clarke (26) as a guide, thematic analysis was used to identify themes within the data. Accordingly, transcripts were read thoroughly so that familiarity with the data could be achieved. Initial codes were generated in a data-driven way; the content of the entire data set was coded without using a pre-existing coding frame.

Two transcripts were coded independently by MD (psychologist) and the codes generated by the two researchers compared. Comparison between coding content demonstrated 90 % similarity (inter-rater reliability); differences were discussed and resolved. The codes were grouped into key themes which were subsequently reviewed and refined to make sure that the themes were coherent and distinct from each other. Representative quotes were extracted from the data to illustrate typical views within each theme. At this stage the transcripts were re-read to ensure that the final themes accurately reflect the data. The process of data analysis and theming was supervised by and discussed with MD & MMK. Participant demographic characteristics and infant feeding information were analysed using IBM SPSS Statistics for Windows, Version 22.0 (IBM Corp. Armonk, NY).

3.3 Results

Eight focus group discussions took place with an average duration of 45 minutes (range: 44 – 77min). Six of them were conducted in Belfast and two in rural areas, Antrim and Armagh. Following the completion of the 6th focus group, the interviewers felt that data saturation was achieved and no new information was emerging and thus data collection was continued in two final focus groups (8 groups overall).

Even though the call for participation was open to both male and female parents, only women came forward. Their demographic characteristics are presented in Table 2. With few exceptions, the participants of a given focus group were members of the same community or parenting group they were recruited from. This meant that even though they differed in age or number of children, they came from the similar socioeconomic background.

Forty-five women were screened; they were given information on the study and the researchers took their details for further contact. Eight of them didn't continue with the study. The reasons for not participating are as follows:

- Family member (including infant) unwell, n = 3
- Not eligible due to exclusion criteria, n = 2
- Not interested in taking part anymore, n = 1
- Unable to reach on phone, n = 1
- Unknown reason, n = 1

Thirty-seven women (mean age: 30.3 ± 6 years) took part in the discussions with an average of 5 participants per group (range: 3 – 6). Sixteen women were first-time mothers (43% of the sample) with the remainder reporting having between 1 and 3 or more other children. A summary of participants' demographic characteristics is presented in Table 3.B.

Table 3.B Mothers' and infants' characteristics, N=37

Characteristics in Mean and SD	Mean ± SD	Range
Infant's age at the time of focus group (mo)	7.7 ± 3	3 – 16
Mother's age at the time of focus group (y)	30.3 ± 6	19 – 39
Characteristics in Frequencies	*n*	%
First-time mother		
Yes / No	16 / 21	43.2 / 56.8
Mother's ethnicity		
White	36	97.3
Black	1	2.7
Mother's country of birth		
Northern Ireland	34	91.9
Other UK	1	2.7
Other	2	5.4
Mother's education		
Primary school or equivalent	1	2.7
1-4 GCSEs/ NVQ level 1/ Foundation GNVQ/ foreign equivalent	3	8.1
5+O levels/ NVQ level 2/ equivalent	5	13.5
Apprenticeship/ 2 or more A levels/ NVQ level 3	9	24.3
Degree/ Post-grad degree/ NVQ level 4-5	19	51.4
Mother's marital status		
Single (never married)	10	27.0
Cohabiting (living with partner)	5	13.5
Married	19	51.4
Separated	2	5.4
Divorced	1	2.7
Infant's gender		
Girl / Boy	26 / 11	70.3 / 29.7
Breastfed at all		
Yes / No	21 / 16	56.8 / 43.2
Already on solids at the time of FG		
Yes / No	30 / 7	81.1 / 18.9
Age of introduction of solid foods [1]		
Up to 4mo	9	30
4-6mo	14	46.7
6mo and later	7	23.3
First solid foods given		
Baby rice and cereal products	12	32.4
Fruit	2	5.4
Vegetable	2	5.4
Fruit and vegetable	8	21.6
Mix of cereal and fruit	3	8.1
Yoghurt	2	5.4
Other	1	2.7

[1] Frequencies expressed as proportions to women who had already weaned (as opposed to the overall sample).
Abbreviations
SD: Standard Deviation; mo: months; GCSE: General Certificate of Secondary Education; (G)NVQ: (General) National Vocational Qualifications

Slightly more than half of the participants (57%) breastfed at some point post-partum. Thirty mothers had already weaned their children at the time of the focus group (81%) and the remaining 7 were still offering a milk-only diet. However, there were no apparent differences between these two subgroups of women in relation to their attitudes and perceptions on weaning. In relation to practices relating to weaning, the participants who hadn't introduced solids talked about their intentions, since they hadn't had a chance to establish any feeding practices at the time of this study.

Of the mothers who had weaned their infants, 47% (*n*=14) had done so between 4 and 6 months, whereas a third (30%, *n*=9) had started weaning before the 4th month and 23% of the overall sample had weaned according to the WHO guidelines at 6 months (*n*=7). Age of introduction to solid foods was similar between breastfed and formula-fed children. 32% of mothers offered cereal products including baby rice as first foods, with a combination of fruit and vegetables being the next most popular option (22%). Only fruits, only vegetables, or a mixture of cereal and fruits, and yoghurts were other foods options that were offered in the first days of weaning.

Here this paper presents the qualitative findings, as they emerged from the focus groups. The conversations with mothers revealed a series of experiences that enabled them to encourage the development of positive eating habits by their children (Table 3.C). Several experiences worked in the opposite way and therefore, they were classed as challenges to establish healthy eating habits in infancy.

3.3.1 Opportunities to shape a healthy relationship with food

The importance of establishing balanced eating behaviours during the complementary feeding period was acknowledged by all mothers. Mothers perceived the first year of life to be a crucial time for children's exposure to different foods and flavours and the idea of 'getting as many different foods as possible' was discussed. Ultimately, weaning was regarded as "the one time in their life you have complete control over what they eat" (Participant 007_03). The relevant themes that emerged are described below.

1. Acting as a role model for healthy foods

Mothers viewed their contribution in the feeding process as a primary force shaping children's food preferences and habits. One way of achieving this was through modelling, as mothers had noticed that their infants exhibited a liking for the foods that they consumed. The affinity of the infants for their mum's foods was often used as a way of dealing with infant's food refusals and to introduce foods that mums wanted their children to eat.

Table 3.C Summary of the opportunities and challenges to establish a healthy relationship with food, as emerged from the interviews (N = 37)

Opportunities to shape a healthy relationship with food	*Challenges to shape a healthy relationship with food*
1. Acting as a role model for healthy foods	1. Offering a variety of foods only if mum likes them
2. Using covert approaches to feed	2. Misconceptions about the definition of food variety
3. Giving multiple opportunities to try a food	3. "They have their own personality"
4. "It starts in the womb"	4. Being flexible about the feeding environment
5. Facial expressions not being indicative of food rejections	5. Distractions occurring during feeding
6. Food variety "so you don't have a fussy eater"	
7. Without food variety "things aren't going to work properly"	

> Participant 004_01: … now I've started trying to eat what, what I want him to eat so like I'll have the banana too and he'll eat it a lot better …

The awareness of their influence on the infants' behaviour, along with the need to provide healthy meals, urged mothers to improve their own dietary choices. This was a positive strategy where the mum and infant influenced each other's food choices.

> Participant 004_03: If she wasn't here, we would be like throwing something into the microwave where it's really conscious to cook, so I cook what's suitable for her and then we have that, so it helps us eat healthily.

2. Using covert approaches to feed

Infants' limited awareness of what's on the plate was also a favourable condition for mothers to feed various healthy foods; particularly foods that the child had initially rejected. Women talked about hiding the undesired food in a liked one or modifying the consistency of that food.

- Participant 007_04: See I've find that now with the sweets, see the fruit pots and yoghurts my son would rather have them than his dinner…

  Participant 007_03: You should put the dinner in an empty yoghurt pot.

  Participant 007_05: I've done this and I had a yoghurt pot and like mm yoghurt [Laughter] it's a bit of a distraction, do it!

- Participant 002_03**:** Bring something that they did like, then just switch the spoon back…

Moreover, mothers realised that their non-verbal communication during feeding is important and that it influences their infant's attitudes towards a certain food. Creating an encouraging feeding atmosphere was helpful, whereas mum's discouraging facial expressions lessened the child's interest in the food.

- Participant 004_02: … so I would just try to kind of even get her bigger sister to be like 'aww you're doing really well'… And all of us are sitting "oh well done" all being very encouraging.
- Participant 007_05: Your face if you're giving it to them, if you don't like it, they can see you like your face I think you wouldn't be as like keen.

3. Giving multiple opportunities to try a food

Gaining familiarity with a food through repeated exposure to it was utilised to a great extend too; particularly with the foods that were not loved by the child straight away. The frequency that a food was given was seen as a determining factor for a child to get used to this food and eventually enjoy it.

- Participant 008_01: … if you kept trying them until they actually, you know, acquired that taste for it cause the reason I tried the first time not like it you just put it to the side but if you keep trying like that taste will come for it.
- Participant 008_02: … baby has to try something fourteen times before it gets the taste for it.

4. "It starts in the womb"

It was acknowledged that the opportunity for a mother to instil in her child good eating habits arises earlier than the time of weaning. A few participants talked about a mum's contribution to the child's sensory stimuli during pregnancy and lactation. Even though the idea was voiced without relevant probing, there were doubts about its validity.

- Participant 001_01: They say it starts in the womb, don't they? … Especially, I was told especially strong flavours like garlic and curries and stuff like that it starts in the womb and then if you breast feed it's meant to happen then as well.
- Participant 004_01: Sometimes I read too that what you ate in pregnancy can affect what your baby eats but I don't know if that's the thing or not …

5. Facial expressions not being indicative of food rejections

Participants were given a task of interpreting facial expressions of infants' photographs. The photographs showed images of children's facial responses to non-sweet tastes. The task was

presented in order to elicit participants' interpretations of non-hedonic responses to food. It was also an exercise to see how infants' expressions of distaste may affect mothers' feeding practices. Eventually, this exercise offered an opportunity to reveal that mothers were not discouraged by their children's facial cues from offering the foods that triggered these cues. When presented with the images, the various facial expressions were mostly interpreted as occurring outside the food context placing the child in various moods.

- Participant 002_05: B…I wouldn't interpret that as he doesn't want the food.
  Participant 002_04: he looks quite content.
  Participant 002_02: The last one maybe she wants sleep.
- Participant 003_04: There's like the one the wee boy in the middle it's like something do you know like if you have a bit of lemon or something? Like a sour taste. And I think the bottom corner is like I really don't know what's happening here I don't think I like it.
  Participant 003_02: I think tired as well you know she's …
  Participant 003_04: Yawning yeah!

In relation to feeding practices mothers explained that these facial responses did not necessarily indicate rejection of the food offered and mothers were aware that expressions of perceived distaste were common and did not necessarily mean that the infant didn't wish to continue eating their meal. In similar situations at home, this attitude enabled them to carry on with the feeding until the desired food was accepted by their child.

- Participant 005_04: … Like he will screw his face up the first like three (spoonfuls) and then from that he would be fine and he does it with every single thing he eats. It's not just, you think he doesn't like it, but he does ...
- Participant 008_03: Sometimes even when [infant's name] likes her food she screws her face up just the first thing she'll be like urgh and then she's like mmm!

6. Food variety "so you don't have a fussy eater"

Participants talked about the benefits of food variety as motivators to encourage a liking to a diverse eating pattern by their children. Supporting arguments were formulated with varied eloquence relating to the enjoyment of food and prevention of fussiness. A diverse diet in infancy was viewed to help prevent picky eating behaviours, whereas providing a limited food selection was associated with the consumption of monotonous diets and the reluctance to try unfamiliar foods in older ages.

- Participant 002_04: … you're going to be really fussy if you don't introduce it (variety) so they'll just end up eating chips their whole life …

- Interviewer: So how important do you think it is that a baby eats a variety of food?
  P4: So that they get, so you don't have a fussy eater.

Concerns of having a fussy child in the family was a dominant topic in the focus groups. Having a fussy child was linked to increased stress during mealtimes. Also participants drew on their own experiences and concluded that being picky with food will be an inconvenience for the children themselves when they grow up, as it will prevent them from having an enjoyable eating experience.

- Participant 003_04: … I don't think there's anything worse than a fussy child, when it's you know I don't like that I don't want it I don't want it, it can get you really stressed …
- Participant 005_03: … I'm not a big fish eater, I'm more chicken… So it's like some places I would go where there's a set menu and sometimes there's no chicken, so I'm just stuck eating soup and I think oh I kind of want to get [infant's name] into like kind of eating everything …

7. Without food variety "things aren't going to work properly"

In addition to the previous points on food variety, feeding the weaning infants with a wide range of foods was perceived to contribute to a sufficient intake of essential nutrients. Consequently, food exposure was believed to be responsible for a number of health issues. Participants were aware of the link between poor dietary patterns and health problems such as gastrointestinal disorders, constipation, compromised immune function and risk of food allergies and intolerances.

- Participant 002_05: And also vitamins, every food has different type of vitamins so try to keep a wide range …
- Participant 001_01: … my dad is very much meat and two veg and he always has been his whole life and so was his dad before him so… and he has all sorts of bowel problems now to be honest and I think I was always very conscious of that …
- Participant 005_03: … cause if they don't get all their vitamins they're not going to have a very good immune system and things aren't going to work properly …

The risk of developing food allergies and intolerances motivated one participant to form her feeding practices.

> Participant 002_03: And I also think that just with the food intolerances that people have now… my personal belief is that I would try like nuts and things and dairy and all this kind of things …

3.3.2 Challenges to shape a healthy relationship with food

Even though the time of weaning was associated with great maternal control over children's food intake, it was also agreed that there were circumstances where this control was compromised. Some of them were directly linked to the mum, others to the children themselves, while some depended on contextual factors such as the immediate environment.

1. Offering a variety of foods only if mum likes them

During discussions in relation to offering a variety of foods, mothers admitted that their own aversions was an inhibitor of providing a wide range of foods during weaning. Although some mums exposed their infant to foods they didn't enjoy eating, the majority of them wouldn't buy or offer a food that themselves disliked. Similarly, mothers tried to familiarise their children to foods they personally enjoyed eating and hence, the food consumption of their children was often a reflection of their own preferences.

- Participant 003_06: … I won't buy things, you know, that I won't eat.
- Participant 008_01: Yeah we tried him with everything because we liked, he liked homemade Indian and stuff like that, cause we love that sort of stuff and now like he'll like, last night we had tikka masala.

2. Misconceptions about the definition of food variety

When asked how they secure a varied weaning diet, mothers demonstrated knowledge gaps in what food variety means, which was an additional barrier to providing a diverse diet. More specifically, mothers reported strategies which primarily involved exposure to a wide selection of fruit and vegetables. As quoted by one participant, including a range of herbs and spices during food preparation was also characterised as an element of food variety. None of the participants mentioned the importance of feeding foods from all food groups.

- Participant 002_05: I've tried different things, books, I look on the internet for recipes and things like that to see something that she will enjoy… like for example cauliflower and apple or potato and spinach and always try to have the broccoli…
- Participant 002_03: … even I when I make homemade meals I would try to like cumin and paprika, different spices and the fact that they say try to introduce everything.

3. "They have their own personality"

The idea that children develop their own personality early in life emerged recurrently from the data. Mothers believed that the acquisition of food likes and dislikes is an aspect of children's temperament and hence it progressed through a personal trajectory independently from mum's feeding practices.

- Participant 001_04: Like I tried loads of flavours within the first year and I personally don't think it made a difference to him, cause he did try them and he ate them and then as time went on he just, just developed his own kind of little plain taste and likes what he likes and so…
- Facilitator: And how do you think this choice is formed?
  Participant 002_03: They have a little bit of their own personality. And their own taste, so they start to develop their self-awareness …
- Participant 007_04: Like even though they are young, they have their own personality and what they like and dislike.

Moreover, mothers were aware that children were born with a predisposition to sweet taste, an affinity that is responsible for their preference to sweet foods like fruit and confectionary.

> Participant 002_03: Even with the wee ones like fruit puree was always easier to get them to eat that and other stuff, so you're already wired to sort of enjoy those things a little bit better I think.

4. Being flexible about the feeding environment

Mothers talked about the every-day difficulties that pose an obstacle to feeding their infants in a comfortable home environment. In relation to the location where feeding took place, some participants chose places that they considered appropriate to feed the infant, such as in the kitchen using a high chair. However, participants recognised that this was not always possible and had to be flexible depending on their activities.

- Participant 007_01: Kitchen table. The high chair when everyone else is being fed.
- Participant 005_03: But I'll feed her anywhere, like the other day me and [infant's name] were going into town and we were waiting on the bus and she was like right I need to feed her so I just fed her sitting at the bus stop one of her wee jars of food just feed her everywhere.

Diverging attitudes and practices were also apparent regarding the family presence during meals. Family meals were valued and viewed as a chance for family members to come together. Mothers talked about including the infant in parents' meals even before weaning so that they become familiar with dinner time. On the other hand, eating with all the members of the family often proved challenging due to everyone's daily activities. Often, infants were fed separately from the rest of the family due to the mismatch between parents' schedule and infant's routine, but also the strain put on multiparous mothers having to feed more than one child at the same time.

- Participant 008_04: … I would like that to try and do a bit more kind of around the table and bring him in so he knows this time he's going to have something to eat ...
- Participant 007_03: I feed her first cause then she's kind of quiet and content and try and finish the rest (of the children).
- Participant 001_04: Sometimes lunchtime would be on our own because [older baby's name] has a big sleep and I would be trying the weaning then you know whenever I have a bit of peace and quiet.
- Participant 008_02: With [infant's name] he would've sat in the kitchen in his high chair and I'd gave him his lunch and his dinner but me and my husband we sat in the living room and [infant's name] would do like the swing and bounce and whatever or even possibly in bed by the time we were eating.

5. Distractions occurring during feeding

It was acknowledged that infants' restricted attention span during feeding could inhibit the completion of a meal. Mothers identified the objects that drew their children's attention (photographs, phones, TV and tablets) and therefore, were kept away during feeding.

- Participant 001_01: Dining room for us… Anywhere else is too big of a distraction… And even then there's exciting photographs to look at…
- Participant 008_01: … we actually started eating at the table and making a point of it and like putting all the phones down.

On the one hand, some mothers described the distractions under a positive light. For example, the TV had a pacifying effect on infants and made them more willing to open their mouths to the spoon. Similarly, in situations where the feeding didn't progress (smoothly or at all), mothers were keen to use distractors to ease the infant into eating the food offered.

- Participant 005_03: … she stares at the TV, but I have her high chair like pointing at the TV and I'm kind of sitting in front of it so she's still and I just put the spoon in her mouth and she just opens her mouth automatically …
- Participant 007_03: You have to make them laugh to open their mouth and it's like ah!

It was agreed that patience is an important quality for a mother during the weaning period, as feeding takes a long time, and in certain cases, meals were even described as turbulent situations.

- Participant 002_02: But the thing is you have to be patient to feed a kid… Cause you can stay long time, ages and ages waiting on a small thing like this!
  Participant 002_04: It takes so long, it's not like "quick eat your breakfast"!

- Participant 004_01: … and there's some nights he just screams the place down and we're all trying to eat and…

  Participant 004_05: Yeah it's not a pleasant experience…

3.4 Discussion

This study employed a qualitative design to examine underexplored areas of mothers' experiences during the complementary feeding period, particularly in relation to encouraging healthy dietary behaviours. This paper presents some of the most common opportunities mothers encounter when establishing positive eating habits, as well as relevant challenges. Independent of the level of knowledge that participants had regarding infant feeding and nutrition, they were mindful that mothers needed to be equipped with techniques in order to instil a healthy relationship with food in their children. Although the interpretation of what is a balanced and diverse diet was highly variable across the study sample, the intention to provide infants with varied dietary experiences was universal and frequently demonstrated.

3.4.1 Study findings

Although mothers' feeding approaches in certain areas diverged from each other, the findings reveal some common strategies that were used to shape a liking to healthier foods. It was evident that mothers understood that taste preferences were shaped to a large extent in infancy and used many strategies to develop taste preferences in their infant. In addition, mothers also believed that the acquisition of taste preferences was an expression of the child's temperament, as well as inherent. These two ideas were not seen as conflicting, but in most cases as complementing each other.

Mothers in this study played an active role in encouraging healthier food consumption and saw themselves as models encouraging positive eating behaviours in their infants. The need to be a good role model often motivated them to improve their own dietary choices, which has been highlighted in previous research (27). According to Bandura's Social Learning Theory, children observe and imitate behaviours, beliefs and attitudes of individuals in their immediate world such as parents (28). Previous research findings confirm that parental modelling of dietary behaviours and attitudes can influence children's food habits. Brown and Ogden saw a strong association between parents' and their child's snack intake for both healthy and unhealthy snacks (29). Similarly, in a study by Draxten et al, children whose parents modelled eating fruit and vegetables were significantly more likely, than children whose parents did not, to meet daily fruit and vegetable recommendations (30). These studies relate to children between 8-13 years of age, whereas the effect of modelling healthy

eating behaviours in younger children is under-researched. Future research should investigate whether parental role modelling is also likely to encourage healthy eating patterns in infancy.

Offering repeated opportunities for infants to try a certain food was regarded as an effective technique to familiarise them with this food and nurture their liking to it. Maternal confidence in this strategy aligns with previous research findings. Intervention studies with infants have demonstrated that frequent exposure to a certain vegetable leads to a greater acceptance and an increased intake of that vegetable (15,31,32). The official recommendations in the UK and Europe have taken on board these findings and encourage repeated exposure to foods, particularly vegetables, for the development of balanced food preferences in infancy (33,34).

The importance of dietary diversity in the first year of life was acknowledged in this study and mothers were mindful that feeding their infants a varied diet can prevent them from becoming fussy with food, and can contribute to their good health. This finding is in line with previous qualitative evidence, where participants also explained that providing a wide range of foods and flavours during weaning was important and would help their infants adopt a healthy approach to food and avoid picky eating behaviours (35-38). Indeed, infants fed on a variety of foods of different flavour and texture were subsequently shown to be more receptive to foods to which they had no previous exposure (32,39). A study by Mennella et al showed that infants who ate a variety of fruits increased their intake of a specific fruit even though they had no direct experience with this specific fruit during the exposure period in the study (39). Furthermore, other research has shown that daily exposure to fruits enhanced the infants' initial acceptance of a starchy vegetable (carrots) and experience with a variety of vegetables facilitated the acceptance of a novel food (chicken) (32).

Even though the value of feeding a variety of foods was well recognised, the maternal practices to achieve food variety revealed a limited understanding of its meaning. Dietary diversity was translated as providing a plethora of fruit and vegetables and did not address consuming foods from all food groups. The misconception that offering solely an abundance of fruit and vegetables ensures that the infant has a varied diet was not unexpected, since the recommendations on fruit and vegetables consumption in the UK are currently not met (40) and many health campaigns have targeted this message. Previous qualitative research with participants from the UK, Denmark, Germany and Sweden has also highlighted that mothers focus their efforts in feeding more fruit and vegetables during complementary feeding (27,41,42). On the other hand, sources of high quality protein (meat, fish, pulses,

eggs) were not reported by participants as elements of food variety. The omission of animal foods has been previously highlighted by the latest data of DNSIYC on food intake, where 34% of the parents reported avoiding giving all meat/poultry/fish/seafood to their 7-9month-old children (22). This study also revealed that maternal awareness of food allergies and intolerances plays a role in determining the diversity of the meals offered during weaning. In cases of high maternal concern about food allergies, ensuring early exposure to foods that are linked to allergic symptoms as a prophylactic measure was one of the priorities of parents' weaning strategies. WHO also warns that complementary foods should be varied and include adequate quantities of meat, poultry, fish or eggs, as well as vitamin A-rich fruits and vegetables every day (43). Poor parental understanding of infants' nutritional requirements in protein and iron-rich foods can compromise dietary quality and dietary adequacy in essential amino-acids and iron (particularly in breast-fed children) with a negative impact on their nutritional status (44).

The period of weaning was viewed by mothers as a window of opportunity to expose children to a variety of tastes and textures. For some women, it was the only time in the children's lifespan where the mother is in complete control over their dietary intake and therefore, weaning was associated with an urgency to introduce as many flavours as possible in this short timeframe. Similar beliefs have been demonstrated before about the importance of exposing an infant to as many foods as possible (27). In this study, the weaning infant was also seen to be willing to try different foods. A recent review by Taylor confirms this belief and explains that unwillingness to taste new foods (neophobia) is absent in infancy, as children are experiencing food tastes and textures for the first time with no prior expectation of what they taste like (45).

The environment within which feeding takes place varied greatly. As discussed in a previous study by Brown & Lee (35), participants created occasions whereby family members shared a meal and the infant joined in. On the other hand, for the majority of the participants feeding was an additional task to an already busy schedule; this was particularly evident for women who had more than one child. For them, there was no choice but to feed their infants away from the other family members or on-the-go as part of their every-day activities. Incorporating infant feeding around daily maternal activities has been described before by Horodynski et al (46).

Mothers in this study illustrated the clash between the ideal and reality in establishing a comfortable environment. Even though WHO encourages mums to "talk to children during feeding, with eye to eye contact", participants here described drawing children's attention

with objects like the TV to assist with the feeding process. Employing distractions to feed was quoted as a practical way for mothers to foster positive mealtime experiences and avoid conflict over food. TV viewing during meals has been implicated in intervention studies for lessening the response to satiety cues and hence, leading to overeating (47,48). These studies were conducted with pre-school and school-aged children, but there is no similar evidence demonstrated for children in infancy. Therefore, mealtime viewing, seen as a transient behaviour used only in infancy, should not be a cause for concern; however, it could become an issue if it forms a pathway to establishing a habit that persist later in life. Currently, the prevalence of infant feeding in front of the TV is unknown due to the scarcity of relevant data from national surveys. Feeding and TV viewing has been however described as a common maternal practice in previous qualitative literature (46).

3.4.2 Strengths and weaknesses

This study offers a novel perspective in relation to the underlying factors that help and impede a mother's ability to establish healthy eating habits. The data were collected until information saturation was achieved and the broad recruitment approach enabled capturing the views of a varied sample from a range of locations and socioeconomic profiles. Nonetheless, the recruitment method captured the views of a predominately urban population, whereas mothers residing in a rural setting were underrepresented. Additionally, during analysis a slight difference was observed in the views of mums with more than one children and first-time mums in including children in meals with the other members of the family. Similarly, it became evident that further differences in feeding practices could be seen between mothers who have a full-time occupation and those who don't. Further investigation with separate samples could illustrate divergent experiences between first-time and non-first-time mothers.

3.4.3 Conclusion

This study presents qualitative findings on maternal approaches to nutrition during the complementary feeding period by focusing on favourable and not-so-favourable factors and situations which encourage positive eating behaviours. Mothers encouraged their children to develop a preference for healthier foods through modelling and repeated exposure to these foods. While a high perceived value for food variety was demonstrated, the definition of food variety and the methods to provide a varied and balanced weaning diet were poorly understood. Albeit deviant from infant feeding recommendations, using occasional distractions, such as the TV, were practical aids used to ease feeding without stress.

Weaning is a critical timeframe for an infant to establish healthy eating behaviours. Health care professionals in contact with new mothers, particularly health visitors, need to be aware of the common misconceptions around complementary feeding and be equipped with the appropriate knowledge and the resources to correct these misconceptions. The present study findings can be used to inform future education interventions in areas of infant nutrition that caregivers find most challenging. By addressing these areas and by approaching caregivers from a range of educational and financial status there is a great potential for current education initiatives to improve maternal feeding practices and ultimately complementary feeding.

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Chapter 4: Predictors of dietary quality during weaning in a UK sample of mothers; findings from an online survey

4.1 Introduction

4.1.1 Previous research on feeding practices and their determinants

A number of factors are known to influence child feeding practices. Parents are the gatekeepers of nutrition in the first years of life and their feeding practices form children's dietary behaviours. Parental feeding practices encompass a series of perceptions and behaviors that need to be considered in order to gain a deeper understanding of how these practices are formed. Recently, research exploring the determinants of parental food-related practices has targeted a number of mother- and infant-related factors (1-6).

One of these factors is maternal feeding self-efficacy and its influence on children's eating behaviours. Fruit and vegetable consumption is an important aspect of a healthy eating pattern and maternal feeding self-efficacy is a significant predictor of fruit and vegetable intake of children below 2 years (3,5). Previous qualitative work on food exposure and taste preferences during weaning has highlighted that mothers' reluctance to try foods themselves are not familiar with can have a negative impact on the food selection offered to an infant (2). Other mother-related characteristics that have been associated with infant feeding outcomes are postnatal depression and perceived social support (1,4,6). Both mothers' perceptions of low support from their male partner and depressive symptomatology have also been shown to predict shorter breastfeeding duration and earlier introduction of complementary foods.

An infant characteristic that has been often linked to infant feeding practices is temperament. In a study by Rogers & Blissett (2018) earlier introduction to solids was predicted by higher ratings for smiling and laughter (7). Another study reported that infants were more likely to be introduced to solid food before four months if their mothers rated them as higher in distress and activity (8).

4.1.2 Dietary quality – definition and indices in adults

A measure of dietary quality can indicate how closely dietary intake aligns with nutritional recommendations and how varied the choices are across core food groups (9). Numerous indices have emerged to assess dietary quality, some of which have been developed to measure compliance with national guidelines such as the Healthy Eating Index (10), or

adherence to a dietary pattern that is linked with positive health outcomes, such as the Dietary Approaches to Stop Hypertension Score and the Mediterranean Diet Quality Index (11,12). As nutritional assessment shifts from measuring specific nutrients or foods towards looking at whole food patterns, the concept of dietary quality has become more relevant in nutrition research.

4.1.3 Limited research on diet quality during weaning

Diet quality during the critical period of complementary feeding, defined by WHO as the first 6 to 18-24 months, has been underexplored (13). Several studies have assessed individual feeding behaviours i.e. the duration of breastfeeding or the timing of introduction of the first solid foods (14,15), but there has been limited research interest in the overall quality of the diet during the first two years of life. The weaning diet should be characterised by a variety of nutrient-dense complementary foods, by avoidance of non-recommended ingredients and foods (e.g. salt, sugar, cow's milk as main drink) and by the gradual introduction of various textures e.g. lumps that will facilitate food acceptance (16,17).

A small number of studies that have examined whole diets of infants and young children and have quantified their quality by assigning an overall score. These are multiple-component indices developed specifically for this age group that evaluate feeding behaviours relevant to timing, type and portion sizes of food groups (18-21). The Complementary Feeding Utility Index (CFUI) is one of them; developed using data from a large UK cohort in order to determine the degree of adherence to complementary feeding guidelines in the UK, Australia, New Zealand and North America (22). It provides a 14-component scoring system and has been validated as a measure of infant diet quality in a UK population.

4.1.4 Maternal feeding practices and infant weight gain

The importance of complementary feeding practices as a contributor to child overweight has also been previously highlighted. As shown in the 2011 Diet and Nutrition Survey for Infants and Young Children (DNSIYC), the majority of children in the UK aged 4-18 months are heavier than the UK-WHO Growth Standard for their age and gender (14). Additionally, most of them consume more calories than they require with 75% exceeding their age- and gender-specific Estimated Average Requirement for energy. In a recent systematic review, it is concluded that mothers who respond appropriately to children's appetite cues and avoid restrictive or pressurising feeding practices are more likely to have a child within the normal weight status (23). Research has pointed towards some other key areas of infant feeding that might be linked with increased weight gain. Compared to breastfed infants, infants who are formula fed grow more rapidly in weight (24). It has also been demonstrated that high

protein intake during infancy is associated with accelerated growth (25). On the other hand, the timing of introducing complementary foods is not associated with higher risk of developing overweight and obesity based on the updated EFSA scientific opinion (26). The role of maternal feeding practices in the development of early childhood obesity is complex and requires further exploration.

4.1.5 Aim and objectives

While a number of maternal and child characteristics mentioned above have been associated with individual feeding practices, their relationship with the overall weaning diet remains unknown. This study aims to assess the dietary quality in a UK-wide sample of mothers with a child of weaning age, and to identify its key determinants. This will be achieved by: 1) assessing mothers' complementary feeding practices by using a composite nutritional index; and 2) estimating the strength of their association to a number of parental- and infant-related variables, while controlling for potential confounding factors. Findings of this study will help identify mothers who are likely to show low adherence to the complementary feeding recommendations and develop appropriate targeted educational strategies to address this.

4.2 Methods

The study employed a cross-sectional survey design. Ethical approval was obtained from the Ethics Committee of School of Biological Sciences, Queen's University Belfast.

4.2.1 Participant selection

A convenience, self-selected sample of UK parents was recruited online. A number of online parenting groups, parenting support organisations and family information services were approached and the study design and purpose explained. If approval was gained, they were asked to disseminate the call for participation and an information package was given out. The information package included a participant information leaflet and a poster with the main points to consider when participating, including the contact details of the research team, and a link to the survey (see Appendix 2 – Fig 0.A and 0.B). A gift card worth £25 for 10 randomly selected participants was used as an incentive for participation.

Participation was open to all parents and primary caregivers who lived in the UK and were weaning a child at the time that the survey was launched. Additionally, children needed to be younger than 18 months, full-term and healthy (absence of any allergies/intolerances and conditions that affect the ability to feed). Participants consented to take part in the study by clicking on a mandatory field at the beginning of the survey. Eligibility was then assessed through five initial questions that confirmed that participants were legal guardians of full-

term, healthy children who were younger than 18 months and didn't suffer from any food allergies. Non-eligible individuals were unable to continue with the survey.

4.2.2 Data Collection

The questionnaire was piloted with researchers and two parents for timing and clarity. After feedback on wording and flow, minor adaptations were made. The survey was created on the online platform Qualtrics (*Qualtrics XM* 2019). It was launched online on the 17 May 2019 and remained open for completion for 3 months. Participation was anonymous and any contact details submitted to enter the prize draw were stored separately from the survey data. The final questionnaire can be seen in Appendix 2 – Figure 0.C and took 15-20 minutes to complete and included questions in relation to the following characteristics and measures.

4.2.2.1 The dependent variables

Dietary quality. The questions on complementary feeding were based on those used in the ALSPAC longitudinal study, i.e. a UK infant population (27). The questions were adapted in order to match the 13 items of the Complementary Feeding Utility Index (CFUI) (Table 4.A). The average of all item scores was calculated to produce an overall CFUI score which ranged from 0-1 (0 being indicative of poor diet quality and 1 ideal) according to Golley et al (22).

Timing of weaning. The age of introduction of solid foods was asked in weeks and months. The recommendation of the Department of Health on introducing solids from 6 months was considered to define early weaning and weaning on time (16).

Body weight and adiposity. Participants provided information about their child's most recent weight measurement before the survey. The measurements were then plotted on the appropriate Weight-for-Age growth chart for their age and gender, to identify the centile they were on. Being on the 91st centile or between 91st and 98th classified as being overweight, and 98th and above obesity. On the other hand, measurements plotted from the 2nd centile and below were classified as underweight. Children whose measurements were in between were considered normal weight. The UK RCPCH growth charts for the early years (0-4 years) were used in the classification process (28). The strength of association between infant weight status and maternal feeding practices was investigated.

4.2.2.2 Demographic, anthropometric and feeding information

Questions on parental and child age, gender, ethnicity, location of residence, marital status, educational attainment, number of children and annual household income were included in the questionnaire. In this study household income was used as an indicator for socioeconomic status. Additionally, self-reported parental body weight and height were collected. Parental Body Mass Index (BMI) was then calculated and assigned to a BMI

category based on the WHO definition (29). Participants were also requested to give information regarding the cues for the introduction of complementary foods, the use of baby-led weaning (BLW) and sources of weaning advice, in order to obtain a holistic view of weaning practices.

4.2.2.3 Covariates

A number of covariates which were identified from the literature as potential contributors to quality of infant diets were measured. These were:

1. *Food neophobia*. Parents' desire for a diet with variety was measured by using the *Food Neophobia Scale (FNS)*. FNS is a widely used instrument primary developed to measure willingness to try new and unfamiliar foods (30). It has high reliability (Cronbach's α = 0.88) and has been previously used in UK adult populations (31,32). It is a self-administrated, 10-item questionnaire and a high score indicates low willingness to try novel foods. The score is obtained by summing the individual item scores measured on a Likert scale (ranging from *strongly disagree* to *strongly agree*). For this study a 5-point Likert scale was used, as it has been reported that scales with lower graduation in response (3- and 5-point scales) are easier and quicker to use than 7- and 9-point scales (33).

   According to Olabi et al, three categories can emerge by taking into account the mean value in the FNS and its related standard deviation (34); in this way individuals showing scores ≤(M-SD) were classified as neophilic, those above M+SD neophobic, and those with FNS values in between were considered neutral.
2. *Parental self-efficacy in feeding.* Two sub-scales were used to assess this: one that reflects parents' self-judgement of how well they can promote healthy eating (sufficient intake of fruit, vegetables, amount of food and dietary variety); and of how well they can restrict the consumption of non-core foods (confectionary and sweets, crisps and savoury snacks, and sugar-sweetened drinks) (3). Reliability values are α=0.84 and α=0.86 for each sub-scale respectively. Confidence for every behaviour was rated by participants on a 5-point Likert scale ('not at all confident' to 'extremely confident'). An average score ranging from 1-5 was retrieved for every subscale as well as an overall score.

Table 4.A Components of the Complementary Feeding Utility Index (CFUI)

Index item	Variable/s used to derive item
1. Breastfeeding duration	age in months when infant stopped breast feeding
2. Timing of introduction of solid foods	age in months when infant was fed foods or liquids except baby milk
3. Exposure to vegetables	consumption of vegetables prepared at home in times/day
4. Exposure to fruits	consumption of fruit prepared at home in times/day
5. Variety in protein foods	consumption of animal protein foods (meat, fish, eggs) in times/week
6. Exposure to sweet drinks[1]	types of drinks infant consumes per week
7. Exposure to confectionary and savoury snacks[2]	types of confectionary and unhealthy snack foods infant consumes per week
8. Timing of cow's milk introduction	age in months when infant had cow's milk as main drink
9. Exposure to tea and coffee	infant had tea or coffee (yes/no)
10. Exposure to commercial infant foods	age in months when infant introduced to meals with lumps
11. Timing of introduction to lumpy foods	consumption of ready-prepared meals in times/week
12. Number of daily meals and snacks	number of meals and snacks infant consumes per day
13. Feeding on demand	infant fed on demand or on schedule

[1] Five types of sweetened drinks: caffeine-containing fizzy drinks, other sugar-sweetened fizzy drinks, sugar-free fizzy drinks, fruit drinks (including squash) and fruit juices
[2] Four types of high salt, sugar and fat foods: chocolate, sweets, crisps and other savoury snacks

3. *Social Support*. The Multidimensional Scale of Perceived Social Support (MSPSS) investigated social network support (35). It is a 12-item instrument which addresses three sources of support: friends, family and significant other (4 items for each source). Participants expressed level of agreement with each item-statement on a 5-point Likert scale. Total scores were retrieved by obtaining the mean; higher total scores demonstrate perceptions of greater social support from these three sources. The scale has good reliability (Cronbach's coefficient alpha = 0.88) and has been previously used in research with mothers living in the UK (36).

   As there is no established guide to determine categories for the MSPSS, the scale response range was divided into three equal sub-ranges. In this approach, any total scale score ranging from 1 to 2.3 could be considered low support; a score of 2.3 to 3.6 could

be considered moderate support; and a score from 3.6 to 5 could be considered high support.

4. *Postnatal depression*. The *Edinburgh Postnatal Depression Scale* (EPDS), a 10-item self-report scale designed to detect postnatal depression was used (37). Developed in a UK sample of post-partum women, EPDS is quick, with a simple method of scoring (i.e. the overall score of the 10 items, each one of which is scored on a 4-point scale) and is widely used to screen for depression even in mothers with older children (38). The score ranges from 0 to 30 and higher scores indicate greater risk of depressive illness.

   Cox et al suggest that women who score above a threshold of 12/13 are most likely to be suffering from a depressive illness of varying severity; thus, participants in this study with a total EPDS score of 13 and above were considered to have postnatal depression (37).

5. *Infant temperament*. The *Infant Behaviour Questionnaire Revised* (IBQ-R) – Short Form was used to assess different domains of infant temperament. The questionnaire collects information drawing on parents' opportunities to observe their children's behaviour across a broad array of contexts (39). More specifically, caregivers are asked to report, on a 5-point scale, the relative frequency of occurrence of specified infant reactions in concrete situations during the previous week.

   IBQ-R Short explores 14 domains, but only three of them were used for this study ("Activity Level", "Distress to Limitations" and "Smiling and Laughter"), as they are the only ones that have been associated in previous research with infant feeding practices (7,8). A mean frequency score was calculated for each one of the three scales.

4.2.3 Statistical analysis

Data were analysed using IBM SPSS Statistics software (Version 25.0). Partially completed questionnaires were included in the analysis, if the total CFUI score could be calculated from the responses. Descriptive statistics were presented in means and standard deviations (SD) for continuous variables, and proportions (%) for categorical. All covariates were measured on an interval scale.

Multivariate binary logistic regression was performed to investigate the independent associations between covariates and weaning age, which was expressed as a dichotomous variable for weaning earlier than 6 months and weaning from 6 months. A number of confounding factors that may influence the timing of weaning were identified in literature and were incorporated in the model. These were parental age, socioeconomic status (SES), education, marital status, milk feeding mode (15,40-43).

Multivariate linear regression was utilised to identify the main predictors of dietary quality in infancy, expressed as CFUI score on a continuous scale. The distribution of CFUI score presented a slight negative skewedness (-0.709); however, data transformation was not deemed necessary, given the magnitude of the sample and difficulty to interpret the results after the transformation. Due to paucity of research regarding predictors of quality in infant diets, all demographic and feeding information that contributed to explaining the dependent variable were adjusted for in the model. Influential factors expressed as categorical variables with more than 2 values were separately investigated further for associations with dietary quality by creating dummy variables and incorporating them in the regression model by using one of them as a reference.

Confidence intervals were set at 95% and statistical significance was established for $P < 0.05$. R square values were used as indicators of the proportion of variance in the feeding practices explained by the selected covariates (*Nagelkerke* R^2 for binary logistic and ordinal regression and *Adjusted* R^2 for linear regression).

4.3 Results

A total of 1062 parents started the online survey. Some participants took the survey twice (*N*=33), some did not provide consent (*N*=51), some did not meet the eligibility criteria (*N*=190), or provided insufficient data (*N*=286), and were excluded. The remaining participants' data (*N*=502) were included for analysis. Of these 466 were females, 30 were males and six did not give information on gender. A flowchart of the numbers of parents who were excluded and those included in the final analysis is presented in Figure 4.A. The samples of men and women were analysed separately and this chapter presents the results of the analysis of the female sample.

4.3.1 Descriptives

The majority of mothers in the sample were white (97%), had attended tertiary education (76%), had an annual household income of 40-60K pounds (57%) and had one child (70%) (see Table 4.B). Their average age was 31 years and the mean age of the babies was 11 months. In terms of children's gender, there was an almost equal split between boys (48%) and girls (52%).

Most infants in this study had been breastfed at some point (84%) and were offered complementary foods at 6 months in compliance with the DH recommendation (72%). Just over half of the mothers (55%) initiated weaning based on the NHS guidelines on the timing of weaning and 57% of mothers scored highly (between 0.8 and 1) in the Complementary Feeding Utility Index. Peer support through face-to-face interaction or social media proved

to be the most influential source for weaning advice. Baby-led weaning was popular within this sample with just over half of participants (54%) following this weaning style. A preference for feeding homemade complementary foods over ready-made ones was reported. Table 4.B and 4.C present in greater detail sample characteristics and feeding practices. Proportions are expressed as valid percentages due to missing cases for every variable.

Figure 4.A Numbers of excluded participants and those included in the final analysis

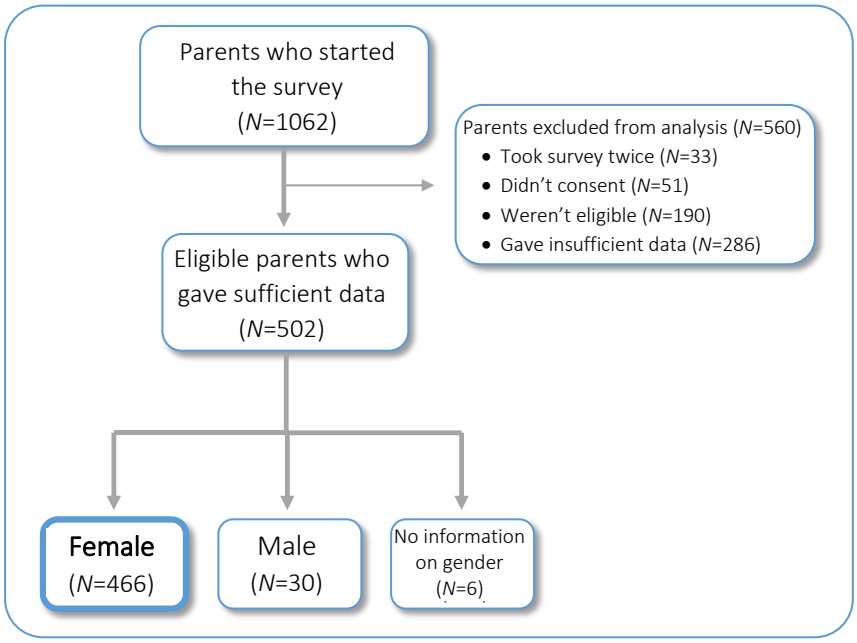

Table 4.B Participant sociodemographic and anthropometric characteristics (N=466)

Continuous variables		Mean ± SD	Min - Max
	Mothers' age (y)	31.53 ± 4.75	19 - 43
	Children's age (mo)	11 ± 3.5	4 - 18
Nominal variables		*N*	Proportion %
	Children's gender		
	Boys / girls	221 / 241	47.8 / 52.2
	Ethnic background		
	White	453	97.2
	Black/Black British	1	0.2
	Asian/Asian British	5	1.1
	Mixed/other ethnic background	7	1.5
	Location of residence		
	England	322	70.2
	Northern Ireland	71	15.5
	Wales	37	8.1
	Scotland	29	6.3
	Marital status		
	Single	24	5.2
	Cohabiting	138	29.7
	Married	299	64.3
	Separated	4	0.9
	Educational attainment		
	Primary school	2	0.4
	GCSE's	26	5.6
	A' levels	85	18.2
	Undergraduate	203	43.6
	Postgraduate	150	32.2
	Household income (£)		
	< 10k	16	3.5
	10 - 20k	32	7.1
	20 - 30k	61	13.5
	30 - 40k	85	18.8
	40 - 60k	257	57
	Total number of children		
	1 / 2 / 3 / 4 or more	326 / 112 / 22 / 6	70/ 24 / 4.7 / 1.3
	Mothers' BMI (kg/cm^2)		
	Underweight	8	2
	Normal weight	189	47
	Overweight	119	29.6
	Obese	51	12.7
	Obese II	23	5.7
	Obese III	12	3
	Children's weight status		
	Underweight	14	3.5
	Normal weight	288	61.8
	Overweight	54	11.6
	Obese	39	8.4

Table 4.C Participant complementary feeding practices (N=466)

Continuous variables		Mean ± SD	Min - Max
	Timing of introduction of solids (wk)	24.66 ± 2.8	8 - 30
	CFUI score	0.8 ± 0.12	0.3 – 1
Nominal variables		*N*	Proportion %
	Breastfeeding		
	Yes / no	390 / 76	83.7 / 16.3
	Timing of introduction of solids (categories)		
	< 6mo	129	27.7
	≥ 6mo	337	72.3
	Quintiles of CFUI score[1]		
	Q1 / Q2 / Q3 / Q4 / Q5	0/3/29/188/246	0/0.6/6.2/40.3/52.9
	Prevalent prompts for introducing solids		
	Baby was interested in food	69	14.8
	Baby was developmentally ready	106	22.7
	I followed the NHS recommendation	258	55.4
	Other[2]	33	7.1
	Sources of feeding advice		
	Health visitor	16	7.2
	Other healthcare staff	7	3.2
	Mother	4	1.8
	Peers	103	46.4
	Books	48	21.6
	Websites	44	19.8
	Following baby-led weaning		
	Yes / combined with spoon / only spoon	121 / 101 / 4	53.5 / 44.7 / 1.8
	Feeding commercial infant foods		
	Yes / never	62 / 155	28.6 / 71.4

[1] The CFUI scoring range was split into equal quintiles to show the distribution of diet quality scores across the sample.

[2] Other triggers for weaning include: being encouraged by the health visitor, changes in baby's weight, perceived hunger, disrupted sleep and mother's desire to stop breastfeeding

Table 4.D Other participant characteristics and infant temperament (N=466)

	Mean ± SD	Min - Max	*N*	Proportion %
Food neophobia (*continuous variable*) (*N*=466)	19.01 ± 8.6	0 - 47		
Food neophobia (*categorical variable*)[1]				
Neophilic / neutral / neophobic			43/347/76	9.2/74.5/16.3
Self-efficacy promoting healthy foods (*N*=450)	4.15 ± 0.8	1 - 5		
Self-efficacy limiting non-core foods (*N*=450)	4.23 ± 0.75	1 - 5		
Perceived social support (*continuous*) (*N*=445)	4.34 ± 0.72	1.17 - 5		
Perceived social support (*categorical*)[2]				
Low / medium / high			8/61/376	1.8/13.7/84.5
Postnatal depression (*continuous*) (*N*=439)	7.91 ± 4.97	0 - 26		
Postnatal depression (*categorical*) (*N*=439)[3]				
No / yes			361/78	82.2/17.8
Activity level (*N*=424)	2.91 ± 0.87	1 - 5		
Distress to limitations (*N*=418)	2.65 ± 0.90	1 - 5		
Smiling & laughter level (*N*=413)	3.93 ± 0.69	1 - 5		

[1] Mothers with FNS scores ≤(M-SD) were classed as neophilic, ≥M+SD as neophobic, and those in between neutral.

[2] Total scale scores from 1-2.3 were considered as low support; 2.3- 3.6 as moderate support; and 3.6- 5 as high support.

[3] Mothers with a total EPDS score of 13 and above were considered to have postnatal depression.

In relation to feeding foods from specific food groups, 32% mothers reported offering three or more vegetables every day, and 27% and 37% offered one or two vegetables respectively; only 4% reported not offering any vegetables on a daily basis. Similarly, with fruits, the majority of mums (40%) offered three or more fruits a day, 33% offered two and 24% one fruit a day; 3% offered less frequently than every day. There was a low reported consumption of sweetened drinks among this sample of infants and 81% of the participants didn't offer any sweet drinks including fruit juice. Out of those who offered some type of drinks the most common was fruit squash (10%) followed by fruit juice (7%); unfortunately, data on portion sizes or preparation method (diluted or not) was not available. A significant proportion of mums (46%) reported not offering any high-fat, high-sugar snacks to their infants, whereas 20% offered one type per week, 19% two and 13% three. Savoury snacks (e.g. crisps and cheesy biscuits) were the most frequently offered food among those who reported giving foods from this category (46%) on a weekly basis.

The mean self-efficacy for promoting healthy foods and avoiding less healthy foods was high (see Table 4.D). Most participants (75%) had a neutral attitude towards trying novel foods and only 16% of them were categorised as neophobic. The majority scored high for social support and absence of postnatal depressive illness (85% and 82% respectively). Infants scored highly on the smile and laughter domain of the infant temperament scale.

4.3.2 Determinants of dietary quality

A multivariate linear regression model was used to examine independent associations between the covariates and dietary quality, as shown in Table 4.E. Dietary quality was measured as the overall CFUI score and its values ranged from 0 to 1. A histogram of standardised residuals and a scatter plot of unstandardised residuals against predictive values were used as diagnostic tests for the appropriateness of the model. Standardised residuals were normally distributed and a scatterplot of unstandardized residuals against predictive values showed homogeneity of variance; both indicating that the model was a good fit for any observations for dietary quality, as shown in Appendix 2 - Figures 0.D and 0.F.

Both scales for parental feeding self-efficacy were significant explanatory variables of dietary quality after adjusting for participant age, marital status, education, household income and BMI. Specifically, every unit increase in scores of self-efficacy in promoting healthy foods was associated with obtaining CFUI scores that were higher by 0.018 (P=0.030), and self-efficacy in restricting unhealthy foods was associated with CFUI scores higher by 0.026 (P=0.002). Reliance on the NHS guidelines was also an independent predictor of diet quality during

complementary feeding in this model. Following the NHS recommendations as a prompt to introduce solids was associated with an increase in CFUI by 0.026 compared to relying on other information sources (*P*=0.034). There was no evidence of an association between dietary quality and parental food neophobia, perceived social support, postnatal depression or infant temperament based on the study data.

Table 4.E Multivariate regression model with CFUI score as a dependent variable, (Adjusted R^2=12.8%)

Covariates	B	95% CI	*P* [1]
Reliance on NHS recommendations	**0.026**	**0.002, 0.050**	**0.034**
Food neophobia	-0.001	-0.003, 0	0.160
Self-efficacy in promoting healthy foods	**0.018**	**0.002, 0.033**	**0.030**
Self-efficacy in limiting non-core foods	**0.026**	**0.010, 0.043**	**0.002**
Social support	-0.011	-0.029, 0.008	0.261
Postnatal depression	-0.003	-0.005, 0	0.055
Activity level	-0.001	-0.015, 0.014	0.922
Distress to limitations	0.004	-0.009, 0.018	0.534
Smiling & laughter	0.003	-0.015, 0.021	0.750

[1] *P* values occurred after adjusting for participant age, marital status, education, household income and BMI
Abbreviations: B=Unstandardised regression coefficient, CI=Confidence interval for B

4.3.2.1 Predictors of adherence to recommended feeding practices

Separate analyses were performed for each item of Complementary Feeding Utility Index that had fewer missing values than 50% of the sample. These were maternal feeding practices including the timing of introduction of solid foods, exposure to vegetables, to fruits, to protein sources, sweet drinks and confectionary and savoury snacks. Higher values of each CFUI item were related to higher compliance with the complementary feeding recommendations. Multivariate ordinal regression analysis was performed to identify significant explanatory variables of every feeding practice. Table 4.F presents the regression coefficients (Estimate b) and *P* values after controlling for a number of demographic characteristics (same ones as with total CFUI score).

The regression model revealed that reliance on the NHS guidelines and high infant distress levels were positively associated with adhering to the recommended timing of introduction of solids (*P*<0.001, *P*= 0.014 respectively), whereas maternal age was adversely associated with it (*P*=0.020). Maternal self-efficacy in feeding was positively associated with following a number of weaning recommendations; mothers with higher self-efficacy in promoting healthy foods were more likely to offer vegetables three or more times daily (*P*<0.001) and

those with high self-efficacy in avoiding unhealthy foods were more likely to offer two or more fruits a day (*P*=0.027) and to avoid giving sweet drinks (*P*=0.006).

Infant temperament had an overall significant effect on the amount of vegetables and fruit offered daily in the adjusted model. Infants that scored highly in activity level were more likely to be given the recommended daily intake in fruits and vegetables (*P*= 0.009 for both). Maternal BMI was a significant predictor of children's exposure to unhealthy snacks with every unit increase in BMI associated with decreased odds of adhering to the guideline on avoiding high-fat/-sugar snacks (*P*=0.027). Additionally, maternal age was a significant determinant of the exposure to sweetened drinks and exposure to confectionary and savoury snacks and older mothers were more likely to limit the consumption of these foods (*P*=0.042 and *P*=0.032 respectively). Food neophobia, perceived social support and postnatal depression were not predictors of compliance with the complementary feeding recommendations in the adjusted model.

4.3.2.2 Differences in maternal feeding practices based on children's age

Potential changes in feeding practices after 1 year were explored. The previous analysis was repeated with children's age incorporated as an additional covariate, which was a dichotomous variable that split the children below 1 year (infants) and older children. Results showed that mothers with an older child were more likely to provide the recommended daily amount of fruit (*P*=0.001) and variety of protein sources (*P*=0.004) compared to those with a child in infancy. Older children were more likely to have sweet drinks and snacks and more frequently than infants (*P*<0.001 for both food groups). There were no age-related differences in the overall dietary quality offered, as measured by the overall CFUI score.

Table 4.F Multivariate regression model with individual CFUI items (ordinal variables) as dependent variables

Covariates [1]	Timing of introducing solids		Exposure to vegetables		Exposure to fruits		Variety of protein-rich foods		Exposure to sweet drinks		Exposure to confectionary	
	R^2 =53.4%		R^2 =15.2%		R^2 =10.9%		R^2 =9.7%		R^2 =11.7%		R^2 =13.8%	
	Est (b)	*P*	Est (b)	*P*	Est (b)	*P*	Est (b)	*P*	Est (b)	*P*	Est (b)	*P*
Participant age	**-0.095**	**0.020**	0.021	0.426	0.013	0.724	-0.006	0.809	**0.076**	**0.042**	**0.056**	**0.032**
Maternal BMI	0.007	0.804	0.010	0.596	0.007	0.778	0.015	0.437	-0.016	0.529	**-0.041**	**0.027**
Food neophobia	-0.030	0.187	0.001	0.922	-0.005	0.772	-0.023	0.110	0.013	0.489	-0.006	0.666
Self-efficacy in promoting healthy foods	-0.086	0.696	**0.537**	**<0.001**	0.126	0.481	0.165	0.250	0.108	0.567	0.083	0.550
Self-efficacy in limiting non-core foods	0.056	0.800	0.074	0.627	**0.418**	**0.027**	0.121	0.413	**0.522**	**0.006**	0.081	0.581
Social support	-0.342	0.180	0.009	0.960	-0.343	0.148	-0.005	0.978	0.046	0.835	0.091	0.582
Postnatal depression	-0.039	0.318	-0.003	0.916	-0.056	0.097	-0.017	0.506	0.013	0.708	-0.045	0.076
Activity level	-0.152	0.567	**0.344**	**0.009**	**0.460**	**0.009**	-0.014	0.916	-0.084	0.650	-0.024	0.856
Distress to limitations	**0.470**	**0.014**	-0.231	0.070	0.018	0.913	-0.009	0.940	-0.059	0.735	-0.046	0.710
Smiling & laughter	-0.173	0.453	0.320	0.051	0.183	0.364	0.106	0.523	0.074	0.737	-0.278	0.092
Reliance on NHS recommendations	**4.201**	**<0.001**	0.032	0.884	0.146	0.601	0.328	0.136	0.348	0.241	-0.388	0.070

[1] The model for every dependent variable was adjusted for marital status, education and household income

4.3.3 Determinants of weaning age

A multivariate binary logistic regression model aimed to identify the independent predictors of compliance with recommendation to wean from 6 months. As seen in Table 4.G, after adjustment for confounders, the strongest association was seen for relying on the NHS recommendation, with the parents who used the recommendation as a prompt to introduce solids being 48 times more likely to introduce solids at 6 months, compared to those who didn't (*P*<0.001). Timely weaning was also positively associated with infant scoring high for distress to limitations (OR=1.47, *P*=0.042). A negative association with weaning on time was observed for perceived social support. Scoring higher in the multidimensional scale of perceived social support by a unit was associated with a 57% increase in the likelihood of weaning early (*P*=0.023). There was no association between the likelihood of weaning early or on time, and food neophobia, feeding self-efficacy, postnatal depression or other dimensions of infant temperament.

Table 4.G Multivariate regression model with weaning age (binary variable for weaning <6mo or ≥6mo) as a dependent variable, (Nagelkerke R^2=55.8%)

Covariates	B	OR	95% CI	*P* [1]
Reliance to the NHS recommendations	**3.878**	**48.35**	**20.79, 112.43**	**<0.001**
Food neophobia	- 0.043	0.958	0.92, 1	0.060
Self-efficacy in promoting healthy foods	- 0.186	0.830	0.55, 1.26	0.379
Self-efficacy in limiting non-core foods	0.209	1.233	0.82, 1.86	0.320
Social support	**- 0.571**	**0.565**	**0.35, 0.92**	**0.023**
Postnatal depression	- 0.023	0.977	0.91, 1.05	0.544
Activity level	- 0.246	0.782	0.53. 1.15	0.214
Distress to limitations	**0.385**	**1.470**	**1.01, 2.13**	**0.042**
Smiling & laughter	0.155	1.168	0.75, 1.81	0.488

[1] P values occurred after adjusting for participant age, marital status, education, household income and breastfeeding
Abbreviations: B=Unstandardised regression coefficient, OR=Odds ratio, CI=Confidence interval for OR

4.3.4 Determinants of infant weight

Children in the sample were split into categories based on their weight: underweight, normal weight, overweight and obese. Multivariate ordinal regression was performed with children's weight status as the dependent variable and a number of maternal feeding practices as potential predictors. The choice of confounding factors was based on previous literature that has linked maternal education, family income and maternal weight with feeding practices that in turn have been linked to overweight in early years (44).

For the independent variables that were measured on an ordinal scale, the lower categories were compared with the highest to produce the regression coefficients and *P* values. The regression coefficients and significant tests for each of the independent variables in the model are presented in Table 4.H.

Breastfeeding duration, exposure to vegetables, exposure to animal foods high in protein and exposure to sweet drinks were identified as significant predictors of weight in the sample. Children that were breastfed for longer were less likely to be overweight (*P*=0.014). Specifically, children who were offered vegetables once per day or less frequently than daily were less likely to be in a higher weight category compared with those who ate three or more vegetables (*P*=0.043 and *P*=0.004 respectively). Having three foods from the group of meat/fish/egg per week was associated with being in a lower weight category than having two of these foods per week (*P*=0.036). Early consumption of sweetened drinks in this age was a significant explanatory variable, with the intake of one or two types of drinks being related to greater risk of increased adiposity when compared to zero intake (*P*=0.004 and 0.005).

The age of introduction of lumpy textures in food was an additional determinant of children's weight in this sample. Children that had lumpy foods at some point between 6 and 8 months were less likely to be in a heavier weight category compared to those fed lumps earlier or later (*P*=0.003 and *P*=0.025). The other feeding practices explored in this analysis were not significant predictors of babies' weight status in the adjusted model (consumption of fruit, confectionary and savoury snacks, commercial baby foods, responsive feeding).

4.4 Discussion

This study investigated the relationship between maternal and baby characteristics, and dietary quality in a sample of children of weaning age in the United Kingdom using the Complementary Feeding Utility Index, a multiple-component instrument designed by Golley and colleagues (22). The study also determined which of these characteristics relate to the timing of weaning and children's weight status. The covariates explored in this study were carefully selected after reviewing the existing literature on determinants of infant feeding; these include maternal food neophobia, perceived social support, self-efficacy in feeding a child, presence of postnatal depression and some dimensions of infant temperament.

Table 4.H Multivariate regression with children weight status (ordinal variable) as dependent variable (Nagelkerke R^2=52.1%)

Covariates	Est (b)	*P*
Breastfeeding duration	**-1.750**	**0.014**
Exposure to vegetables		
0 per day	**-4.130**	**0.004**
1 per day	**-1.750**	**0.043**
2 per day	-0.813	0.277
3 or more per day	-	-
Exposure to fruit		
0 per day	3.757	0.061
1 per day	0.951	0.209
2 or more per day	-	-
Variety in protein sources		
0 types per week	1.276	0.247
1 type per week	0.340	0.758
2 types per week	**1.322**	**0.036**
3 types per week	-	-
Exposure to sweet drinks		
2 type	**3.009**	**0.005**
1 types	**2.284**	**0.004**
0 types	-	-
Exposure to confectionary and savoury snacks		
4 types	0.850	0.554
3 type	-0.782	0.358
2 types	-0.362	0.699
1 types	0.258	0.745
0 types	-	-
Consumption of manufactured baby foods	0.134	0.850
Timing of introduction of lumpy foods		
Late (>8mo)	**5.194**	**0.025**
Early (4-6mo)	**4.118**	**0.003**
On time (6-8mo)	-	-
Responsive feeding		
No - fed on schedule	0.959	0.148
Yes - fed on demand	-	-

P values occurred after adjusting for maternal education, household income and maternal BMI status

Information on demographics and feeding practices was also collected. To the authors' knowledge, this study is the first to assess the quality of weaning diets in a UK sample using a validated instrument for the target population which considers multiple aspects of diet, as opposed to isolated food groups or methods. It's also the first study to associate diet quality with mothers' and child's behavioural, psychological and sociological aspects.

4.4.1 Study findings

4.4.1.1 Findings regarding dietary quality

The reported dietary quality was high for the sample. The participants achieved a great average diet quality score, and the vast majority of them scored in the two highest quintiles on the index. Index scores in this study are greater than those observed in a large UK cohort conducted in 1990 by Golley et al (mean index score of 0.48) (22). In Golley et al's study, low index scores were associated with short breastfeeding durations, untimely introduction of solids and frequent exposure to sugary drinks. In contrast, in the present study most participants introduced solid foods in compliance with the 6-month recommendation and reported a limited exposure to sweet drinks. In addition, Golley et al's research was conducted with a much greater sample size (6065 children) compared with our sample size of 466. Recruiting a greater sample might have resulted in greater variability in feeding practices and findings might have been more in line with those by Golley et al.

Even though the Complementary Feeding Utility Index provided a validated measure of dietary quality for the target population and hence, was considered appropriate for this study, its ability to highlight cases of low food diversity is limited. As the authors of the index point out, a total CFUI score is obtained by linear aggregation of the 13 component scores which assumes that all individual components are interchangeable. As previous qualitative data show, mothers demonstrated limited awareness for the importance of protein-rich complementary foods (45). In this way, if mothers taking part in the present survey didn't offer any protein-rich animal foods, they could still obtain a great total CFUI score if they scored high in the other 12 individual components of the index, which wouldn't indicate that there is a feeding practice calling for improvement. Future dietary quality assessment methods need to consider issues of food diversity as well as ways to highlight when diversity is compromised.

In this study dietary quality offered during weaning was predicted by mothers' self-efficacy in promoting healthy foods and in restricting non-recommended snacks. At the same time, mothers who were prompted by the NHS guidelines to introduce solid foods appeared to have a greater likelihood to provide their children with a diet that is compliant to the complementary feeding guidelines. In Golley et al's study total CFUI scores were associated with several demographic factors such as maternal age, education, marital status and BMI, whereas in this study, none of these characteristics were identified as significant predictors of dietary quality. Mothers in this study were mostly white, married, well-educated and from wealthy households; the lack of socioeconomic diversity in the present sample might be

responsible for the absence of association between demographic factors and the level of dietary quality offered. It would be advantageous for future cross-sectional studies to include larger, more diverse samples that will provide greater confidence in interpreting the results.

4.4.1.2 Findings regarding maternal self-efficacy

Study findings revealed high levels of maternal feeding self-efficacy for both sub-scales demonstrating that mothers in the sample perceived themselves to have good ability to encourage their children to eat a balanced diet and to restrict children's intake in unhealthy snacks. Apart from a relationship with overall dietary quality, study results showed that maternal feeding self-efficacy was also significantly associated with the consumption of specific food groups; there was a positive correlation with the variety of vegetables offered and negative correlation with exposure to sweet drinks. Mothers' self-assessment of their capacity of child feeding has been the focus of recent research on feeding behaviours whereby several studies found that high feeding self-efficacy is a significant predictor of healthier eating patterns (greater fruit and vegetables intake, lower consumption of snack foods) in infants and young children (3,5,46,47). Hence, the present findings validate the existing literature and add to the body of evidence supporting that mothers who perceive themselves to have good feeding skills can effectively foster a healthy diet for their children. It is suggested that there's further scope for work that will aim to confirm the relationship between maternal feeding self-efficacy and the overall quality of diet in early years and explain the link between the two.

4.4.1.3 Findings regarding reliance on NHS guidelines

The most influential source of information in this sample regarding feeding appeared to be mother's peers, whereas only a tenth of the sample quoted the advice from health professionals as very helpful. Irrespective of this, more than half of the participants based their decision to introduce solids on the NHS recommendation which was a predictor of timely weaning and offering a diet of great quality. It is not surprising that adherence to official recommendation predicts timely introduction of solids; good knowledge of the guidelines has been formerly associated with delayed weaning (40,48). Additionally, as the latest Infant Feeding Survey reveals, mothers who postpone introduction of solids to six months are more likely than those doing so earlier to have based their decision on formal information sources (15). The association between relying on the NHS guidelines and the level of dietary quality introduces an entirely novel insight into factors that can determine the quality of weaning diet, as this relationship has not been explored so far. It is possible that increased trust in the guidance on timing of weaning may be also correlated with good

awareness of the overall complementary feeding recommendations, which can in turn encourage positive feeding practices to ensure food variety and avoid unsuitable foods.

4.4.1.4 Findings regarding infant temperament

Aspects of children's temperament, as perceived by their mothers, have been correlated with several feeding practices. Results showed that infants who had a distress-prone temperament were more likely to be weaned from 6 months and not earlier. The opposite relationship was shown by Wasser et al where infants who showed more distress were introduced to solid food earlier (8). Rogers & Blissett on the other hand, revealed that the timing of introduction to solid food was not significantly related to infant distress levels, but associated with smiling and laughter, and mothers who rated their infants higher in smiling and laughter introduced solid food earlier (7). Hence, this study contradicts previous findings regarding distress and timing of weaning. A reason for this discrepancy might be that mothers who rated their children as easily distressed might have considered their frequent crying and fussing as an obstacle for a smooth transition to solids and might have postponed it as a result. Additionally, results showed that participants provided more fruit and vegetables to children who were more physically active. Two previous studies investigated the associations of infant temperament with specific groups and intake of obesogenic foods and drinks. In a Norwegian cohort, infants who were more surgent (social and active) were more likely to be given sweet drinks (49), whereas in an Australian cross-sectional study, mothers of infants with a more difficult temperament were more likely to use food to sooth (50). In light of the existing literature and present findings there is conflicting evidence regarding the role that infant temperament plays in shaping maternal feeding patterns. More studies are required to explore the relationship between different dimensions of child temperament and weaning practices.

4.4.1.5 Findings regarding maternal age and weight status

Participants' age and adiposity were not associated with overall diet quality offered to their children, but predicted some of the feeding practices. Older mothers weaned early, but avoided offering sweet drinks and unhealthy snacks. This may reflect a more relaxed attitude in following the 6-month recommendation with age, but good awareness of foods to avoid during weaning. Contrary to our results, previous UK data from 2010 revealed that older mothers introduced solids when their baby was older (15). However, the narrow age range of participants needs to be pointed out; most mothers were between 27-37 years old and there were no teenage mums in the sample. A wider range in maternal age would facilitate better exploration of how mother's age correlates to feeding patterns. Furthermore,

maternal BMI had a positive relationship with frequent exposure to confectionary and savoury snacks such as chocolate bars, crisps and sweets. A previous UK study supports the idea that heavier mothers are less likely to restrict the consumption of unhealthy snacks; its results showed that mothers with overweight and obesity had a less healthy home food environment compared with mothers with a healthy weight (51). Hence, it is suggested that mother's age and weight be taken into consideration by health professionals offering advice on weaning and motivate them to explain the reasons that unhealthy snacks should be avoided during weaning.

4.4.1.6 Findings regarding perceived social support

This study found a significant relationship between the level of social support and timing of weaning. Mothers who said they received great support from their immediate social network weaned earlier than those feeling less supported (prior to 6 months). Social support, as assessed in this study, addressed three important sources of emotional and practical support: family, friends and the significant other. Male partners hold an important role in the decision to initiate and maintain breastfeeding which has been well reported in previous literature (6,52,53), but there is paucity of research investigating their influence on the decision-making process regarding the timing of weaning. Additionally, the evidence shows that a close personal network can encourage women to delay the introduction of complementary foods (54). Former qualitative work shows that weaning advice from the immediate social circle is perceived as practical and helpful, but also as negative and pressurising. Advice from peers with experience in weaning a child is trusted and actively sought for (55-58). On the other hand, pressure from friends and family to introduce solids early (maternal grandmothers in particular) is documented in a number of qualitative studies (59-63). Participants in a study by Arden spoke of a 'competition among new mums to get their baby onto solids the quickest', indicating that having a strong network of peers can be influential to wean early (60). It is possible that maternal self-efficacy plays a role in this association, and mothers with lower self-efficacy might be more eager to seek feeding information from family and friends and to follow it, instead of forming their own feeding decisions. Overall, it appears that having a personal network of support can contribute to the decision regarding when to introduce complementary foods, but further research is required to understand the mechanisms through which this network influences infant feeding decisions and to discover ways to utilise social support to improve feeding practices.

4.4.1.7 Findings regarding the association between feeding practices and weight

There was a high prevalence of increased adiposity in the sample with one in five children being overweight or obese. It is not certain how this proportion compares to national UK data, as DNSIYC reports only the proportion of children that are above the 50th centile of the weight curve (14), whilst for this study children were classified overweight and obese if they were above the 91st and 98th centile respectively (28). Shorter breastfeeding duration was a significant determinant of increased body weight adjusted for age and gender, which is consistent with wider literature (24,64-66).

Overweight and obesity were also predicted by a feeding pattern characterised by frequent consumption of sweetened drinks and low variety of animal protein sources. Frequent exposure to drinks containing sugar has been formerly identified as a risk factor of child overweight, although findings are not consistent across studies (67). Regarding the role of protein-rich foods in relation to BMI, mixed findings have emerged from research. Even though total intake of animal protein is directly linked with growth in the first year (25,68), limited evidence exists on the effect of the variety of animal foods in relation to weight. A study that investigated protein intake of 2-year olds in the UK observed that a dietary pattern characterised by greater diversity in protein sources may confer a lower risk of excess weight gain (69); an observation that is in agreement with present findings. Different sources of protein may have varying effects on growth in the first years of life, which are not fully understood yet (69). The present study utilises a cross-sectional design, thus no conclusion can be drawn about the correlation of the variety of different protein types to weight later in childhood. Further research on this area is required to investigate whether the diversity in dietary protein sources is associated with body weight in infancy and later childhood and what is the possible mechanism.

Higher intake of vegetables was positively correlated to being in a higher weight class. This correlation is surprising, since high vegetable intake has been associated with lower risk of overweight (70). Previous analysis of dietary patterns during the first 1-3 years revealed that the average intake of vegetables of children with excess weight was significantly lower than the recommended amounts. In this study however, findings may reflect that children who ate vegetables ate generally more and therefore, had a more accelerated growth pattern. This however, remains unknown, as there were no information regarding children's overall dietary intake. Additionally, findings suggest that a transition from pureed to lumpy foods between 6 and 8 months may help maintain a healthy weight. The importance of an appropriate texture introduction during weaning for food acceptance has been highlighted

in previous studies (17,71). However, a direct link with children's growth pattern has not been yet explored.

Overall dietary quality in this study didn't seem to correlate to weight status contrary to what was previously demonstrated by Rios et al who observed that infants and toddlers who had diets of poor quality were more likely to have excessive weight (19). Golley and colleagues found no association between CFUI scores and BMI in a follow-up measurement they conducted when the ALSPAC sample was 7-8 years old (72). Comparing the present findings with those by Golley et al however, would not be relevant due to differences in study design. Contrary to ALSPAC which utilises large cohort data obtained through multiple follow-ups, the present study draws on cross-sectional data and therefore is unable to conclude any long-term associations between dietary quality in complementary feeding and weight status in childhood. Further research work is warranted to clarify how early feeding practices and dietary patterns contribute to the development of childhood obesity.

Additionally, this paper didn't reveal any associations related to the preparation method of complementary foods, whereas a study looking at commercial versus home-made foods showed that infants who were offered commercial were more likely to have an accelerated growth and higher adiposity (73). Presumably a bigger cohort sample would be more appropriate to investigate the presence and strength of this association.

4.4.2 Limitations

A number of limitations should be considered when reading this paper. This paper draws on cross-sectional data and as a result, it is impossible to establish any associations between maternal feeding practices and long-term outcomes in relation to children's eating behaviours or weight status. Given the study design it is also impossible to suggest any cause-and-effect links. On the other hand, attention should be drawn to the evidence supporting that food preferences are established during complementary feeding (74) and rapid weight gain during the first year may result to overweight later in life (75). Therefore, awareness of early determinants of good eating habits and of a healthy growth pattern, as identified in this paper, can be valuable.

Even though the recruitment approach managed to reach out to a large audience of mothers from all UK countries through various forums and organisations, the sample was in its majority well-educated, affluent and white; a major challenge of research with a self-selected sample. When comparing to the 2011 Census data for the UK population, 15-25% of which belongs to an ethnic minority group (Northern Ireland being an exception), it is evident that Black or Asian mothers or those of mixed ethnicity were underrepresented in

this study (a mere 3% of the sample) (76-78). Additionally, and based on the same statistics, approximately a quarter of the entire UK population has achieved a Level 4 qualification (e.g. university degree) and higher, whereas in the present study mothers with a university and postgraduate degree were three quarters of the sample. Absence of ethnic and demographic diversity in the sample limits the generalisability of the results and may be responsible for the lack of association between maternal demographic characteristics and feeding practices. Future studies need to consider different sampling approaches targeted towards different ethnicities and low-income households.

Participants reported their current feeding practices, but the timing of weaning was reported retrospectively, which might introduce recall bias; particularly for the participants with older children. It is envisaged however, that weaning would be a milestone for mothers and therefore its timing will be well-remembered and the associated bias minimal. In addition, since the information was collected online and the questionnaires self-administered, some of the questions might have been open to misinterpretation e.g. savoury snacks being misinterpreted as snacks marketed for babies (as opposed to adult snacks like crisps). Finally, the self-reported nature of the survey also increases the risk of social desirability bias, whereby mothers might have reported a 'desired intake' as opposed to the 'true intake' of their children (79).

4.4.3 Conclusion

Despite its limitations this study is a novel exploration of infant temperament, maternal social support, food neophobia, feeding self-efficacy and postnatal depression as potential correlates of maternal feeding practices; in particular dietary quality. In a sample of mostly white, well-educated mothers living in the UK good adherence to the complementary feeding recommendations was demonstrated indicating that their children received a weaning diet of high quality. Maternal reliance on the official weaning recommendations and self-efficacy in promoting healthy foods and limiting unhealthy ones were predictive of high dietary quality. The results also suggest that aspects of children's early temperament may influence the timing of introduction and the type of complementary foods, and future work should explore them as covariates of feeding practices. Children who are active appeared more likely to have a food pattern higher in fruits and vegetables. A more distressed temperament on the other hand was related to postponing introduction of solid foods until 6 months. Younger and overweight mothers are more likely to offer snacks that are high in fat, sugar and salt to their children. Finally, based on findings of this study perceived support from a network of significant others was associated with early weaning; further research is

required to identify ways that social environment may promote sub-optimal weaning practices.

This paper offers a number of important considerations for professionals involved in weaning education; a key one being the need to facilitate good awareness of the complementary feeding guidelines as a mean to promote better feeding patterns. Emphasis should be placed on supporting mothers to strengthen their confidence in feeding their child by equipping them with ideas on how to encourage the consumption of healthy foods and to avoid unhealthy snacks. Making younger mothers more aware of the health risks of unhealthy snacks during infancy can be beneficial to improve their feeding practices. Partners and close family should be integrated into weaning education to ensure compliance with the recommended timing of weaning. Moreover, this study provides researchers with directions for future explorations of determinants of dietary quality in weaning. Present findings are limited by the lack of demographic variation in the study population and are mostly pertinent to mothers of white ethnicity with high qualifications and income. Future projects need to explore further recruitment pathways to capture the practices of a more socioeconomically variant sample including mothers of ethnic minority groups as well as deprived households.

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Chapter 5: Gender differences in weaning practices in a UK sample of parents

5.1 Introduction

Interventions to prevent childhood obesity have taken a turn towards approaches that involve the whole family, as opposed to the children alone (1). This is due to the key role that parents play in shaping children's eating behaviours by providing a family environment where healthy meals and snacks can be available and positive food habits can be modelled (2). Through their feeding style (responsive or not) parents can also increase children's autonomy in determining frequency and amount of food provided (3). Therefore, researchers should consider both parents' contribution to children's eating habits, including that of fathers'. However, information on fathers' approaches with regard to children's eating habits remains understudied.

The available evidence, albeit scarce, indicates that fathers' practices and own eating habits can encourage the development of healthy dietary choices in children. Longitudinal studies have identified dietary and weight associations between fathers and their children (4-6). Walsh and colleagues identified positive correlations in the intake of fruit and sweet snacks in 317 father-child dyads, and the correlations lasted from 20 months to 5 years of age (4). Additionally, a cohort of 3285 families (Longitudinal Study of Australian Children) investigated how the self-reported weight status of fathers' of 4-year olds correlated to their children's adiposity when they were 8 years old (5). Authors concluded that paternal adiposity, but not maternal, was significantly correlated with their children's. The same study found that 4- and -5 years olds were more likely to be overweight if their fathers engaged in a permissive and disengaged parenting style; there was an absence of association with mothers (6).

Fathers' participation in mealtimes and child feeding is gaining increasing recognition. An analysis of a nationally representative sample of 10,403 men living in the US revealed that 96% of fathers living with their children share a meal with them every day or most days of the week (7). According to data collected from Australian fathers, 42% perceived that they were equally responsible with their female partners for organizing meals for their child and 60% for deciding if their child eats healthy foods (8). In the UK in particular, there is a slow but evident increase in fathers' involvement in child care and adjustments in the legal frameworks facilitate greater father involvement in parenting (9).

However, fathers are still underrepresented in research on childhood nutrition and mothers are the primary focus of recruitment approaches in this area. Indicatively, in a systematic review of 667 papers that examined the parental effect on obesogenic behaviours, fathers constituted only 17% of the overall sample size and a mere 10% of the selected studies reported father-specific data (10). Moreover, currently available data come from a limited number of observational studies with small samples of predominately well-educated affluent fathers (11). Thus, more high quality studies are warranted to increase understanding of fathers' feeding practices and to explore possible ways to foster healthy dietary choices during childhood.

In addition, fathers' feeding practices and their unique contribution to their children's diet, particularly during the critical period of complementary feeding have been largely overlooked. Therefore, increasing understanding of key determinants of fathers' feeding behaviours and exploring differences from mothers' feeding behaviours can guide future family-based lifestyle interventions.

5.1.1 Aim and objectives of this study

This chapter aims to investigate whether fathers' self-reported feeding practices during complementary feeding are different from that of mothers. The objectives of the chapter are:

1. To investigate differences between fathers and mothers in: a) the timing of introduction of solid foods; b) adherence to complementary feeding guidelines; and c) dietary quality offered.
2. To assess the same feeding practices in a sample of fathers and explore the strength of their association to a number of parental- and infant-related variables, while controlling for potential confounding factors.

5.2 Methods

This study is part of a wider survey on dietary quality in complementary feeding period in a sample of UK parents. The full protocol of the survey has been described in the previous chapter (Chapter 4). It draws on cross-sectional data collected through the online platform *Qualtrics*.

5.2.1 Recruitment

Targeted recruitment strategies were employed to involve fathers in the survey and to capture a large male sample from all UK countries. This included searching and getting in touch with father-specific groups on Facebook, parenting organisations and charities ('Fathers Network Scotland', 'Dads Unlimited UK' and others). After contact was established

with the administrator of these groups by email or telephone, the study information was posted online for the members to see and follow the link to start the survey. An established network of contacts in the university was also utilised to further disseminate the call for participation. Language used in the call for participation was modified to ensure it was appropriate for a male audience to encourage engagement of fathers. Eligibility criteria included living in the UK and being a legal guardian of a child who has been introduced to solid foods, where the child was younger than 18 months and has no former health conditions or food allergies.

5.2.2 Measurements

The study used the same data collection protocol and questionnaires as in the previous chapter. The outcome variables and covariates measured are described below.

5.2.2.a Dependent variables

The following feeding practices and perceptions were considered as dependent variables in this analysis.

1) Dietary quality offered during the complementary feeding age

The Complementary Feeding Utility Index (CFUI) was used as an indicator of the quality of weaning diets. Having been developed to measure compliance to the complementary feeding guidelines in the UK, the index has been validated for the study's population (12). The overall index score occurred after summing the individual scores of 13 components in relation to specific food groups (e.g. fruit and vegetables, confectionary, ready-made foods) and more general feeding methods (breastfeeding, responsive feeding, timing of lumpy foods). Total index score was measured in a continuous scale and took values from 0 to 1, with 0 indicating very low dietary quality and 1 very high.

2) Adherence to the complementary feeding guidelines

Adherence with the complementary feeding guidelines was assessed through the individual CFUI components. CFUI components took a limited number of values depending on how closely a feeding practice followed the relevant recommendation. These were transformed in ordinal variables that took three values: one for low compliance (when the score for this component was 0), high (when score was 1), and moderate (for any values in between). Additionally, the index components that had to do with the recommended intake of a specific food group provided a tool to assess dietary patterns offered by fathers.

3) Timing of introducing solid foods

The timing of introduction of solids was assessed as a dichotomous variable for weaning early and on time. Based on the UK Department of Health guidelines timely weaning was initiated

from 6 months onwards, while before this age was defined as early weaning (13). Furthermore, timing of weaning was explored as part of measuring adherence to feeding recommendations; participants were allocated to low, moderate or high adherence based on when they introduced complementary foods in their infant's diet.

4) Perceptions regarding complementary feeding

This category encompasses two variables: sources of feeding information that parents considered as most reliable and useful during weaning; and the main prompts to introduce complementary foods alongside baby milk and whether these were the official recommendation offered by the NHS.

5.2.2.b Covariates

Apart from demographic information and self-reported anthropometrics, a number of psychological, sociological and behavioural aspects were considered in this study as potential predictors of feeding practices. These included parents' food neophobia levels, perceived social support, their risk of presenting postnatal depression, and their self-efficacy in feeding their children. Regarding postnatal depression, it is estimated that around 10% of new fathers present relevant symptoms and several studies have used the Edinburgh Postnatal Depression Scale (EPDS) among male samples (14,15); the same scale was used in this study. Moreover, data was collected on aspects of infant temperament that have been previously explored as correlates of maternal feeding practices; activity levels, distress to limitation, and smiling and laughter.

5.2.3 Data analysis

Response sets with enough information to allow a total index score to be calculated for each participant were considered complete. Incomplete response sets were not included in the analysis.

Initially analysis aimed to explore differences between genders. For this purpose, a sub-sample of mothers (*N*=30), equal to that of fathers, was drawn from the overall female sample (*N*=466) participating in the survey. To ensure that there were no major socioeconomic differences between male and female parents, the sub-sample of females was matched with that of males. An initial comparison in demographic characteristics in the overall sample revealed gender differences in education attainment, but not on any other socioeconomic factors, and therefore the two groups were matched on education.

Descriptives of the study sample were provided for demographic and anthropometric characteristics, and for the covariates. Continuous variables were summarised by the mean and standard deviation (SD), and categorical variables by the total number and proportion

(N, %). Proportions for variables that contained missing values were expressed as valid percentages. Comparisons for every variable between genders are reported by the *Student's t* statistic and by Pearson chi-square (χ^2) for continuous and categorical variables respectively.

Regression analysis was also performed to identify potential predictors of fathers' feeding practices in the men-only dataset. Binary logistic regression investigated the independent association between covariates and timing of weaning. Linear regression tested the presence of associations with dietary quality that was assessed as overall CFUI score and was measured on a continuous scale after checking for normality. Ordinal regression was performed to investigate the independent relationship between the covariates and exposure to four food groups. A multivariate approach was followed for all regression models.

The significance level used for the interpretation of all statistical tests was set at $P \leq 0.05$. All analyses were performed with IBM SPSS Statistics 26.

5.3 Results

5.3.1 Gender-related differences in feeding practices during complementary feeding

5.3.1.a Sample characteristics

A total of 1062 parents followed the link to the survey, of which 674 were mothers and 57 fathers. The remaining responders didn't provide information on gender or didn't go as far as the question on gender. Complete responses came from 466 mothers and 30 fathers. The final sample included 60 participants including equal numbers of fathers and mothers.

Characteristics are presented in Table 5.A. In terms of ethnicity, one female participant was of mixed ethnic background; the remaining participants, both female and male, were white (98.3%). The average participant was 31 years at the time of the survey, had a child aged 11 months and was overweight (BMI ≥ 25 kg/m^2). The majority lived in England, was married, had a university degree and one child. All men but one had a male child, whereas women had equal number of male and female children (χ^2=20.317, P<0.001). There were no other differences between female and male participants in demographic and anthropometric characteristics.

Table 5.A Demographic and anthropometric characteristics of male and female participants and children

	Males, *N*=30		Females, *N*=30		Test statistics	
	Mean	(SD)	Mean	(SD)		
Participant age (y)	30	(6)	31	(4)	$t(57) = -0.533$	$P = 0.594$ [1]
Child age (mo)	11	(4)	11	(3)	$t(58) = 0.019$	$P = 0.985$ [1]
Participant BMI (kg/m^2)	27.59	(5.27)	28.11	(7.2)	$t(49) = -0.292$	$P = 0.767$ [1]
	N	(%)	*N*	(%)		
Child gender					**$\chi^2(1) = 20.317$**	**$P < 0.001$**
Boy / Girl	29/1	(96.7% /3.3%)	13/17	(43.3% /56.7%)		
Location of residence					$\chi^2(3) = 0.941$	$P = 0.816$
England	20	(66.7%)	21	(72.4%)		
N. Ireland	6	(20%)	4	(13.8%)		
Wales	3	(10%)	2	(6.9%)		
Scotland	1	(3.3%)	2	(6.9%)		
Marital status					$\chi^2(3) = 3.896$	$P = 0.273$
Single	2	(6.7%)	0			
Cohabiting	12	(40%)	10	(33.3%)		
Married	15	(50%)	20	(66.7%)		
Separated	1	(3.3%)	0			
Education					$\chi^2(3) = 0$	$P = 1.00$ [2]
GCSE's	8	(26.7%)	8	(26.7%)		
A'levels	3	(10%)	3	(10%)		
Undergraduate	13	(43.4%)	13	(43.3%)		
Postgraduate	6	(20%)	6	(20%)		
Number of children					$\chi^2(3) = 0.357$	$P = 0.949$
1 / 2 / 3 / 4 or more	21/6/ 2/1	(70%/20%/ 6.7%/3.3%)	22/6/ 1/1	(73.3%/20% /3.3%/3.3%)		
Household income					$\chi^2(4) = 2.859$	$P = 0.582$
Below 10K	2	(6.7%)	0			
10-20 K	3	(10%)	3	(10.3%)		
20-30 K	2	(6.7%)	4	(13.8%)		
30-40 K	5	(16.7%)	6	(20.7%)		
40-60 K	18	(60%)	16	(55.2%)		
Participant BMI category					$\chi^2(5) = 5.063$	$P = 0.408$
Underweight	0		3	(12.5%)		
Normal	8	(29.6%)	5	(20.8%)		
Overweight	10	(37%)	7	(29.2%)		
Obese	7	(25.9%)	5	(20.8%)		
Obese class II	1	(3.7%)	2	(8.3%)		
Obese class III	1	(3.7%)	2	(8.3%)		
Child BMI category					$\chi^2(3) = 1.272$	$P = 0.736$
Underweight	1	(3.8%)	1	(4%)		
Normal	15	(57.7%)	18	(72%)		
Overweight	7	(26.9%)	4	(16%)		
Obese	3	(11.5%)	2	(8%)		

Bold entries indicate significant differences in group odds (significance level $P < 0.05$)

[1] *P* values occurred with equal variances assumed (Significance value Levene's test > 0.05)

[2] Groups were matched for education status; hence *P* value is 1

Table 5.B shows the distribution of other variables that were assessed in the survey. These included self-reported levels of parental feeding self-efficacy, three dimensions of infant temperament, parental food neophobia, perceived social support and risk of postnatal depression. Perceived social support as a categorical variable has three levels: low, moderate and high perceived support, but the sample reported receiving only moderate and high levels of support. Analyses revealed absence of any significant gender differences in the above variables. Both fathers and mothers reported high levels of self-efficacy in promoting healthy foods and limiting unhealthy ones. Most of them were in low risk for postnatal depression, received high levels of support from their surrounding environment and were neutral in their willingness to try novel foods.

Table 5.B Other variables reported by male and female participants

	Males, *N*=30		Females, *N*=30		Test statistics	
	Mean	(SD)	Mean	(SD)		
Feeding self-efficacy in promoting a healthy diet	4.04	1.1	4.26	0.9	$t(58) = -0.813$	$P = 0.420$
Feeding self-efficacy in limiting non-core foods	4.26	0.7	4.09	0.9	$t(58) = 0.800$	$P = 0.427$
Infant activity	2.81	0.8	2.81	0.8	$t(53) = -0.018$	$P = 0.986$
Infant distress	2.67	0.8	2.63	1.0	$t(52) = 0.167$	$P = 0.868$
Infant smiling & laughter	4.00	0.7	3.72	0.8	$t(52) = 1.402$	$P = 0.167$
	N	(%)	*N*	(%)		
Food neophobia					$\chi^2(2) = 0.925$	$P = 0.630$
Neophilic	2	(6.7%)	1	(3.3%)		
Neutral	22	(73.3%)	25	(83.3%)		
Neophobic	6	(20%)	4	(13.3%)		
Social support					$\chi^2(1) = 0.157$	$P = 0.692$
Moderate	5	(16.7%)	6	(20.7%)		
High	25	(83.3%)	23	(79.3%)		
Postnatal Depression					$\chi^2(1) = 3.511$	$P = 0.061$
Yes	7	(25%)	2	(6.9%)		
No	21	(75%)	27	(93.1%)		

[1] Participants with FNS scores ≤(M-SD) were classed as neophilic, ≥M+SD as neophobic, and those with FNS values in between neutral.

[2] Total scale scores from 1-2.3 were considered as low support; 2.3- 3.6 as moderate support; and scores 3.6- 5 as high support. The sample reported receiving only moderate and high levels of support.

[3] Participants with a total EPDS score of 13 and above were considered to have postnatal depression.

5.3.1.b *Differences in compliance with recommended feeding practices*

Measurements of compliance with the complementary feeding guidelines were compared between men and women (see Table 5.C). Adherence to recommendations in relation to the timing of introduction of cow's milk and of lumpy foods, as well as meal frequency are not presented, as more than half of the values for these variables were missing.

No differences were observed between mothers and fathers on their adherence to the ten recommended weaning practices, assessed in this study. Majority of children were breast-fed for 6 months (50% for the male sample and 73% for female) and were introduced to solids in line with the 6-month recommendation (72% for male sample and 70% for female). The majority of parents offered two or more different fruits daily (male:73%, female:64%) and avoided offering sweet drinks (male:67%, female:77%) and caffeinated beverages (male:97%, female:93%) demonstrating good adherence to the recommendations for these food groups. Most parents offered 1-2 vegetables daily (male:70%, female:67%) and limited intake of confectionary and savoury snacks (male:48%, female:60%) demonstrating moderate adherence to the relevant recommendations.

5.3.1.c *Differences in perceptions relating to complementary feeding, age of weaning and quality of weaning diet*

Gender differences in feeding practices were explored further (Table 5.D). Analysis was performed to investigate useful sources of weaning information, the age of introducing solids and the overall dietary quality offered to the children. Results showed that the most trusted source of influence on complementary feeding, for both genders were people who had recently had children of their own. Almost half of men and women introduced solid foods at the timing that they did because of the NHS guideline. A third of them weaned earlier than 6 months and the average quality of diet offered by both fathers and mothers was very high (around 75%). No gender differences were found in these variables. A significant difference in adopting a baby-led approach to weaning was observed between genders, where mothers were more likely to let the baby lead the feeding process compared to fathers (χ^2=5.776, P=0.016).

Table 5.C Adherence to complementary feeding recommendations in male and female participants

	Males, *N*=30		Females, *N*=30		Test statistics	
	N	(%)	*N*	(%)		
Breastfeeding duration					$\chi^2(2) = 3.647$	$P = 0.161$
Good (≥6mo)	15	(50%)	22	(73.3%)		
Moderate (1-5mo)	6	(20%)	4	(13.3%)		
Poor (never)	9	(30%)	4	(13.3%)		
Timing of weaning					$\chi^2(2) = 0.983$	$P = 0.612$
Good (6mo)	21	(72.4%)	21	(70%)		
Moderate (4-6mo)	8	(27.6%)	8	(26.7%)		
Very poor (<4mo)	0		1	(3.3%)		
Exposure to vegetables					$\chi^2(2) = 0.360$	$P = 0.835$
Good (≥3 times/d)	7	(25.9%)	7	(25.9%)		
Moderate (1-2 times/d)	19	(70.4%)	18	(66.7%)		
Poor (0 times/d)	1	(3.7%)	2	(7.4%)		
Exposure to fruits					$\chi^2(2) = 3.382$	$P = 0.184$
Good (≥2 times/d)	19	(73.1%)	16	(64%)		
Moderate (1 time/d)	5	(19.2%)	9	(36%)		
Poor (0 times/d)	2	(7.7%)	0			
Variety in animal protein foods					$\chi^2(2) = 0.669$	$P = 0.716$
Good (≥3 types/wk)	10	(35.7%)	13	(46.4%)		
Moderate (1-2 types/wk)	13	(46.4%)	11	(39.3%)		
Poor (0 types/wk)	5	(17.9%)	4	(14.3%)		
Avoidance of sweet drinks					$\chi^2(2) = 2.276$	$P = 0.320$
Good (0 types/wk)	20	(66.7%)	23	(76.7%)		
Moderate (1-2 types/wk)	8	(26.7%)	7	(23.3%)		
Poor (3 types/wk)	2	(6.7%)	0			
Avoidance confectionary					$\chi^2(2) = 0.875$	$P = 0.646$
Good (0 types/wk)	13	(44.8%)	10	(33.3%)		
Moderate (1-3 types/wk)	14	(48.3%)	18	(60%)		
Poor (4 types/wk)	2	(6.9%)	2	(6.7%)		
Avoidance of commercial foods					$\chi^2(2) = 1.995$	$P = 0.369$
Good (0 times/wk)	8	(50%)	9	(75%)		
Moderate (1-11)	4	(25%)	2	(16.7%)		
Poor (≥12 times/wk)	4	(25%)	1	(8.3%)		
Avoidance of tea/coffee					$\chi^2(1) = 0.316$	$P = 0.574$
Yes	28	(96.6%)	28	(93.3%)		
No	1	(3.4%)	2	(6.7%)		
Adoption of responsive feeding					$\chi^2(2) = 2.926$	$P = 0.232$
Good (always)	5	(26.3%)	6	(46.2%)		
Moderate (sometimes)	8	(42.1%)	6	(46.2%)		
Poor (never)	6	(31.6%)	1	(7.6%)		

[1] P values occurred with equal variances assumed (Levene's Test significance value > 0.05)

Table 5.D Feeding practices of males and females during complementary feeding

	Males, *N*=30		Females, *N*=30		Test statistics	
	N	(%)	*N*	(%)		
Sources of weaning advice					$\chi^2(5) = 2.350$	$P = 0.799$
Health visitor	3	(15.8%)	2	(15.4%)		
Other health staff	0		1	(7.7%)		
Mother	1	(5.3%)	0			
Peers	8	(42.1%)	5	(38.5%)		
Books	2	(10.5%)	2	(15.4%)		
Websites	5	(26.3%)	3	(23.1%)		
Reliance on NHS guidelines as prompt to introduce solids					$\chi^2(1) = 1.071$	$P = 0.301$
Yes	14	(46.7%)	18	(60%)		
No	16	(53.3%)	12	(40%)		
Timing of introduction of solid foods					$\chi^2(1) = 0.042$	$P = 0.838$
≥ 6mo	21	(72.4%)	21	(70%)		
< 6mo	8	(27.6%)	9	(30%)		
Adoption of baby-led weaning (BLW)					**$\chi^2(1) = 5.776$**	**$P = 0.016$**
Only BLW	5	(26.3%)	9	(69.2%)		
Combined with spoon	14	(73.7%)	4	(30.8%)		
	Mean	(SD)	Mean	(SD)		
Overall dietary quality offered	0.74	(0.13)	0.78	(0.11)	$t(58) = -1.224$	$P = 0.226$[1]

Bold entries indicate significant differences in group odds (significance level $P < 0.05$)

5.3.2 Determinants of fathers' feeding practices

5.3.2.a Determinants of timing of weaning

Timing of weaning was one of the feeding practices assessed and was measured as a dichotomous variable for early weaning (before 6 months) and timely weaning (6 months onwards). A multivariate binary logistic regression model was performed including all the covariates that were measured in this study. The model adjusted for confounding factors identified in the relevant literature: parental age, marital status, educational attainment, household income and infant feeding method (breastfeeding or bottle). Based on the final model, as seen in Table 5.E, there is no evidence to suggest a significant association between age of weaning and food neophobia, feeding self-efficacy, social support, postnatal depression or infant temperament.

5.3.2.b *Determinants of dietary quality*

A multivariate linear regression model was used to examine independent associations between the covariates and dietary quality measured as CFUI score on a continuous scale, as shown in Table 5.F. After adjusting for participant age, marital status, education, household income and BMI category, the data showed that food neophobia, feeding self-efficacy, social support, postnatal depression or infant temperament were not significantly associated with dietary quality offered by fathers during complementary feeding.

Table 5.E Multivariate regression model with timing of weaning as dependent variable (N=29, Nagelkerke R^2=54%)

Covariates	B	OR	SE	*P* [1]
Food neophobia	-0.049	0.952	0.126	0.698
Feeding self-efficacy for promoting healthy foods	-0.666	0.514	1.135	0.557
Feeding self-efficacy for limiting non-core foods	-1.042	0.353	1.435	0.468
Social support	3.162	23.626	2.905	0.276
Postnatal depression	-0.097	0.907	0.189	0.606
Infant activity	-4.430	0.012	2.760	0.108
Infant distress	2.129	8.403	1.821	0.242
Infant smiling & laughter	0.400	1.491	1.164	0.731

[1] *P* values occurred after adjusting for participant age, marital status, education, household income and breastfeeding

Table 5.F Multivariate regression model with dietary quality as dependent variable (N=30, Adjusted R^2=29.3%)

Covariates	B	SE	*P* [1]
Food neophobia	0.006	0.004	0.180
Feeding self-efficacy for promoting healthy foods	0.050	0.041	0.252
Feeding self-efficacy for limiting non-core foods	-0.033	0.052	0.542
Social support	0.027	0.071	0.715
Postnatal depression	0.002	0.006	0.785
Infant activity	0.055	0.036	0.151
Infant distress	0.011	0.035	0.755
Infant smiling & laughter	-0.066	0.037	0.101

[1] *P* values occurred after adjusting for participant age, marital status, education and household income and BMI
Abbreviations: B=Unstandardised regression coefficient, SE=standard error of unstandardised coefficient B

5.3.2.c *Children's adiposity and fathers' feeding practices*

Analysis examined the differences in dietary quality and exposure to specific food groups based on children's weight. Children were classified into three groups: normal weight, overweight and obese based on their weight status, determined by growth curves for age and gender.

One-way analysis of variance (ANOVA) was performed to assess the levels of diet quality, as reflected by the overall CFUI scores measured on a continuous scale, for the three weight groups. Pearson's chi squared test assessed groups' exposure to vegetables, fruits, protein-rich foods, sweetened drinks and confectionary. The test statistics (*F* statistic for diet quality and χ^2 for exposure to different food groups) and levels of significance are presented in Table 5.G. There was no difference between the three groups of normal weight, overweight and obese children in the dietary quality they received and their exposure to the different food groups i.e. vegetables, fruits, animal protein sources, sweet drinks and confectionary.

Table 5.G Fathers' feeding practices based on children's weight status

	Normal weight (*N*=16)	Overweight (*N*=7)	Obese (*N*=3)		
	Mean (SD)	Mean (SD)	Mean (SD)	Test statistics	
Dietary quality	0.77 (±0.12)	0.76 (±0.10)	0.68 (±0.08)	$F(2)=0.800$	$P=0.462$
	N (%)	*N* (%)	*N* (%)		
Exposure to vegetables				$\chi^2(4)=1.837$	$P=0.766$
0 times/d	5 (33.3%)	1 (16.7%)	0		
1-2 times/d	6 (40%)	3 (50%)	2 (66.7%)		
≥3 times/d	4 (26.7%)	2 (33.3%)	1 (33.3%)		
Exposure to fruits				$\chi^2(4)=6.444$	$P=0.168$
0 times/d	0	1 (16.7%)	0		
1 time/d	5 (33.3%)	0	0		
≥2 times/d	10 (66.7%)	5 (83.3%)	3 (100%)		
Variety in animal protein foods				$\chi^2(4)=11.940$	$P=0.063$
0 types/wk	2 (26.7%)	1 (14.3%)	0		
1-2 types/wk	5 (33.3%)	4 (57.1%)	3 (100%)		
≥3 types/wk	6 (40%)	2 (28.6%)	0		
Exposure to sweet drinks				$\chi^2(4)=6.286$	$P=0.615$
≥3 types/wk	1 (6.3%)	1 (14.3%)	0		
1-2 types/wk	3 (18.7%)	1 (14.3%)	1 (33.3%)		
0 types/wk	12 (75%)	5 (71.4%)	2 (66.7%)		
Exposure to confectionary				$\chi^2(4)=5.170$	$P=0.739$
4 types/wk	0	1 (14.3%)	0		
1-3 types/wk	8 (53.3%)	2 (28.6%)	1 (33.3%)		
0 types/wk	7 (46.7%)	4 (57.1%)	2 (66.7%)		

5.4 Discussion

The present study adds to the small body of literature on paternal feeding practices by examining the potential predictors of complementary feeding practices in a sample living in the UK. It also provides a comparative exploration of maternal and paternal feeding practices. The findings suggest that there are no gender-differences in the timing of weaning, quality of weaning diet, and adherence to the weaning guidelines. Gender differences however existed in using a baby-led approach to weaning. To the authors' knowledge, this is the first study that measured the level of dietary quality provided by fathers during the complementary feeding period and aimed to identify determinants of their feeding behaviours from a pre-selected set of characteristics including food neophobia, feeding self-efficacy, social support, postnatal depression and infant temperament.

5.4.1 Key findings on gender-differences

This study revealed no gender differences in the adherence to complementary feeding guidelines including the recommended timing of solid introduction. Additionally, no differences were observed in the level of dietary quality that fathers provided compared to mothers. These results demonstrate that parents value the importance of complementary feeding recommendations irrespective of their gender and have the ability to provide a nutritionally balanced and diverse weaning diet. It is difficult to test the validity of these findings, as there is only a handful of studies comparing feeding patterns between mothers and fathers, and the majority of which have to do with the use of non-responsive feeding practices, such as restriction of food amount and pressure to eat (16-19). In an American study, mothers reported setting more limits in unhealthy snacking and ensuring better daily exposure to fruit and vegetables than fathers (18). Contrary to this, in the present study both male and female participants reported to offer a good availability of fruit and vegetables and to restrict consumption of sweet drinks and snacks. However, the children in the current sample are younger than children in the study by Hendy et al, which can partly explain the lack of consistency between findings. Fathers and mothers possibly engage in similar feeding behaviours through complementary feeding and start forming diverging practices after that. Qualitative work would prove useful in unravelling the perceptions of fathers and mothers with children in weaning age and older children. Ideally qualitative findings would be complemented by the analysis of cross-sectional data from large groups of parents following a stratification approach (males-females, younger-older children) that will allow comparisons in various weaning behaviours based on gender.

Results showed that a significantly greater proportion of mothers adopted baby-led weaning (BLW) compared with fathers. BLW is still a relatively novel approach to weaning (the term first appeared in literature in 2005 - (20)) and only a small number of studies exist in this area which are entirely based on female data (21). Qualitative interviews show that information on baby-led weaning is mostly acquired online from other mothers' experience, as opposed to advice from health professionals (22). Consequently, mothers' affinity to the method, and not fathers', may be attributed to a greater awareness of the method and actively seeking information about it. One additional reason for such relationship could be that the survey question on baby-led weaning did not provide a definition, and fathers who practised BLW might have been unaware of the term and so they did not report it. Fathers' preference to spoon-feeding, as opposed to baby-led, should not be viewed under a negative light, as it is currently unknown whether BLW holds any health benefits when compared with the traditional method of weaning (21). Nevertheless, it would be interesting to see whether future research would confirm gender differences of use of baby-led weaning and explain them.

5.4.2 Key findings on determinants of paternal feeding behaviours

This study also examined the relationships between a set of paternal and infant factors that may be linked with the timing of weaning and quality of diet provided. These factors included fathers' food neophobia, social support, infant temperament and feeding self-efficacy; none of these covariates however were found to be predictive of fathers' feeding practices. The absence of significant association between child temperament and fathers' feeding patterns is in line with a previous study by Haycraft & Blissett (23). The relationship between paternal feeding behaviours and food neophobia, social support and feeding self-efficacy has not been explored by previous studies, and, to the authors' knowledge, this is the first study that looked into it. It is possible however, that the absence of a relationship means that examining the same characteristics as with mothers is not relevant to father-focused research and that future studies should identify other characteristics to predict fathers' feeding practices. Conducting qualitative work with fathers, similar to work by Spyreli et al (24), to explore barriers and facilitators in providing a healthy weaning diet will help uncover correlates unique to them. These correlates can inform cross-sectional research and enable more appropriate regression models to predict paternal weaning behaviours.

Children's adiposity was not a determinant of the dietary quality they received and their exposure to specific food groups such as fruit, vegetables and unhealthy snacks. The existing evidence is inconclusive on whether an association between children's weight and fathers'

feeding patterns exists. High body mass index in childhood has been previously predicted paternal restrictions of food intake and pressure to eat (19,25-27); two studies though have found no relationship with fathers' practices (16,23). It is noteworthy that it has been previously reported that fathers of older children are more likely to monitor their children's food intake if they are concerned about their weight, compared with fathers of younger children (27,28). This might indicate that fathers of infants might not be mindful yet of how children's dietary intake is related to their weight, which would explain the current absence of association between children's weight status and fathers' practices. Additional studies on fathers' perceptions on children's weight in the first two years and their relationship with feeding patterns offered are needed.

Almost all men (96%) who completed the survey had a male child. This observation applied to all fathers who participated in the survey including those who submitted partially complete responses. This could suggest that fathers in the UK are more likely to get involved in their son's diet than their daughter's, although the small sample size doesn't allow great certainty in drawing this conclusion. The studies that have previously investigated the associations between child sex and fathers' feeding practices convey mixed results (16,17,19,28,29). Two studies that looked at the feeding styles of father-mother dyads showed that fathers engage in pressurising feeding behaviours more with male children than female (19,29). On the other hand, there are studies that found no significant associations between child gender and paternal feeding approaches (16,17,28). In conclusion, it is not clear whether fathers engage in feeding in ways that vary depending on child's gender, but it is certainly an area worth exploring further. Focus group discussions with an exclusively male sample can reveal conscious bias towards boys versus girls during feeding. This could be then followed by a survey that employs quota-sampling (i.e. recruiting equal numbers of fathers with male children to those with female); such design could enable identifying factors that drive paternal weaning behaviours in diverging ways that they are not aware of.

The sample of men in this study were in their majority married or co-habiting. Initially, authors falsely presumed that males who complete a survey regarding their children's nutritional intake would be the primary caregiver, due to their partners not being present. This is not the case with this sample and this might indicate that fathers are increasingly becoming more aware of their role as providers of food and models of eating behaviours. However, male participation in the survey was still low proportionally to female and father-driven data represented a mere 6% of the final complete set. On one hand paternal involvement in child feeding research has grown over the last years (10) and qualitative data

indicate that fathers consider child feeding well within their role (30). However, in the UK children are still likely to share a meal with their mums more frequently than with their dads (17) and mothers report a greater feeling of responsibility in child feeding compared to their male partners (16).

5.4.3 Study limitations

It is worth being mindful of limitations when considering the results of this study. Authors established contact with a number of parenting groups that targeted exclusively fathers in order to capture a sufficient male sample. Nevertheless, due to constraints in available time and resources to complete this study, the sample size was smaller than desired in order to ensure reliability of the statistical analysis. Capturing data from a greater number of fathers would allow greater confidence in interpreting the study results. This requires original and father-targeted approaches to recruitment and data collection, such as engaging fathers via male-only programs and at convenient times and locations for them (after work hours) (31). As in all studies with a focus on nutrition, this study's data are entirely based on self-report, which may be a potentially biased source of information about dietary intake, as well as children's weight. It would be advantageous if reported data were complemented with observation data, although this would prove difficult due to the limited time and resources.

Participants were white, and in majority well-educated and with good earnings. A more socially diverse sample could demonstrate greater variance in their feeding practices, particularly in the age of solid introduction, as previous data has shown (32). When it came to the comparisons between males and females however, matching between male and female participants minimised demographic differences that could account for differences in feeding practices.

Decisions on the choice of confounding factors for the statistical analysis were based on mother-focused research and therefore they might not have been relevant to a male sample. The lack of similar research can partly justify this decision. Finally, fathers' reports might not necessarily reflect their own feeding decisions, but practices already established by their female partners that fathers went on board with.

5.4.4 Conclusion and considerations for future research

Despite methodological limitations this study provides an unexplored insight into feeding practices employed by fathers during complementary feeding and comparing them with those of mothers. The study reveals that in a small UK sample of parents there are no gender-related differences in the age of weaning, the compliance with weaning guidelines and the dietary quality provided. Baby-led weaning is more popular among women, but the gender

differences in perceptions of the value of baby-led weaning remain unknown. Present findings validate existing literature and support that paternal feeding practices are shaped independently of their child's adiposity. This study's data point towards a greater paternal involvement with nutrition during complementary feeding when their children are male compared to female.

The present study adds to the previous work showcasing the marked increase in fathers' desire to be involved with their babies' diet and forms a basis for future cross-sectional studies. In view of the literature which underlines the importance of parental factors in forming feeding practices, future research should consider including larger and more socio-economically diverse samples of parents and employ a recruitment approach that is targeted to a male audience. Exploring paternal feeding practice further will help determine the unique contribution of fathers to establishing healthy eating behaviours during the critical stage of complementary feeding.

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Chapter 6: Discussion

6.1 Summary of findings

This project consists of three studies exploring parental perceptions, attitudes and practices relating to complementary feeding. Three different research methodologies were employed in order to approach the topic from different perspectives.

6.1.1 A systematic review of qualitative literature (Chapter 2)

Initially, a systematic review provided a synthesis of the existing qualitative evidence on parental perceptions and attitudes in relation to baby weaning practices in higher-income countries. Its conception was based on the growing number of published qualitative studies with findings on parental experiences during weaning. The value of a systematic review lay in bringing together those findings and offering a more comprehensive understanding of feeding behaviours across various populations around the globe. This process enabled a thorough investigation of the factors contributing to parental compliance to guidelines, as well as highlighting the common challenges parents are confronted with during weaning. Included studies varied in their analysis approach with some of them utilising more complex analyses than others. A framework synthesis was considered as an appropriate way to collate the individual findings. A range of factors emerged that affected either timing of weaning or type of food offered, or both.

The framework synthesis of this systematic review highlighted that the nutritional content of complementary foods and their health benefits or risks is a principal concern when choosing child's meals. Decisions on the type of foods are not always a product of evidence-based research, but of perceptions deriving from parents' cultural and religious background, as well as social norms. In regard to the available sources of information on child feeding, parents have a great exposure to grandmothers and healthcare professionals but with diverging views on their usefulness and credibility. With the inclusion of studies focusing on maternal experiences on baby-led weaning (BLW) the review offers an overview of the positive aspects and practical limitations of the method. The perception that an exclusively milk-based diet doesn't satisfy a baby is prevalent and strongly prompts parents to introduce solids before 6 months, as recommended by the World Health Organisation (WHO). Sceptical attitudes towards the applicability of universal guidelines for every child irrespective of their unique characteristics and anthropometry can provoke low compliance to the WHO guidelines on weaning.

6.1.2 A qualitative study (Chapter 3)

The second chapter reports on a qualitative exploration of views on food preferences, food diversity and feeding environment in a sample of 37 mothers living in Northern Ireland. Employing a thematic analysis, the study identified a number of maternal perceptions and feeding practices that have the potential to augment or compromise their efforts to shape healthy eating behaviours for their children. Mothers felt that role modelling of healthy eating and offering a repeated exposure to healthy foods, despite children's negative facial expressions, help foster a liking for healthier meals. The perception that a varied diet provides nutritional sufficiency and long-term health benefits, and prevents fussy eating, also motivates mothers to provide a diverse diet. However, the focus groups showed that mothers have a limited understanding of the definition of food diversity and have tendencies to avoid feeding foods that they personally don't like. These findings pose a challenge to providing a varied and balanced weaning diet which could subsequently have a negative impact on setting the foundation for future healthy food habits.

Additionally to providing novel insights into maternal views and perceptions during weaning, conducting this qualitative exploration proved valuable when progressing to designing a survey on mothers' weaning practices (Chapter 4). The qualitative approach uncovered characteristics unique to the target population that were used in the development of an appropriate survey questionnaire (1). In addition, experience gained during recruitment helped understand effective methods to engage with mothers and include them in quantitative research.

6.1.3 An online survey (Chapter 4 and 5)

The third study investigated feeding practices and dietary quality in a sample of parents living in the UK using a cross-sectional methodology. The results were analysed separately for fathers and mothers. Chapter 4 addresses the weaning practices of 466 mothers. Results showed that high feeding self-efficacy among mothers was associated with a weaning diet characterised by high quality, high intake of vegetables and low intake of sweetened drinks (fizzy drinks, squash and juice). Women who perceived their children as physically active offered a dietary pattern richer in fruit and vegetables than those who didn't. Younger and overweight mothers were more likely to offer unhealthy snacks (chocolate, sweets and crisps); young maternal age was also correlated with offering sweetened drinks. Gathering information on child weight allowed regression analyses that determined feeding practices that may contribute to overweight. Longer breastfeeding duration, low intake of sweet drinks, wide variety of animal foods and timely transition from purees to lumpy foods (at 6-

8 months) was associated with lower odds of overweight in the first 18 months of life. Mothers who base their decision to wean on the official recommendations, who have a narrow social network of support and a child that often cries or fusses were more likely to wean from 6 months than mothers who weren't prompted by the NHS recommendation, with a high level of social support and those with a child with low distress. Importantly, this study was cross-sectional and, therefore, only associations between feeding practices and maternal characteristics were inferred; no causal relationship was assumed.

The fifth chapter specifically focused on the differences in complementary feeding behaviours between fathers and mothers. Thirty fathers completed the survey and these were matched to the same number of mothers based on demographics. In the sample as a whole, parents adhered well to the weaning guidelines and provided their children with a diet of high quality. There were no gender-differences in dietary quality offered, or in the levels of compliance with individual complementary feeding recommendations, including the timing of introduction of solid foods. More mothers adopted a baby-led weaning approach compared to fathers. Fathers' characteristics including food neophobia, feeding self-efficacy, social support or postnatal depression were not predictive of their feeding practices. Child temperament and weight were not associated with paternal weaning behaviours, but the gender of the child was. Almost all fathers who took part in the survey had a male child; this can indicate that fathers of male children were more likely to take decisions in relation to child's diet compared to those with a female child.

6.2 Maternal factors that facilitate positive weaning practices

The findings of this work suggest that there are a number of mother-related factors that can shape their feeding practices during the first years of life and can encourage them to adhere to the feeding guidelines. The maternal perceptions and strategies shown by the qualitative study (Chapter 3) offer a practical guide for new mothers to provide their children with a healthy and diverse diet. Offering children multiple opportunities to taste a food, being uninfluenced by their expressions of distaste, and demonstrating healthy food choices during shared mealtimes, have been proved successful for the sample of mothers in this project. The quantitative literature supports the effectiveness and rationale of utilising these techniques (2-4). Furthermore, mothers who consider themselves capable of securing a varied nutrition for their children including nutrient-dense foods, such as fruit and vegetables, have a good level of feeding self-efficacy, which, based on the survey findings, is positively correlated to a weaning diet of high quality. Reinforcing the rationale for following approaches like the ones mentioned above may help mothers build up their confidence in

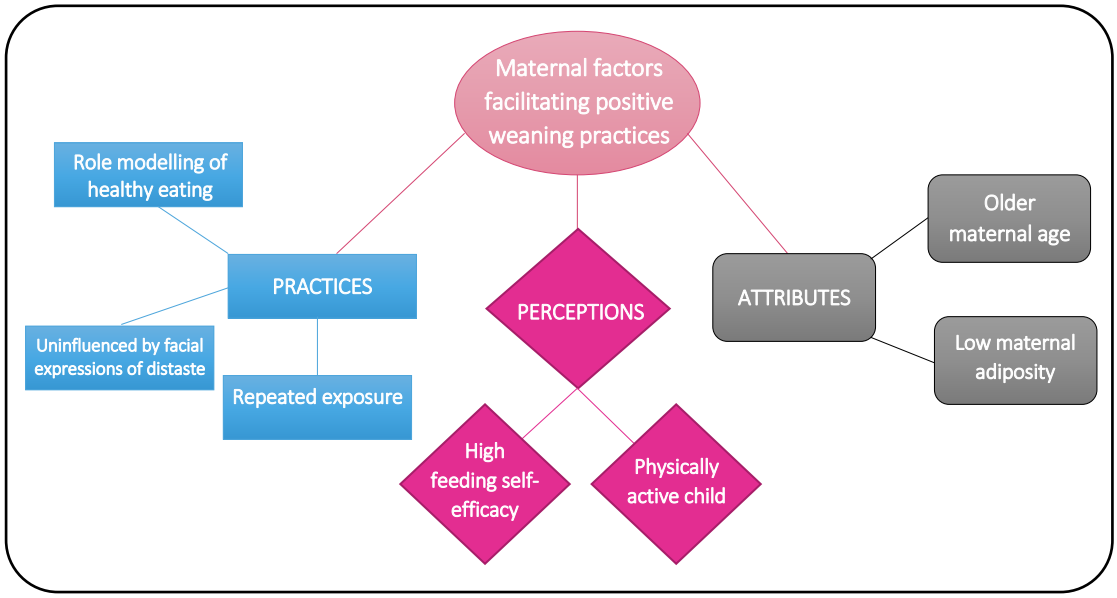
their feeding skills. Data from the systematic review (Chapter 2) further justify the use of repeated exposure to healthy foods as a way to gain familiarity to them and develop a liking with time. Repeated exposure has been shown to increase acceptance of some vegetables e.g. dark green or cruciferous, a food group that children innately reject due to their bitter taste (5).

The survey (Chapter 4) provided an opportunity to test the association between a number of mother and infant related attributes with positive maternal feeding behaviours. This study highlighted that the perception of having a physically active child can influence mothers' feeding practices and is related to offering a higher intake of fruit and vegetables. The survey also revealed that older and normal weight mothers demonstrate a good capacity of setting limits to non-recommended foods, compared to younger overweight mothers. The reason for this association needs to be explored along with other maternal attributes (e.g. relevant to nutritional knowledge) that mediate these associations. However, it could be that older mothers who have previously had children, or have had children later in life, may have greater experience and self-efficacy in weaning.

Findings from the survey, the qualitative project and the systematic review complement one another, so that an overarching conclusion can be drawn. This conclusion is in relation to maternal characteristics and attitudes that relate to positive maternal complementary feeding behaviours, and is illustrated by Figure 6.A. Specifically, findings of this overall project suggest that maternal age, adiposity, perception of own ability to feed a child and of child's temperament, as well as engaging in certain feeding behaviours, such as modelling and repeated exposure, are factors associated with positive weaning practices.

Moreover, qualitative data obtained in the project, both from the focus groups and the synthesis of literature, illustrate that mothers have a strong intention of providing a healthy diet for their baby and one that will secure their wellbeing. Independent of their nutritional knowledge, parents' primary consideration when choosing complementary foods is the health benefits (or potential health risks) associated with the consumption of these foods. This is also the case for parents who can't afford the financial cost of certain foods (fresh fruit, meat or organic produce), but are happy to pay it if they perceive the food to be an essential part of children's diet. The need to provide a top-quality diet is triggered by the belief that the period of complementary feeding offers a unique but brief window of opportunity when they have absolute control over their children's nutrition and when they can familiarise them with healthy foods so that children can develop their own healthy relationship to food when growing up.

Figure 6.A Attributes, perceptions and practices of mothers that act as facilitators of offering good dietary quality and diversity during weaning



6.3 Maternal factors that impede positive weaning practices

The current landscape of weaning education is formed by information received from a great variety of sources. The systematic review demonstrated the polarised views relating to feeding information from healthcare professionals and grandmothers. Mothers who were prone to seek information from their own mothers were teenage or younger mothers and those with strong family ties. Negative parental views from the above are owing to perceptions that the grandmothers' advice is out-dated and that are not in line with healthcare professional's instructions and the official guidelines. The survey illustrated that fathers and mothers found weaning information through peers and websites most helpful. However, the content of such websites is not necessarily evidence based or up-to-date and so the validity of information available online greatly varies (6). Furthermore, weaning education and guidelines have changed through the years and new evidence has emerged in the last decade to improve weaning practices. Due to their complexity and time-specific nature, weaning recommendations should be delivered by healthcare experts or other trusted sources who are familiar with the current evidence base and can communicate complex information in a simple manner. However, this research shows that there can also be a limited trust in advice from healthcare professionals. This, combined with the general overflow of information from all available sources, may create confusion and, as demonstrated by the systematic review, may reduce compliance with complementary feeding guidelines.

When considering factors that might influence maternal feeding behaviours this research indicates that it is worth considering mothers' own dietary behaviours and, in particular, their willingness to try novel foods or not i.e. food neophobia. Qualitative findings show that neophobic mothers may restrict access to foods they have an aversion to and, as a result, compromise the food variety fed to the child. When this hypothesis was tested in the survey, the level of food neophobia or neophilia was not associated with the dietary diversity offered to their children. However, only a small proportion of mothers were classified as neophobic, which might account for the non- association. Future cross-sectional studies with similar numbers of neophobic and neophilic parents should explore differences in children's dietary intake based on parents' own food aversions.

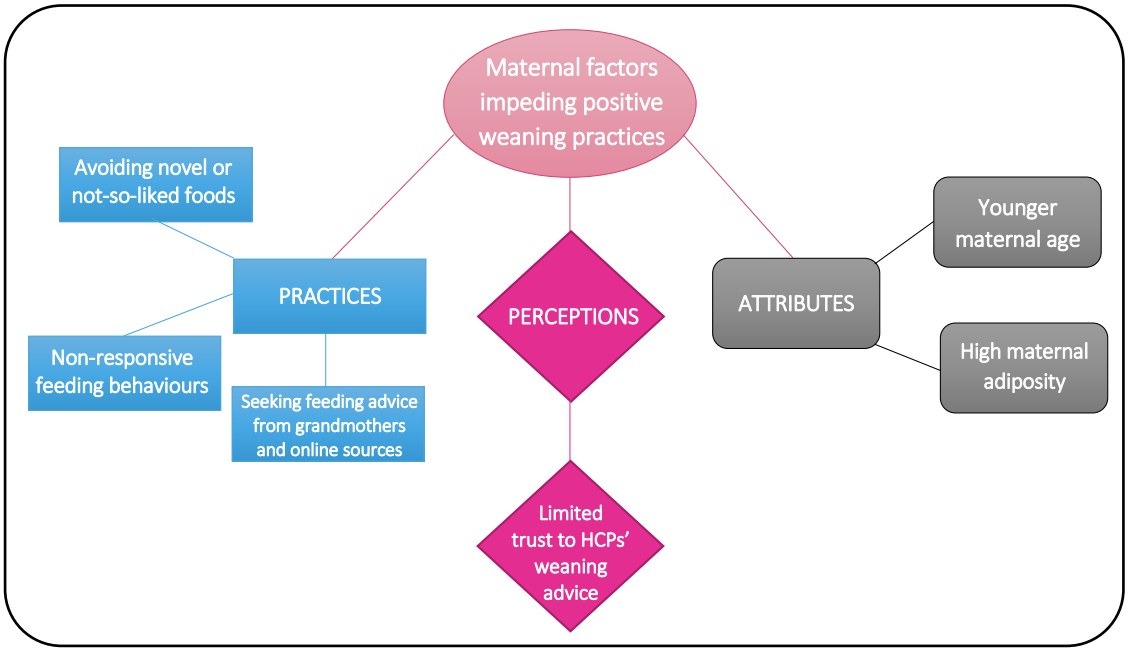
The systematic review showed that coercive feeding behaviours and feeding on schedule are common parental practices. Feeding to sooth is prompted by several parent and infant characteristics including an infant growing quickly, disrupted sleep pattern and parents' own views on appropriate food portion sizes; all of which can lead to overfeeding. In the survey, non-responsive feeding practices were not correlated with increased adiposity at the weaning age. Although the effects of responsive feeding in the first years of life are not fully understood yet (7), the long-term mismatch of parental feeding to hunger cues may lead to positive energy balance and increased BMI in childhood (8).

Overall, limited trust to advice from health providers in conjunction with high perceived value in other sources of potentially out-of-date, non-evidence-based weaning advice, being non-responsive to child's appetite cues and maternal food neophobia were highlighted in this research work as factors that can pose a barrier to forming positive weaning practices. Figure 6.B provides a schematic representation of these factors categorised as perceptions and practices. The figure also includes younger maternal age and high adiposity as attributes that correlate to non-recommended feeding behaviours in a reverse association to that illustrated in Figure 6.A.

6.4 Understanding and following the complementary feeding guidelines

The systematic review explored mothers' attitudes towards, and awareness of, the World Health Organisations guidelines in relation to the timing of weaning. Mothers report good awareness of the guidelines, but often negative attitudes towards them, as those were perceived to be inflexible and reflective of a one-size-fits-all approach. Instead, mothers are prompted by infant-related signals to introduce solid foods; such signals include baby showing interest for their food, signs of hunger and bad sleep patterns.

Figure 6.B Attributes, perceptions and practices of mothers that act as barriers of offering good dietary quality and diversity during weaning



By quoting these signals mothers justify introducing solid foods earlier than 6 months. Contrary to this finding, the official recommendation on the appropriate age of weaning is a compelling prompt for women living in the UK, as demonstrated in the survey. Basing the decision to wean on the official recommendation predicts weaning on time, as well as higher scores of dietary quality. This means that women who introduce complementary foods based on the relevant guideline, are more likely to offer a feeding pattern that adheres to a number of feeding recommendations. These recommendations have to do with intake of essential and non-recommended food groups (fruits and vegetables, confectionary and tea), as well as appropriate or non-recommended feeding practices (timely introduction of cow's milk, responsive feeding). This original finding indicates that mothers who are compliant to the 6-month recommendation, are more likely to comply with other complementary feeding recommendations. This relationship might go further than complementary feeding to include mothers' high adherence level to other public health guidelines (avoidance of smoking, physical activity etc). To conclude, adhering to the official recommendations on weaning holds benefits in relation to providing a safe and nutritionally sufficient diet, and health providers need to emphasise these benefits, particularly to mothers with a sceptical attitude towards the recommendations.

6.5 Recommendations for health visitors and other health professionals who deliver weaning education to parents based on current findings

This work flagged the difficulties that health providers come up against as part of their educational work. By suggesting 6 months as an appropriate age for introduction of solids they can come across as inflexible and rigid and as inconsiderate of the unique nutritional requirements of every child. On the other hand, if healthcare professionals deviate from the weaning recommendations (e.g. suggesting earlier food introduction for management of reflux), their advice is perceived as not trustworthy and is dismissed. Additionally, the systematic review highlighted that, despite their professional expertise and knowledge of the relevant evidence base, the credibility of healthcare professionals is automatically compromised, if they haven't had personal experience with weaning.

It is acknowledged that there is an ever growing body of evidence around infant nutrition and complementary feeding that health providers have to stay on top of. Additionally, communicating the weaning guidelines and practical recommendation in a way that conveys the rationale behind them requires continuous professional development amongst health professionals. Evidence-based strategies that are conducive to food acceptance over-time, such as repeated exposure, also need to be a part of the weaning education, as well as barriers to such strategies, including food waste which mothers will want to avoid.

Consequently, the role of health visitors and other health professionals tasked with the delivery of weaning education can be quite challenging. This research aimed to provide an updated, parent-driven insight into ways to improve weaning education and address some of these challenges. Comprehensive, straightforward and easy-to-understand information should be delivered to all mothers irrespective of their previous experiences with weaning. Mothers' personal circumstances should always be taken into consideration. Their cultural background and religion may influence their views on health and diet and, thus, their feeding approaches with children as well. Some individual characteristics might make them more vulnerable to information from other sources; younger mothers and those living away from their country seem more likely to consult their mothers on weaning and potentially end up following out-dated, non-recommended feeding strategies. Ultimately, a focus on enhancing maternal self-efficacy is warranted to increase mothers' confidence in the weaning guidelines, tackle reasons for weaning other than hunger, as well as addressing barriers to trust in healthcare professionals.

The importance of following the official feeding guidelines and the risks associated with low compliance should always be explained as part of complementary feeding guidance. In the

case of family history of food allergy, it is crucial that thorough information be collected, and attention be drawn to the types of foods they need to include (or to avoid) and the appropriate timing they should do so. Information on complementary feeding practices should be complemented with practical tips for every-day nutritional challenges e.g. securing food variety, dealing with food refusals. Finally, involving fathers and familiarising them with the complementary feeding recommendations should be an essential element of weaning education. Particular attention needs to be drawn in engaging fathers of female children, as findings of this research show that fathers of male children tend to be more involved in their children's diet.

6.6 Strengths

Each study in this thesis has informed the next and all four chapters addressed gaps in the literature. No previous qualitative exploration has identified a set of specific opportunities and challenges to foster healthy eating habits during weaning. Even though the systematic review builds on work of previous reviews (9,10), it provides an updated and more comprehensive synthesis of the evidence published after the latest review (10). The novelty of the survey lies in the use of a composite index of assessing quality of the overall diet, as this was determined by the inclusion of food groups, as well as the feeding approaches mothers engaged in. The survey also provides an original comparative analysis of paternal and maternal feeding practices. Most former studies are focusing on parental feeding practices during childhood, and this further emphasises the unique contribution of this project. Parental feeding practices in the first years of life, and in particular from the first time that solid foods are fed to 18 months, remain largely underexplored.

Triangulation techniques were employed when possible to enhance trustworthiness of this research and to increase its methodological rigor. During the systematic review, two researchers worked independently on study selection during the abstract screening stage to ensure that all identified studies that met the eligibility criteria were included. The qualitative data analysis (coding and organising codes under overarching themes) was also performed by two investigators and achieved a high level of inter-rate reliability.

Primary data were collected for two of the studies, the qualitative exploration and online survey. Participant selection was a product of a diligent recruitment approach. Seeking participants for the qualitative study was based on a thorough search for gatekeepers and on face-to-face interaction with mothers to whom the value of participating in the study was explained. Recruitment also targeted a variety of locations within Belfast. As a result, the final sample of mothers greatly varied in educational attainment, financial circumstances and

marital status and therefore the focus group discussions elicited a rich set of information. Additionally, the endpoint of data collection was established after achieving information saturation. These realisations increase confidence that the conclusion of this exploration resonate with most women irrespective of their socio-economic background.

6.7 Limitations

Capturing a greater sample would be advantageous particularly in terms of male participation. Participants were mostly white, affluent and with good education. Low educational attainment and household income have been previously associated with inappropriate feeding practices (suboptimal dietary diversity, consumption of non-recommended foods) (11-13). Thus, lack of demographic diversity can compromise the generalisability of the survey findings for the more socially deprived parents.

Additional limitations should be considered when interpreting this project's findings. Results are derived through self-reported information which is shown to be susceptible to social desirability bias i.e. the tendency to respond in a manner consistent with expected norms (14). The confidential nature of the research conduct was emphasised to participants, in order to increase accuracy of the reported information. However, more objective data collection methods are available (e.g. observation during feeding) and would ideally be used to eliminate recall and social desirability biases. Moreover, the qualitative and cross-sectional designs employed in this project prevent inferences regarding a causal relationship with parental feeding behaviours. Findings however, may suggest associations that can be subsequently tested bearing in mind the lessons learnt through this project.

This project is more of an exploration of maternal factors rather than those relating to fathers. The review identified and included only two studies with an exclusive focus on paternal experiences during weaning. Additionally, in Chapter 5, only 30 fathers provided complete data in a survey of 502 participants. Consequently, the present manuscript is more relevant to mothers and it can only postulate a direction for future father-focused research.

6.8 Directions for future research

Parents are the gatekeepers of children's nutrition, and those that can set the ground for establishing long-lasting positive eating habits. Therefore, research on complementary feeding should be parent-focused and parent-driven. It is hoped that findings emerging from this project will enable researchers to approach the subject with a fresh view, and will suggest to them hypotheses to test and pitfalls to avoid when employing the following study designs:

- Qualitative studies. Researchers engaging in qualitative research should increase transparency of their work by adhering to standards of reporting qualitative research, as discussed in the systematic review of this project. Additionally, it would be useful if they provided information on socioeconomic profile and family status of their participants, so that readers can have a better grasp of the context within which the results emerged.
- Cross-sectional studies. Cross-sectional research that seeks to further examine and confirm the relationship between infant and parent correlates with feeding behaviours need to target more demographically diverse audience. Gathering large samples of parents who vary in educational, financial and marital status would increase researchers' confidence in interpreting their results.
- Interventions. After establishing consistent associations through cross-sectional data, the design of good-quality trials to improve weaning practices is the next step. Present findings can be used to inform educational interventions in areas of complementary feeding that parents find most challenging. Furthermore, this project points towards the importance of feeding self-efficacy in shaping weaning behaviours. Future work should examine pathways to increase parental feeding self-efficacy, and confirm its role in providing dietary quality during complementary feeding.

The role of fathers during weaning has not been fully elucidated due to paternal underrepresentation in research. Inclusion of fathers in qualitative and quantitative research looks promising in determining how fathers can contribute to healthier eating behaviours. Gender differences in parents' perceptions and feeding practices can be examined only if sufficient numbers of both mothers and fathers come forward. Researchers aiming to capture information from a male audience should utilise new recruitment routes and test different correlates from those in mothers' research.

6.9 Conclusion

This project identifies a variety of parental considerations when weaning a child, and sheds light into their role in shaping their feeding behaviours. This was achieved throughout the course of three studies which: 1) reviewed the existing qualitative evidence on parental experiences during complementary feeding in developed countries; 2) obtained qualitative information from a sample of mothers living in Northern Ireland; and 3) analysed cross-sectional data on feeding practices of parents across the UK.

Parental considerations during complementary feeding vary in nature and can be categorised as practices (e.g. repeated exposure to healthy foods), perceptions (e.g. feeding self-efficacy), and characteristics (e.g. age, adiposity). This manuscript presents how these parental perceptions, practices and attributes (collectively named as 'factors') influence their feeding behaviours and more specifically are related to a healthy and diverse weaning diet, or alternatively to non-recommended weaning practices. High maternal efficacy in feeding, role modelling of eating healthy and repeated exposure to nutritious foods are considered facilitators of engaging in positive complementary feeding practices. Younger and normal weight mothers and those who perceive their child as physically active are more likely to offer an eating pattern high in fruit and vegetables and avoid unhealthy non-recommended foods. On the contrary, factors that are considered barriers to a balanced weaning diet include mothers' avoidance of foods, non-responsive behaviours, and limited trust to feeding information from health providers. The last barrier is linked with the search for advice from others sources, whose content has not been assessed for validity.

The value of this research extends to primary health implications and its contribution can be summarised as follows: providing a comprehensive evaluation of complementary feeding behaviours and identifying common domains of weaning that parents struggle with; equipping public health professionals (paediatricians, health visitors and general practitioners) with a comprehensive list of suggestions for an improved weaning education; and proposing parental perceptions, characteristics and practices for future studies to target to improve complementary feeding.

6.10 References

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Appendices

Appendix 1 – Supplementary material of Chapter 2: A systematic review of qualitative evidence

Table 0.A Characteristics of studies included in the systematic review

Study No	Study ID	Country	Specific eligibility criteria	Caregivers' gender (F/M)	Caregivers' age (y) (M±SD, range)	Children's age (M±SD, range)	First-time parents (*N*)	Sample size (*N*)	Sampling method	Data collection approach	Data analysis approach
1	Anderson 2001	UK	Female, Delivered locally	F	27 ± 4.8	13 ± 4.2 w (8 – 18)	22	29	Purposive	Focus groups	Thematic
2	Anderson 2010	USA	Male, WIC income eligibility	M	21 – 57	3 – 6 mo	10	21	Purposive, Snowball	Phone interviews	Thematic
3	Arden 2010	UK	Not reported (N/R)	F	32.3 ± 4.51 (22 – 45)	80 ± 38 w (26-155)	N/R	105	Purposive	Individual interviews (via email)	Content
4	Arden 2015	UK	BLW parents	F	29 – 39	9 – 15 mo	12	15	Purposive	Individual interviews (via email)	Thematic
5	Beck 2018	USA	Low income [1], Latino parents	F & M	31.9	11.6 mo	N/R	26	Purposive	Individual interviews	General inductive
6	Boak 2016	Australia	Taking part in *Splash!* cohort	F	20 – 43	4 – 15 mo	11	32	Purposive	Individual interviews	Thematic content
7	Bramhagen 2006	Sweden	N/R	F	20 – 42	0.8 – 1.3 y	4	18	Purposive	Individual interviews	Content

Abbreviations: y=years, w = weeks, mo = months

[1] Study recruited from clinics that serve low-income populations – not a specific inclusion criterion

Table 0.A (Continued)

Study No	Study ID	Country	Specific eligibility criteria	Caregivers' gender (F/M)	Caregivers' age (y) (M±SD, range)	Children's age (M±SD, range)	First-time parents (*N*)	Sample size (*N*)	Sampling method	Data collection approach	Data analysis approach
8	Brown 2013	UK	Female, BLW parents	F	28.6 ± 5.62	12-18 mo	N/R	36	Purposive, Snowball	Individual interviews	Content/ Thematic
9	Cameron 2012	New Zealand	Female, BLW parents	F	N/R	8-24 mo	N/R	20	Purposive, Snowball	Individual interviews	Content
10	Caton 2011	UK	N/R	F	28.5 ± 1.2 (20 – 36)	58.4 ± 4.2 w (34 – 76)	N/R	13	Purposive	Individual interviews	Thematic
11	Cheney 2019	USA	Low income, Latino	F	18 – 40	<2 y	N/R	19	Convenience	Focus groups	Codebook analysis
12	Dutta 2006	Brazil, Jamaica, Mexico, Panama	Low income	F	N/R	6 – 24 mo	N/R	79	Random, Purposive [2]	Individual interviews	Thematic
13	Heinig 2006	USA	Female, WIC participants	F	24.6 ± 6.4 [3] 29.1 ± 5.8	7 ± 2.3 mo [3] 7.6 ± 2.2 mo	23 [3] 34	64 (27-37)[3]	Purposive	Focus groups	Thematic
14	Horodynski 2007	USA	Enrolled in Medicaid	F	17 – 41	3 w – 12 mo	1/3 of sample	23	Purposive, Snowball	Focus groups	Content / Thematic
15	Horodynski 2012	USA	Female, Native American	F	19 – 56	0 – 12 mo	N/R	42	N/R	Focus groups	Content / Thematic
16	Horodynski 2014	USA	Female, Low-income, Adolescent, First-time mum	F	15 – 19	0 – 12 mo	16	16	Purposive	Focus groups	Content / Thematic

[2] Random sampling in Brazil and Mexico and purposive sampling in Jamaica and Panama

[3] Samples split into English- and Spanish-speaking participants; characteristics given respectively

Table 0.A (Continued)

Study No	Study ID	Country	Specific eligibility criteria	Caregivers' gender (F/M)	Caregivers' age (y) (M±SD, range)	Children's age (M±SD, range)	First-time parents (*N*)	Sample size (*N*)	Sampling method	Data collection approach	Data analysis approach
17	Jessri 2015	Canada	Female, Middle Eastern	F	25.5 ± 10.0	3 – 11 mo	N/R	22	Purposive, snowball	Focus groups	Thematic
18	Kavanagh 2010	USA	WIC participants	F [4]	>18	0 – 6 mo	N/R	109	Purposive	Focus groups	Thematic (Grounded Theory)
19	Lee 2015	USA	Chinese descent, New York resident	F	21-40	<12 mo	11	22	Snowball, Convenience	Individual interviews	Thematic
20	Leung 2017	UK	Female, Chinese ethnicity, London resident	F	M: 36	<12 mo	8	10	Purposive	Individual interviews	N/R
21	Lindsay 2008	Brazil	Female, Low-income, Enrolled in PACS/PSF	F	M: 28 19 – 49	12 – 36 mo	N/R	41	Purposive	Focus groups	Content / Thematic
22	Merriman 2013	Ireland	Enrolled in *Growing Up in Ireland* study	F & M [5]	M: 32 M: 36 [6]	9 – 11 mo	41	122	Purposive, Stratified	Individual interviews	Thematic
23	Monterrosa 2012	Mexico	Female	F	25.9 ± 5.3 (18 – 37)	12.4± 4.1 mo (5 – 18)	N/R	29	Strategic, Convenience	Individual interviews	Thematic
24	Nielsen 2013	Denmark	Female, Youngest child 7 or 13 mo	F	N/R	7 & 13 mo	N/R	45	Purposive, Stratified, Snowball	Focus groups	Thematic

[4] Males were also recruited in the study, the sample however consisted predominately of females (105/109)

[5] Both parents were interviewed in 71.3% of cases, mothers were considered as the primary caregiver in most of them

[6] Mean ages are given for primary and secondary caregivers respectively

Table 0.A (Continued)

Study No	Study ID	Country	Specific eligibility criteria	Caregivers' gender (F/M)	Caregivers' age (y) (M±SD, range)	Children's age (M±SD, range)	First-time parents (*N*)	Sample size (*N*)	Sampling method	Data collection approach	Data analysis approach
25	Nielsen 2014	Denmark	Female, Youngest child 7 or 13 mo	F	M:31 (21 – 41)	7 & 13 mo	25	45	Purposive	Focus groups	Thematic
26	Redsell 2010	UK	3 sites with high risk of obesity and 1 with low	F [7]	30.1 ± 6.28 (19 – 45)	M: 5.51 mo (1 – 11)	N/R	38	Purposive	Focus groups	Thematic
27	Rodriguez-Oliveros 2014	Mexico	Female	F	M: 27.9	< 2y	N/R	12	Purposive	Food-attributes exercises	Thematic
28	Russel 2016	Australia	Female, No university degree	F	29 ± 8 (21 – 38)	6.5±4.5 mo (2 – 11)	15	29	Purposive, Snowball	Phone interviews	Thematic
29	Savage 2016	USA	Female, WIC participants, Formula feeding	F	25.6 ± 6.1 (19 – 43)	< 2y	N/R	68	Purposive	Focus groups & Phone interviews	Thematic
30	Schwartz 2013	France	Female	F	32.2 ± 4.0 (25.2–39.2)	7.4 ± 3.2 mo (3 – 14.3) [8]	8	18	Convenience	Focus groups & Individual interviews	Thematic
31	Spyreli 2019	UK	Infants 3-14 mo at recruitment	F	30.3 ± 6 (19 – 39)	7.7 ± 3 mo (3 – 16)	16	37	Purposive, snowball	Focus groups	Thematic

[7] Males were also recruited in the study, the sample however consisted predominately of females (36/38)

[8] Children's age originally reported in days (220.6 ± 96.9 days (89 – 429)

Table 0.A (Continued)

Study No	Study ID	Country	Specific eligibility criteria	Caregivers' gender (F/M)	Caregivers' age (y) (M±SD, range)	Children's age (M±SD, range)	First-time parents (*N*)	Sample size (*N*)	Sampling method	Data collection approach	Data analysis approach
32	Synnott 2007	Germany, Italy, Spain, Scotland, Sweden	N/R	F [9]	N/R	<12 mo	46	109	Convenience	Focus groups	Content / Thematic
33	Thullen 2016	USA	Parenting dyads	F & M	N/R	23.1 ± 11.4 mo	8	24 dyads	Purposive	Individual interview	Thematic
34	Tully 2019	Island of Ireland	Disadvantaged families	F [9]	M: 30 (16 – 47)	M: 8 mo (3 – 18)	N/R	83	Purposive	Focus groups	Thematic
35	Van der Merwe 2007	South Africa	From all language groups	F	20 – 30 (the majority)	6 – 12 mo	N/R	64	Purposive	Focus groups	Thematic
36	Walsh 2015	Australia	Female, First-time mum	F	N/R	6 – 12 mo	21	21	Purposive, Convenience	Focus groups & Individual interviews	Thematic (TPB)
37	Yue 2016	China	N/R	F	N/R	6 – 18 mo	N/R	60	Random	Individual interviews	Thematic

[9] Males were also recruited in the study, the sample however consisted predominately of females

Table 0.B List of studies not included in the systematic review on the basis of full text

	Study ID	Primary reason for exclusion	More information
1.	Abel et al, 2001	Year of study	Focus groups before 2001
2.	Aidarous & Ahmad, 2016	Full text not available	
3.	Andrews et al, 2015	Study design	Qualitative evaluation of intervention
4.	Babington, 2006	Age of participants' children	Lack of clarity in the paper – author uncontactable
5.	Babington, 2007	Age of participants' children	Birth – 6y
6.	Bentley et al, 2017	Study doesn't discuss weaning	
7.	Brotanek et al, 2009	Age of participants' children	Birth – 4y
8.	Brown & Lee, 2011	Focuses on breastfeeding	
9.	Cameron et al, 2011	Full text not available	
10.	Carstairs et al, 2017	Age of participants' children	Birth – 4y
11.	Chen, 2010	Study doesn't discuss weaning	
12.	Cheresheva, 2015	Criteria RE participants not met	It is a presentation of pre-posted online narratives
13.	Cidro et al, 2014	Study design	Qualitative evaluation of intervention
14.	Condon et al, 2015	Participants not the primary caregivers	Mothers and grandmothers
15.	Cricco-Lizza, 2006	Focuses on breastfeeding	
16.	Culhane-Pera et al, 2002	Full text not available	
17.	Dodgson et al, 2002	Focuses on breastfeeding	
18.	Du Plessis et al, 2018	Study doesn't discuss weaning	
19.	Ertem & Ergun, 2013	Focuses on breastfeeding	
20.	Escobar et al, 2018	Full text not available in English	
21.	Forero et al, 2018	Full text not available in English	
22.	Galegos et al, 2013	Focuses on breastfeeding	
23.	Gericke et al, 2010	Full text not available	
24.	Heinig et al, 2009	Focuses on breastfeeding	
25.	Helvey, 2012	Study doesn't discuss weaning	
26.	Hilbig et al, 2012	Focuses on breastfeeding	
27.	Hoban & Liamputtong 2017	Study doesn't discuss weaning	
28.	Hodges et al, 2008	Study doesn't discuss weaning	
29.	Jama et al, 2018	Children's health status	
30.	Jones, 2010	Set in a developing country	
31.	Kim et al, 2012	Full text not available	
32.	Kordsalarzeh et al, 2018	Focuses on breastfeeding	
33.	Kruger & Gericke, 2003	Focuses on breastfeeding	
34.	Kudlova, 2005	Full text not available in English	
35.	Kuswara et al, 2016	Focuses on breastfeeding	
36.	Lakshman et al, 2012	Study design	Qualitative evaluation of intervention
37.	Liamputtong & Nakscook, 2001	Year of study	Interviews before 2001
38.	Lima et al, 2014	Full text not available in English	
39.	Lindsay et al, 2009 *	Study doesn't discuss weaning	

Table 0.B (Continued)

	Study ID	Primary reason for exclusion	More information
40.	Lindsay et al, 2017	Age of participants' children	2 – 5y
41.	Lopez del Valle et al, 2005	Age of participants' children	Birth – 5y
42.	Lovelace & Rabiee-Khan, 2015	Age of participants' children	Birth – preschool age
43.	Majee et al, 2017	Study doesn't discuss weaning	
44.	Maliwichi & Nesengani, 2013	Full text not available	
45.	Mangwane et al, 2010	Full text not available	
46.	Maslin et al, 2015 *	Children's health status	Babies with cow's milk allergy included
47.	McGarvey et al, 2006	Study design	qualitative evaluation of intervention
48.	Mohamad et al, 2018	Study design	Mixed methods, qualitative element not sufficient
49.	More, 2015	Full text not available	
50.	Murphy, 2007	Study doesn't discuss weaning	
51.	Murray et al, 2008	Focuses on breastfeeding	
52.	Myers et al, 2014	Age of participants' children	Birth – 8y
53.	Quintero Romero et al, 2006	Study design	Mixed methods – no significant qualitative element
54.	O'Key & Hugh-Jones, 2010 *	Age of participants' children	Birth – 10y
55.	Peacock-Chambers et al, 2017	Focuses on breastfeeding	
56.	Raven et al, 2007	Participants not the primary caregivers	Mothers, grandmothers and health workers
57.	Redsell et al, 2011	Full text not available	
58.	Rudzik & Ball, 2016	Focuses on breastfeeding	
59.	Sacco et al, 2007	Study design	Cross-sectional
60.	Samli et al, 2006	Full text not available in English	
61.	Scott et al, 2009	Age of participants' children	Birth – 7y
62.	Spence et al, 2016	Study design	qualitative evaluation of intervention
63.	Stapleton et al, 2009	Study doesn't discuss weaning	
64.	Steinman et al, 2010	Focuses on breastfeeding	
65.	Tarrant et al, 2004	Focuses on breastfeeding	
66.	Valencia et al, 2016	Study doesn't discuss weaning	
67.	Woo Baidal et al, 2015	Age of participants' children	Pregnant women also interviewed – findings reported together
68.	York & Hoban, 2013	Age of participants' children	Participants are pregnant women

* These papers have been identified during the reference hand-searching process

Table 0.C Critical appraisal of studies included in the systematic review according to the Standards of Reporting Qualitative Research checklist

Study ID	Title	Abstract	Introduction		Methods						
			Problem formulation	Research question	Qualitative approach	Researcher characteristics	Context	Sampling strategy	Ethical issues	Data collection	Data collection instruments
1. Anderson 2001	~	~	✓	✓	✓	✓	✓	~	X	~	~
2. Anderson 2010	~	✓	✓	✓	X	✓	~	✓	✓	~	✓
3. Arden, 2010	~	~	✓	✓	~	X	X	~	~	✓	✓
4. Arden 2015	~	✓	✓	✓	~	~	X	~	✓	✓	✓
5. Beck 2018	~	✓	✓	✓	X	~	✓	✓	✓	✓	✓
6. Boak 2016	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
7. Bramhagen 2006	✓	✓	✓	✓	~	✓	✓	~	✓	~	~
8. Brown 2013	~	✓	✓	✓	~	~	X	✓	✓	~	✓
9. Cameron 2012	✓	✓	✓	✓	✓	~	~	✓	~	✓	✓
10. Caton 2011	✓	✓	✓	✓	✓	✓	✓	~	X	✓	✓
11. Cheney 2019	~	~	✓	✓	✓	✓	✓	✓	✓	✓	✓
12. Dutta 2006	~	✓	✓	✓	✓	~	✓	✓	✓	✓	~
13. Heinig 2006	~	~	✓	✓	✓	✓	~	✓	✓	✓	~
14. Horodynski 2007	~	✓	✓	✓	✓	✓	~	~	✓	~	✓
15. Horodynski 2012	~	~	✓	✓	~	✓	~	X	✓	✓	✓
16. Horodynski 2014	~	✓	✓	✓	✓	~	~	~	✓	✓	✓
17. Jessri 2015	✓	~	✓	✓	✓	✓	~	✓	✓	✓	~
18. Kavanagh 2010	~	~	✓	✓	✓	✓	~	~	✓	✓	~
19. Lee 2015	~	✓	✓	✓	✓	X	~	~	✓	✓	X
20. Leung 2017	~	✓	✓	✓	~	✓	✓	~	X	✓	X
21. Lindsay 2008	✓	✓	✓	✓	~	✓	✓	~	✓	✓	~
22. Merriman 2013	✓	~	✓	✓	✓	~	X	✓	✓	✓	~
23. Monterrosa 2012	~	~	✓	✓	✓	✓	✓	✓	✓	✓	~
24. Nielsen 2013	✓	~	✓	✓	✓	~	~	~	✓	✓	~

Table 0.C (Continued)

Study ID	Title	Abstract	Introduction		Methods						
			Problem formulation	Research question	Qualitative approach	Researcher characteristics	Context	Sampling strategy	Ethical issues	Data collection	Data collection instruments
25. Nielsen 2014	~	✓	✓	✓	✓	✓	✓	~	✓	~	✓
26. Rodriguez-Oliveros 2014	~	✓	✓	✓	✓	✓	✓	X	✓	✓	~
27. Redsell 2010	~	✓	✓	✓	X	✓	X	~	✓	✓	✓
28. Russell 2016	✓	✓	✓	✓	✓	~	✓	✓	✓	✓	✓
29. Savage 2016	✓	~	✓	✓	X	✓	~	✓	✓	~	✓
30. Schwartz 2013	✓	✓	✓	✓	✓	✓	~	✓	~	✓	✓
31. Spyreli 2019	✓	✓	✓	✓	~	✓	~	✓	✓	✓	✓
32. Synnott 2007	✓	~	✓	✓	✓	✓	~	~	~	✓	~
33. Thullen 2016	~	✓	✓	✓	~	X	~	~	~	~	~
34. Tully 2019	~	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
35. Van der Merwe 2007	~	~	✓	✓	✓	~	✓	~	✓	✓	~
36. Walsh 2015	✓	✓	✓	✓	✓	~	~	✓	✓	~	~
37. Yue 2016	✓	✓	✓	✓	✓	✓	✓	~	✓	✓	~

Table 0.C (Continued)

Study ID	Methods				Results		Discussion		Conflicts of Interest	Funding
	Units of study	Data processing	Data analysis	Techniques enhancing credibility	Synthesis & Interpretation	Links to empirical data	Integration with prior work	Limitations		
1. Anderson 2001	~	~	X	✓	✓	~	~	~	X	✓
2. Anderson 2010	✓	✓	✓	✓	✓	~	✓	✓	✓	✓
3. Arden 2010	✓	✓	~	✓	✓	✓	~	~	✓	✓
4. Arden 2015	✓	✓	✓	X	✓	✓	✓	✓	X	✓
5. Beck 2018	~	~	✓	✓	✓	✓	~	✓	✓	✓
6. Boak 2016	✓	✓	✓	✓	✓	✓	✓	✓	X	✓
7. Bramhagen 2006	✓	✓	✓	✓	✓	✓	~	✓	X	✓
8. Brown 2013	~	~	✓	✓	✓	✓	~	X	✓	✓
9. Cameron 2012	X	~	✓	✓	✓	✓	~	✓	✓	✓
10. Caton 2011	✓	✓	✓	✓	✓	✓	~	X	X	X
11. Cheney 2019	~	~	✓	✓	✓	✓	✓	~	✓	✓
12. Dutta 2006	X	✓	✓	✓	✓	~	~	X	X	✓
13. Heinig 2006	✓	✓	✓	✓	✓	✓	~	~	✓	✓
14. Horodynski 2007	~	~	✓	✓	✓	✓	~	✓	X	✓
15. Horodynski 2012	~	~	✓	✓	✓	✓	~	~	X	✓
16. Horodynski 2014	~	~	✓	X	~	✓	~	~	X	✓
17. Jessri 2015	~	✓	✓	✓	✓	✓	✓	✓	✓	✓
18. Kavanagh 2010	~	✓	✓	✓	✓	✓	~	X	✓	✓
19. Lee 2015	~	~	✓	X	✓	✓	✓	~	✓	X
20. Leung 2017	~	~	X	X	✓	✓	~	~	X	X
21. Lindsay 2008	✓	✓	✓	✓	✓	✓	~	X	X	✓
22. Merriman	✓	~	✓	X	✓	✓	~	X	X	✓
23. Monterrosa 2012	~	~	✓	✓	✓	✓	✓	✓	X	✓
24. Nielsen 2013	~	✓	✓	✓	✓	✓	✓	~	✓	✓
25. Nielsen 2014	✓	~	✓	X	✓	✓	✓	~	X	✓

Table 0.C (Continued)

Study ID	Methods				Results		Discussion		Conflicts of Interest	Funding
	Units of study	Data processing	Data analysis	Techniques enhancing credibility	Synthesis & Interpretation	Links to empirical data	Integration with prior work	Limitations		
26. Rodriguez-Oliveros 2014	✓	~	✓	✓	✓	✓	✓	✓	✓	✓
27. Redsell 2010	~	✓	✓	✓	✓	✓	~	✓	✓	✓
28. Russell 2016	✓	✓	✓	✓	✓	✓	✓	~	✓	✓
29. Savage 2016	✓	~	✓	✓	✓	✓	~	~	X	✓
30. Schwartz 2013	~	~	✓	✓	✓	✓	~	✓	X	✓
31. Spyreli 2019	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
32. Synnott 2007	~	~	✓	✓	✓	✓	~	✓	X	✓
33. Thullen 2016	~	~	✓	X	✓	✓	~	~	X	X
34. Tully 2019	~	~	✓	✓	✓	✓	✓	✓	✓	✓
35. Van der Merwe 2007	~	~	✓	✓	✓	X	✓	~	X	✓
36. Walsh 2015	~	X	✓	X	✓	✓	✓	✓	✓	✓
37. Yue 2016	~	✓	✓	X	✓	✓	~	~	X	✓

Table 0.D: Occurrence of topics within selected literature (N=37) – a priori selected topics and newly emerging topics

Themes and subthemes	Number of studies	Proportion to all included studies
A priori selected topics:		
Factors that influence the choice of foods	**26**	**70%**
Actual/perceived health properties	22	
Baby's preferences/aversions	11	
Cultural and religious beliefs	10	
Food cost and availability	8	
Parental factors (risk aversions, skills)	16	
Knowledge of and attitudes towards WHO guidelines on timing of weaning	**17**	**46%**
Awareness of the recommended weaning age	8	
Understanding the evidence basis of the guidelines	6	
Attitudes towards the guidelines	15	
Views on the available sources of weaning advice	**30**	**81%**
Grandmothers	21	
Health care professionals	26	
Peer influence	18	
Previous experience	13	
Strategies to establish healthy eating habits	**15**	**41%**
Providing variety of foods	10	
Repeated exposure to foods	5	
Baby-led weaning	5	
Modelling	3	
Perceptions of commercial infant foods	**12**	**32%**
Additives and harmful ingredients	7	
Poor taste	4	
Inadequate nutritional value	6	
Cost	4	
Newly emerging topics:		
Prompts for the introduction of solid foods	**22**	**60%**
Baby-related prompts[1]	16	
Mother-related prompts	6	
Feeding practices that deviate from the WHO guidelines on timing of weaning	**16**	**43%**
Untimely introduction of solids	11	
Feeding for reasons other than hunger	8	
Feeding practices that deviate from the WHO guidelines on type of complementary foods	**10**	**27%**
Feeding foods unsuitable for infancy	5	
Overfeeding / not being attentive to satiety cues	5	
Experiences of baby-led-weaning mothers [2]	**3**	**8%**

[1] This can be further broken down into subcategories: baby being hungry (*N*=16); interest in food (*N*=13); changes in baby's weight (*N*=8); developmental cues (*N*=8)

[2] All 3 studies described both positive and negative aspects of the method

Table 0.D (Continued)

Themes and subthemes	Number of studies	Proportion to all included studies
Fathers' role during weaning	**4**	**11%**
Feedback from mothers for improved weaning education	**11**	**30%**
Suggested areas of inadequate information	8	
Health care professionals' role in weaning education	5	

Figure 0.A. Participant information leaflet for mothers interested in participating in the survey

QUEEN'S UNIVERSITY BELFAST

Dietary quality and diversity during weaning

Participant Information Leaflet

Would you like to be part of a nutritional study on parents focusing on weaning?

You are being invited to take part in a research study for parents with children during weaning age. This leaflet will tell you why the research is being done and what it will involve. If anything is not clear or if you would like more information, please email us (see contact details at the end of this leaflet).

What is this study about?

The study focuses on baby weaning, which is the time when your children start eating foods other than just baby milk, and get to explore many different tastes and textures. Weaning is an exciting and important time, but at the same time, parents might find it a bit stressful.

In our study, we are interested to hear about your experiences with feeding your child and some other aspects of your life with your child. This will allow us to get a sense of some common challenges encountered by parents and other aspects of every-day life that might be related to them.

Why am I being asked to take part?

If you have already started feeding your baby anything apart from baby milk and if your baby is younger than 18 months old, we would like to encourage you to take part in the study. Your views and experiences will be really useful in helping us understand how to support new parents with feeding their children safe and nutritious food.

If your baby was born pre-term or suffers from any food allergies or digestive disorders, we won't be able to include you in our study.

You don't have to take part if you don't want to. Also if you decide to participate and change your mind, you can withdraw at any time without giving us any reason.

What will happen if I take part?

We will ask you to complete an online survey with questions about your baby and her/his food habits, about yourself and your family, and your everyday life with your baby.

You might find the questions of personal nature, as they are about you, your baby and your home. All the information you provide about yourself and your family will be kept completely confidential.

The survey is very straightforward and will take around 20 minutes to complete. You can do it whenever and wherever you want, as long as you have an internet connection. At the beginning of the survey, you will be asked to give consent to say you are happy to take part in the study.

Figure 0.A (Continued)

What are the possible benefits of taking part?

By taking part in our study you will help us understand the issues that parents deal with during the demanding period of weaning. The results of our study will help healthcare professionals such as health visitors and paediatricians support new mothers more efficiently with feeding their little ones.

Answering questions about your baby and your baby's diet will also help you:

- reflect on your past experiences as a parent and even prepare you for similar situations in the future.
- gain access to useful educational material on infant feeding. You will find a few links at the end of the survey.
- If you choose to enter a draw, you may be selected for a gift voucher worth £25 as a 'thank you' for your time and for sharing your experiences.

What happens at the end of the study?

After you complete the survey, we will not be contacting you again for this study. The findings from this study will be analysed by our research team and the results may be later published in an academic journal, or presented at conferences. Your data will not be shared with anyone.

Who is organising and carrying out the research?

This project is designed and carried out by researchers at Queen's University Belfast. The purpose and the content of the study has been already reviewed and given favourable opinion by the University's Research Ethics Committee.

Who to contact for further information?

Please feel free to contact us with any questions you may have.

Miss Eleni Spyreli
PhD Researcher
Institute for Global Food Security
Queen's University Belfast
Email: weaningstudy@qub.ac.uk
Phone: 079 089 73438

Thank you!

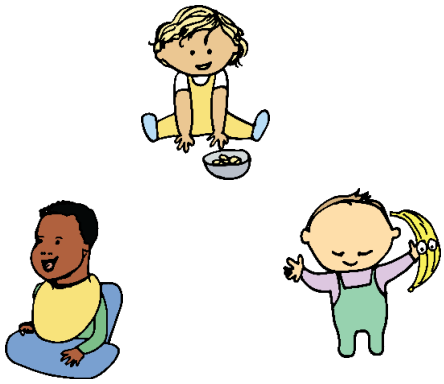

Figure 0.B Poster for online study dissemination

Have you had a baby younger than 18 months?

Have you weaned or are you currently weaning your baby?

If the answer to both questions is YES, we are interested to hear about your experiences with feeding your child and your every-day life as a parent.

We are inviting you to take part in our survey which is a part of a UK-wide research study by Queen's University Belfast.

The survey is straight-forward and takes about 20 minutes to complete.

By taking part you enter a prize draw for 10 *One4All* gift cards worth £25. You will also have the chance to access helpful and up-to-date information on feeding your little ones.

Click here to take part in the survey:

[link]

For more information email Eleni on weaningstudy@qub.ac.uk
or call on 079 089 73438

Figure 0.C Final full questionnaire used for the survey

QUEEN'S UNIVERSITY BELFAST

The following questionnaire will help us understand about you and your baby, and your food habits, and will contribute to our research on baby weaning. Please answer the following questions as accurately as you can and remember there are no right or wrong answers.

All of your answers will be kept anonymous i.e. your name will never be given with your responses.

If you have more than one child, answer about your youngest child.

If you are unclear about your participation in this research project, please contact our research team who will be happy to help you: Miss Eleni Spyreli, Queen's University Belfast, espyreli01@qub.ac.uk

Thank you for taking part!

A. SCREENING QUESTIONS

1. Are you a legal parent/ guardian, who usually provides care for your baby?

Yes ☐
No ☐

2. Was your baby born early or on time?

Early (before 37 weeks) ☐
On time (after 37 weeks) ☐

3. Has a medical professional ever told you that your baby has any food allergies or intolerances?

Yes ☐ ⇒ Please give details ☐
No ☐

4. Has your baby ever been diagnosed with any medical condition which affects his/her ability to feed, swallow or digest foods?

Yes ☐ ⇒ Please give details ☐
No ☐

5. What is your baby's date of birth?

(DD/MM/YYYY) ☐

B. DEMOGRAPHIC QUESTIONS

Figure 0.C (Continued)

SOME QUESTIONS ABOUT YOU

1. What is your gender?

Male ☐
Female ☐

2. What is your age?

☐

3. What is your ethnic background?

White ☐
Black/African/Caribbean/Black-British ☐
Asian/Asian-British ☐
Mixed/multiple ethnic groups ☐ ⇒ Please specify ☐
Any other ethnic background ☐ ⇒ Please specify ☐

4. Where do you live? (Write your postcode or just the name of your town)

☐

5. What is your current marital status?

Single (never married) ☐
Cohabiting (living with partner) ☐
Married ☐
Separated / Divorced ☐
Widowed ☐

6. What is the highest level of education you have completed to date?

Primary school or equivalent ☐
GCSEs / NVQ level 1-2 / equivalent ☐
A-Levels / Apprenticeship / NVQ level 3 / equivalent ☐
University undergraduate degree / NVQ level 4-5 ☐
University post-graduate degree ☐

7. How many children do you have in total?

1 ☐
2 ☐
3 ☐
4 or more ☐

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Figure 0.C (Continued)

8. What is your total annual household income (before tax and deductions, but including benefits)?

Below £10,000	☐
£10,001 - £20,000	☐
£20,001 - £30,000	☐
£30,001 - £40,000	☐
£40,001 - £60,000	☐

9. Do you know your weight and height?
Please indicate if it's in stones, pounds or kilos

Weight	
Height	

SOME QUESTIONS ABOUT YOUR CHILD

Please answer the following questions about your youngest child, if you have more than one.

10. What is your baby's gender?

Boy	☐
Girl	☐

11. What is your baby's current weight?
Please indicate if it's in stones, pounds or kilos

Weight	

Figure 0.C (Continued)

C. COMPLEMENTARY FEEDING

Please tell us about the current food habits of your child.

1. Was your baby breast fed?

- Yes, she/he is still being breast fed ⇒ How many times a day on average? ☐ times
- Yes, was breast fed but now stopped ⇒ How old was she/he when breastfeeding stopped? (put 00 if less than 1 month) ☐ months
- No, he was never breast fed

2. Does your child currently have formula milk?

- No
- Yes ⇒ Please specify brand and name ☐

3. How old was your baby when she/he was fed any foods or liquids except baby milk? (including adding cereal to baby milk)

- She/he is still fed on baby milk exclusively
- ☐ weeks old / ☐ months old

4. What was the main reason for you to feed your baby any foods apart from milk? (please choose only one reason)

- a) Baby was hungry
- b) Baby couldn't sleep well
- c) Baby was interested in the food she/he saw around
- d) Baby was developed enough to start having solids
- e) Baby needed to gain more weight
- f) She/he was a big baby and I felt she/he needed something more than milk
- g) I introduced foods because I wanted to reduce or stop breastfeeding
- h) I followed the NHS recommendation on 6 months
- i) I was told that it was the time to ⇒ Please specify by whom: ☐

Figure 0.C (Continued)

5. Does your child eat any raw or cooked vegetables (except potato), that are prepared at home?

Please name all the vegetables your baby eats and tick (✓) the frequency

	More than once a day	Once a day	3 or more times a week	Once or twice a week	Less than once a week
.....					
.....					
.....					
.....					
.....					
.....					
.....					

No, my baby doesn't eat any vegetables ☐

6. Does your child eat any raw or cooked fruit, that is prepared at home?

Please name all the fruit your baby eats and tick (✓) the frequency

	More than once a day	Once a day	3 or more times a week	Once or twice a week	Less than once a week
.....					
.....					
.....					
.....					
.....					
.....					
.....					

No, my baby doesn't eat any fruit ☐

7. Does your child eat any of the following foods (not in bought/pre-prepared baby or toddler foods): Please tick (✓) 'No' or 'Yes' and, if 'Yes', tick the frequency

	No	Yes	More than once a day	Once a day	3 or more times a week	Once or twice a week	Less than once a week
a) egg							
b) cheese							
c) yoghurt							
d) meat or meat products (chicken, beef, pork, lamb)							
e) fish or fish products							

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Figure 0.C (Continued)

	No	Yes	More than once a day	Once a day	3 or more times a week	Once or twice a week	Less than once a week
f) liver/liver pate							
g) kidney							
h) shellfish (prawns, mussels, cockles)							
i) baked beans							
j) green peas							
k) other legumes (lentils, chickpeas, red kidney beans)							

8. Does your child have any of the following foods:

Please tick (✓) 'No' or 'Yes' and, if 'Yes', tick the frequency

	No	Yes	More than once a day	Once a day	3 or more times a week	Once or twice a week	Less than once a week
a) coca cola or pepsi							
b) other fizzy drink (fanta, club orange, 7up)							
c) sugar-free fizzy drink (coke zero, fanta zero, pepsi max)							
d) apple juice							
e) blackcurrant juice							
f) other fruit juice							
g) any other fruit drink (orange squash)							
h) baby juice / fruity spring water							
i) crisps							
j) other savoury snacks (cheesy biscuits)							
k) chocolates							
l) mints (polo)							
m) sweets (haribo, jelly babies)							
n) tea							
o) coffee							

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Figure 0.C (Continued)

9. Does your child drink:

Please tick (✓) 'No' or 'Yes'. If 'Yes', write the age your child was when she/he first had these foods and tick how frequently your child currently has them.

	No	Yes	Age started		More than once a day	Once a day	3 or more times a week	Once or twice a week	Less than once a week
a) ordinary cows' milk				months					
b) other milk (please describe)				months					

10. Does your baby eat any of the following prepared baby foods, toddler foods or junior foods (from jar, pot or pouch)?

Please tick (✓) 'No' or 'Yes' and, if 'Yes', tick the frequency

	No	Yes	More than once a day	Once a day	3 or more times a week	Once or twice a week	Less than once a week
a) savoury meat							
b) savoury fish							
c) savoury vegetable							
d) baby fruit pouch/jar							
e) baby milk dessert or pudding							

11. Babies first solid meals are usually a puree. When did your child first start having meals with lumps in it?

Age started ☐ months

She/he hasn't had lumps in his food yet ☐

12. How many meals and snacks does your child have each day?

(milk feeds not included)

meals ☐

snacks ☐

13. Is your baby fed 'on demand', i.e. whenever she/he is hungry?

Yes always ☐

Yes some of the time ☐

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Dietary quality and diversity during weaning

Survey Questionnaire – Version 1.0 08/05/2019

Figure 0.C (Continued)

No, she/he is only fed on schedule ☐

14. Have you followed the approach of baby-led weaning, i.e. infant picking up pieces of food and feeding themselves?

Yes, I have followed only baby-led weaning ☐
Yes, combined with spoon-feeding ☐
No, I have only used spoon-feeding ☐

15. Which source of advice did you find most helpful during weaning your baby?
(please choose only one)

Health visitor ☐
Paediatrician ☐
Other healthcare staff ☐ Please specify: ☐
Your mother ☐
Your peers (friends, family members or other parents in online forums) ☐
Books ☐
Websites and online sources ☐ Please name the source(s): ☐

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Dietary quality and diversity during weaning
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Figure 0.C (Continued)

D. YOUR FOOD PREFERENCES

The following section is about you. We are interested in how you feel about the following statements. Choose from 'Strongly Disagree' to 'Strongly Agree'.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1. I am constantly sampling new and different foods.					
2. I don't trust new foods.					
3. If I don't know what is in a food, I won't try it.					
4. I like foods from different countries.					
5. Ethnic food looks too weird to eat.					
6. At dinner parties, I will try a new food.					
7. I am afraid to eat things I have never had before.					
8. I am very particular about the foods I will eat.					
9. I will eat almost anything.					
10. I like to try new ethnic restaurants.					

Figure 0.C (Continued)

E. CONFIDENCE IN FEEDING

Answer the following questions choosing from 'Not confident at all' to 'Extremely confident'.

How confident are you that you could get your baby to eat:

	Not confident at all	Slightly confident	Somewhat confident	Fairly confident	Extremely confident
1. Enough fruit?					
2. Enough vegetables?					
3. Enough food?					
4. A wide range of foods?					

How confident are you that you could say no to your baby's demands for:

	Not confident at all	Slightly confident	Somewhat confident	Fairly confident	Extremely confident
5. Sweet snacks, confectionary, lollies or ice cream?					
6. Potato crisps/salty snack foods and biscuits?					
7. Soft drink, cordial and other sweetened drinks?					

Figure 0.C (Continued)

F. HELP FROM THOSE AROUND YOU

Read the following statements and answer by choosing from 'Strongly Disagree' to 'Strongly Agree'.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1. There is a special person who is around when I am in need.					
2. There is a special person with whom I can share my joys and sorrows.					
3. I have a special person who is a real source of comfort to me.					
4. There is a special person in my life who cares about my feelings.					
5. My family really tries to help me.					
6. I get the emotional help and support I need from my family.					
7. I can talk about my problems with my family.					
8. My family is willing to help me make decisions.					
9. I have friends with whom I can share my joys and sorrows.					
10. My friends really try to help me.					
11. I can count on my friends when things go wrong.					
12. I can talk about my problems with my friends.					

Figure 0.C (Continued)

G. YOUR MOOD

Think about the past 7 days and choose the answer that best describes your mood.

1. I have been able to laugh and see the funny side of things

- As much as I always could ☐
- Not quite so much now ☐
- Definitely not so much now ☐
- Not at all ☐

2. I have looked forward with enjoyment to things

- As much as I ever did ☐
- Rather less than I used to ☐
- Definitely less than I used to ☐
- Hardly at all ☐

3. I have blamed myself unnecessarily when things went wrong

- Yes, most of the time ☐
- Yes, some of the time ☐
- Not very often ☐
- No, never ☐

4. I have been anxious or worried for no good reason

- No, not at all ☐
- Hardly ever ☐
- Yes, sometimes ☐
- Yes, very often ☐

5. I have felt scared or panicky for no good reason

- Yes, quite a lot ☐
- Yes, sometimes ☐
- No, not much ☐
- No, not at all ☐

6. Things have been getting on top of me

- Yes, most of the time I haven't been able to cope at all ☐
- Yes, sometimes I haven't been coping as well as usual ☐
- No, most of the time I have coped quite well ☐
- No, I have been coping as well as ever ☐

Figure 0.C (Continued)

7. I have been so unhappy that I have had difficulty sleeping

- Yes, most of the time ☐
- Yes, sometimes ☐
- Not very often ☐
- No, not at all ☐

8. I have felt sad or miserable

- Yes, most of the time ☐
- Yes, quite often ☐
- Not very often ☐
- No, not at all ☐

9. I have been so unhappy that I have been crying

- Yes, most of the time ☐
- Yes, quite often ☐
- Only occasionally ☐
- No, never ☐

10. The thought of harming myself has occurred to me

- Yes, quite often ☐
- Sometimes ☐
- Hardly ever ☐
- Never ☐

Figure 0.C (Continued)

H. YOUR BABY'S PERSONALITY

The next section focuses on your baby's behaviour. As you read each description below, please indicate how often your baby did this during the last week (the past seven days). Choose from 'Never or very rarely' to 'Always or almost always'.

	Never or very rarely	Less than half the time	About half the time	More than half the time	Always or almost always	Does not apply
During feeding, how often did your baby:						
1. lie or sit quietly?						
2. squirm or kick?						
3. wave arms?						
When being dressed or undressed how often did your baby:						
4. squirm and/or try to roll away?						
When placed in an infant seat or car seat, how often did your baby:						
5. wave arms and kick?						
6. squirm and turn body?						
When placed on his/her back, how often did your baby:						
7. squirm and/or turn body?						

	Never or very rarely	Less than half the time	About half the time	More than half the time	Always or almost always	Does not apply
How often did your baby:						
8. seem angry (crying and fussing) when you left her/him in the crib?						
9. seem contented when left in the crib?						
10. cry or fuss before going to sleep for naps?						
How often during the last week did your baby:						
11. protest being placed in a confining place (infant seat, play pen, car seat, etc.)?						

Figure 0.C (Continued)

	Never or very rarely	Less than half the time	About half the time	More than half the time	Always or almost always	Does not apply
When your baby wanted something, how often did she/he:						
12. become upset when she/he could not get what she/he wanted?						
13. have tantrums (crying, screaming, face red, etc.) when she/he did not get what she/he wanted?						
After sleeping, how often did your baby:						
14. cry if someone doesn't come within a few minutes?						

	Never or very rarely	Less than half the time	About half the time	More than half the time	Always or almost always	Does not apply
How often during the last week did your baby:						
15. laugh aloud in play?						
16. smile or laugh after accomplishing something (stacking blocks)?						
17. smile or laugh when given a toy?						
When being dressed or undressed during the last week, how often did your baby:						
18. smile or laugh?						
When put into the bath water, how often did your baby:						
19. smile?						
20. laugh?						
When face was washed, how often did your baby:						
21. smile or laugh?						

You have now completed the questionnaire.
Thank you very much for your time and effort! We really appreciate your help with our research.

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Dietary quality and diversity during weaning
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Figure 0.E The histogram of standardised residuals of the linear regression shows an approximately normal distribution indicating the choice of model was appropriate

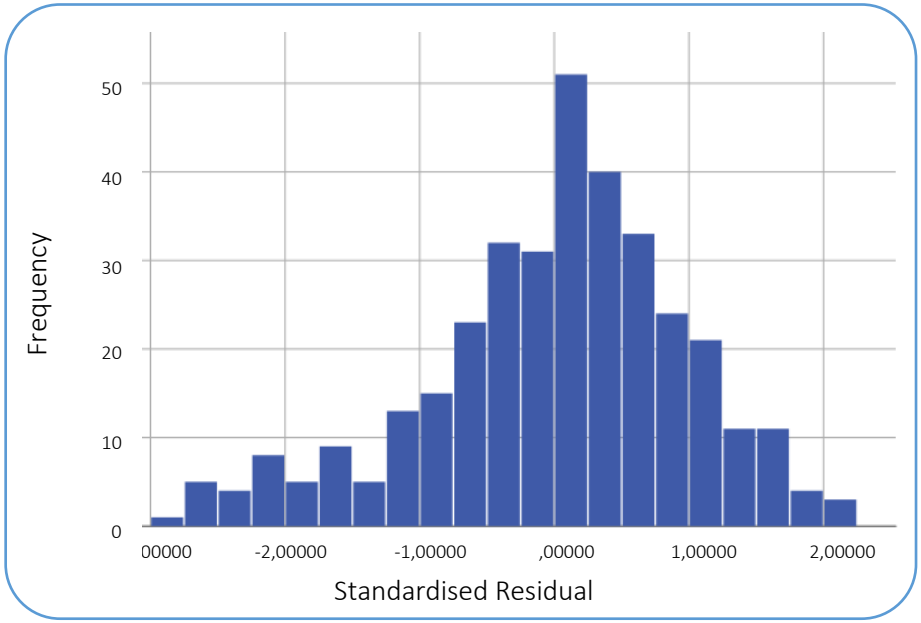

Figure 0.D The plot of unstandardised residuals against fitted values for the linear regression shows homogeneity of variance indicating the choice of model was appropriate