Australian National University

COMPaRE-PHC

CENTRE FOR OBESITY MANAGEMENT & PREVENTION RESEARCH EXCELLENCE IN PRIMARY HEALTH CARE

Obesity prevention in infants using m-Health: the *Growing Healthy* program

Elizabeth Denney-Wilson, Rachel Laws, Sarah Taki, Georgie Russell, Eloise Litterbach, Roz Elliot, Sharyn Lymer, Karen J Campbell

21 July 2016

ACKNOWLEDGEMENTS

This research is a project of the Australian Primary Health Care Research Institute, which was supported by a grant from the Australian Government Department of Health. The information and opinions contained in it do not necessarily reflect the views or policy of the Australian Primary Health Care Research Institute or the Australian Government Department of Health.

The authors would also like to acknowledge our collaborators: David Crawford, Kylie Ball, John Lynch, and Rachael Taylor. We would also like to thank Kok Leong Ong who developed the app, and Cathrine Fowler who provided advice and review of app content. We would like to acknowledge Leva Azadi who assisted with development of the breastfeeding content and our research assistant Louisa Wilson. We are very grateful to the participating nurses and parents.

CITATION

Denney-Wilson E, Laws R, Taki S, Russell CG, Litterbach EK, Elliot R, Lymer S, Campbell KJ. *Obesity prevention in infants using m-Health: the Growing Healthy program.* Report prepared for the Australian Primary Health Care Research Institute. Canberra: Centre for Obesity Management and Prevention Research Excellence in Primary Health Care; 2016.

Centre for Obesity Management and Prevention Research Excellence in Primary Health Care

T +61 2 95144554

E elizabeth.denney-wilson@uts.edu.au

W http://compare-phc.unsw.edu.au

Contents

Abbreviations

App	An application for smart phones
BF	Breastfeeding
BMI	Body mass index
CI	Chief Investigator
COM-B	Capability Opportunity Motivation Behaviour
iOS	IPhone operating system
LGAs	Local government areas
MCH	Maternal and Child Health
m-health	Mobile health
OECD	Organisation for Economic Cooperation and Development
PHC	Primary health care
RCT	Randomised control trial
WIC program	Women, Infants, and Children: The special supplemental nutrition program for women, infants and children in the USA

Background

About one quarter of Australian pre-school children are overweight. Early childhood is an important period for establishing behaviours that will affect weight gain and health across the life course. Early feeding choices, including breast and/or formula, timing of introduction of solids, physical activity and electronic media use among infants and young children are considered likely determinants of childhood obesity. Parents play a primary role in shaping these behaviours through parental modelling, feeding styles and the food and physical activity environments provided. Children from low socio-economic backgrounds have higher rates of obesity making early intervention particularly important. However, such families are often more difficult to reach and may be less likely to participate in traditional programs that support healthy behaviours.

Parents across all socio-demographic groups frequently access primary health care (PHC) services including nurses in community health services and general practices, providing unparalleled opportunity for engagement to influence family behaviours. One emerging and promising area that might maximise engagement at a low cost is the provision of support for healthy parenting through electronic media such as the Internet or smart phones. This is referred to as mobile or m-health.

The Growing Healthy study aimed to explore the feasibility of providing information and support for healthy parenting through electronic media in the form of an application for smart phones (app) and a website. Our background research suggested this as an emerging and promising area for engagement with families with young children and may provide a referral option for primary health care providers. It is also an intervention with a relatively low cost and potential for high reach.

As families with young children have high levels of engagement with PHC services, these could be leveraged to recruit study participants *via* referral to the app. Complementing and not replacing the information and support provided by these existing primary health care services was an important objective as was ensuring the online information and support aligned with that provided by primary health care services and national guidelines. The aim was to make the app a 'trusted source' of information and support for families with children from birth to nine months of age.

WHY FAMILIES WITH YOUNG CHILDREN?

Families with young children are an important target for obesity prevention because

- Risk factors for obesity begin early in life and early intervention is crucial
- Behaviours that are associated with obesity can become established in early life and may track into adolescence and adulthood
- Parents are receptive to information as they establish parenting practices.

This report provides a summary of the research that guided the development of the Growing Healthy app including literature reviews, interviews with parent and PHC practitioners, and focus group testing; and the feasibility trial for the app. We also report preliminary findings from app analytics and parents who used the app.

Stage 1: Literature reviews

Understanding the causes and mechanisms that explain the development of obesity-promoting behaviours among parents and young children from low socioeconomic or Indigenous backgrounds is fundamental to understanding how to prevent them. The Growing Healthy project conducted two reviews of evidence to help inform the development of the intervention. The two reviews focused on

- parent behaviours associated with excess weight gain in young children from disadvantaged backgrounds
- current evidence of interventions to prevent excess weight gain in young children zero to five years of age

The findings provided background to inform the content and the behaviours targeted in the Growing Healthy app. The reviews have been published elsewhere for those interested in further details.[1, 2]

REVIEW #1 PARENT BEHAVIOURS ASSOCIATED WITH EXCESS WEIGHT GAIN IN YOUNG CHILDREN FROM DISADVANTAGED BACKGROUNDS

A systematic review of the literature was conducted to investigate the causes of weight gain in children aged zero to five years from socioeconomically disadvantaged or Indigenous backgrounds in OECD countries. We identified studies addressing relationships between parenting, child eating, child physical activity or sedentary behaviour and child weight in disadvantaged samples.

Methods

Studies addressing relationships between parenting, child eating, child physical activity or sedentary behaviour and child weight in disadvantaged population groups were identified with 32 articles meeting the criteria. Studies were selected for inclusion in the review if they addressed one of the following pathways, nominated due to previously reported associations with overweight or obesity in a variety of populations

a) between parenting behaviours and child eating
b) between parenting behaviours and child activity (physical activity or sedentary behaviours)
c) between children's eating and children's weight
d) between child activity levels (including sedentary behaviours and physical activity) and child weight, and
e) between parenting behaviours and child weight.

Child eating was defined as dietary intake (including breast milk or formula), diet patterns, intakes of specific foods or beverages, food choices, food preferences, eating styles and eating behaviours. The age at which children started consuming solid foods was also included as a 'child eating' variable. Most articles provided evidence from socio-economically disadvantaged ethnic minority groups in the USA. Further details of the search strategy and papers retrieved have been published elsewhere.[2]

Results

Most of the studies included in this review were limited by the study sampling, design, duration or measurement tools that were not sufficiently sensitive. More detailed studies of longer duration are needed if we are to further understand causal relationships in parent–child feeding and activity in disadvantaged families.

Obesity prevention interventions may be less effective in disadvantaged populations because they have not been tailored towards the specific requirements of these families. The review highlighted that there is only a small evidence base explaining causal relationships between parent and child behaviours and children's weight status upon which interventions tailored to disadvantaged groups could be designed.

Overall, only a small number of factors that could affect weight gain in disadvantaged families have been considered in existing studies. The focus to date has been on the duration of breastfeeding, socio-demographic influences, dietary intake and a few selected parental feeding behaviours such as restriction, control and pressure to eat. Consideration of other factors that affect weight such as other parental feeding behaviours, how children are breast or formula-fed (e.g. feeding to appetite) has seldom been undertaken. Additionally, because many of the parent and child behaviours associated with overweight co-occur, studies that isolate or control for confounding are needed to understand mechanisms of effect.

Findings on the relationship between parenting behaviours and child or infant weight and diet generally suggested that parents tailor their feeding practices according to a child's weight status. For example, parents with heavier children used more restriction and less pressure to eat, reflecting findings in samples of mixed socioeconomic position and ethnicity.

Association between breastfeeding and infant weight

Results on the associations between breastfeeding and weight were mixed and the reported positive effects of breastfeeding on infant weight were often reduced when other variables previously linked with child weight such as maternal smoking, weight gain during pregnancy or maternal obesity were controlled for. Mixed results included for example a large study which found a modest protective effect of breastfeeding against obesity but only in non-Hispanic whites and no other racial or ethnic group. Two smaller studies showed no protective effect. Studies of socioeconomically heterogeneous groups of children have shown that breastfeeding – initiation, longer duration or exclusivity – may exert a modest protective effect on child overweight.[3-5]

However, breastfeeding has been associated with other health behaviours such as a more positive eating pattern and later introduction of solid foods.[6] It is possible that the associations between breastfeeding and infant and child overweight seen in disadvantaged families could be partly accounted for by other feeding behaviours associated with greater breastfeeding duration.

Association between formula feeding and infant weight

In this review, we found that the associations between formula feeding and weight were also mixed. This is likely because formula feeding was rarely examined and when it was, definitions and measures of formula feeding varied. Despite this, formula feeding appeared to reduce the protective effects of breastfeeding on weight gain while frequency of formula feeds was somewhat predictive of overweight. The lack of consistency in measures and definitions of formula feeding behaviours and indeed breastfeeding (e.g. whether ever breastfed, breastfed for six months or more, exclusively breastfed and so on) is a limitation in these and many other studies.

Responsive feeding and weight gain

How mothers breastfeed, formula feed or feed from a bottle may be more important than simply whether mothers breast or formula feed.[7, 8] The reasons for this may be that the parent's sensitivity to infant hunger and satiety cues are important mediators through which feeding practices may influence weight gain. Babies who are breastfed determine the end of a feed and are therefore self-regulating intake according to their hunger or fullness while

babies fed from a bottle may be encouraged by their parent to consume a prescribed amount of milk.

In order to understand the relative importance of breastfeeding and formula feeding as predictors of overweight in disadvantaged infants and children, higher quality studies are needed that use well-defined and detailed measurements of breastfeeding and formula-feeding behaviours including the protein content of formula and type of protein, methods of preparation and amounts consumed as well as the timing of introduction and type and amount of solid food.

Associations between age of introduction of solid foods and child weight

The age of introduction to solid foods was also rarely assessed with only four studies examining this as a predictor of infant weight. Only one (high quality) study reported significant associations. In socioeconomically diverse populations, introduction of solid foods before an infant is four months of age has been associated with greater weight gain [9]and early introduction of solid foods is also associated with other behaviours linked to obesity including earlier introduction of high fat foods and sugar sweetened drinks. As these obesity-promoting behaviours cluster and are more prevalent in disadvantaged families, isolating the independent impact of one behaviour is extremely challenging and requires more detailed examination of infant feeding behaviours and better quality data collection.

We concluded that in disadvantaged (and particularly Indigenous) populations, there is little evidence of most of the behavioural variables assessed on children's weight. Where some evidence exists (e.g. for some categories like parental feeding practices), the variation in study designs, dietary outcomes, measures and other limitations made it impossible to draw strong conclusions.

REVIEW #2 INTERVENTIONS TO PREVENT OBESITY IN CHILDREN ZERO TO FIVE YEARS

A second review of literature was conducted to examine the effectiveness of interventions to prevent obesity or improve obesity-related behaviours in children zero to five years from socioeconomically disadvantaged or Indigenous families. This review aimed to determine whether interventions already existed that could be adapted to the Australian primary health care setting. We also sought to understand components of successful interventions that could be incorporated into our program.

Methods

The review included intervention studies published between January 1993 and November 2013 targeting the prevention of unhealthy weight gain in young children aged zero to five years from socioeconomically disadvantaged or Indigenous families. We defined socioeconomically disadvantaged families and their children as those described with low socioeconomic status, low income, low education (high school or below) or from low income areas. Studies of both high and low socioeconomic status groups were included if the findings were stratified by one or more socioeconomic indicators (e.g. education/income). A well-accepted definition of Indigenous populations was used: "the experience shared by a group of people who have inhabited a country for thousands of years, which often contrast to those of other groups residing in the country for a few hundred years".[10] Our review included studies of Indigenous populations from multiple countries.

To be included in our review, studies had to report on one or more of the following primary outcomes: anthropometric measures, child/family diet, parental feeding practices (e.g. breastfeeding, time of introduction of solids, feeding style), physical activity or sedentary behaviours. These outcomes were chosen on the basis of being important predictors of young children being overweight.[11] The review excluded obesity treatment interventions focusing on overweight or obese children only, interventions exclusively targeting

breastfeeding or children with a critical illness or co-morbidity or preschool/childcare based interventions that did not involve or target the parents or home environment. There were no limitations placed on the length of follow up, study design or quality. Further details of the search strategy and findings have been published elsewhere.[1]

Results

Thirty-two intervention studies were identified, with only two (both classified as low quality) in Indigenous groups. Less than 10% of all studies were high quality. Fourteen studies had a primary aim to prevent obesity.

Interventions initiated in infancy (under two years) had a positive impact on obesity-related behaviours (e.g. diet quality) but few measured the longer-term impact on healthy weight gain. Findings among pre-schoolers from three to five years were mixed with the more successful interventions requiring high levels of parental engagement, use of behaviour change techniques, a focus on skill building and links to community resources.

A key finding is that studies that were based on an anticipatory guidance approach in infancy (generally from birth or antenatally) appear to be effective in influencing early obesity-related behaviours such as breastfeeding or the timing of introduction of solids. Anticipatory guidance approaches are those where parents are supported with information and skills development at key points in their babies' development such as when a baby might be hungrier than usual due to a growth spurt.

The findings of this review suggested that interventions need to commence in the antenatal period or at birth to positively impact on breastfeeding outcomes amongst socioeconomically disadvantaged mothers. Studies with positive outcomes successfully engaged parents, had a strong focus on skill building (e.g. cooking skills, media literacy, communication, problem solving, conflict resolution and parenting skills), use of behaviour change strategies (such as self-monitoring and goal setting), social networking, progressive rewards systems and links to community resources. Developing culturally appropriate programs appeared to be critical to engaging parents from racial minority groups.

This review also provided important insights into the types of settings in which to deliver interventions to socioeconomically disadvantaged families with an important factor being the age of the child. For example, the home appears to be an effective setting to deliver interventions for infants less than two years of age with several studies having positive effects on obesity related behaviours.

Primary health care is an emerging setting of interest for children less than two years with three out of four studies conducted with children less than two years showing positive outcomes. These were primarily delivered through the Women, Infants, and Children (WIC) program: the special supplemental nutrition program for women, infants and children in the USA.

Key findings from stage 1

Parents across all sociodemographic groups access primary health care services frequently - on average twenty four visits in first year of life. This offers an unparalleled opportunity to reach the whole population and engage with disadvantaged families to support healthy parenting behaviours. Studies conducted in primary health care settings in this review all used primary health care providers to deliver the intervention as part of routine service delivery, increasing the chances of the intervention being sustained and delivered regularly.

The findings from the two systematic reviews supported the development of an intervention targeting behaviours associated with infant feeding, including breastfeeding, bottle feeding, introduction of solids and using an anticipatory guidance approach. The primary health care or home setting was identified as potential settings. Before proceeding, we explored the views of parents and practitioners to understand their attitudes to excess weight in infants and to assess their support for this approach.

Stage 2: Parent and practitioner views regarding infant feeding and weight gain

We conducted interviews with parents of babies less than one year old and with nurses working in maternal and child health centres to answer the following questions,

- What do parents think about excess weight gain and where do they get information and support when they have questions about feeding their baby?
- What is the current role of maternal and child health nurses and what do they see as their role in supporting parents to feed their babies and prevent excess weight gain?

These qualitative studies have been published elsewhere for those interested in further details.[12] [13]

PART 1: PARENT VIEWS

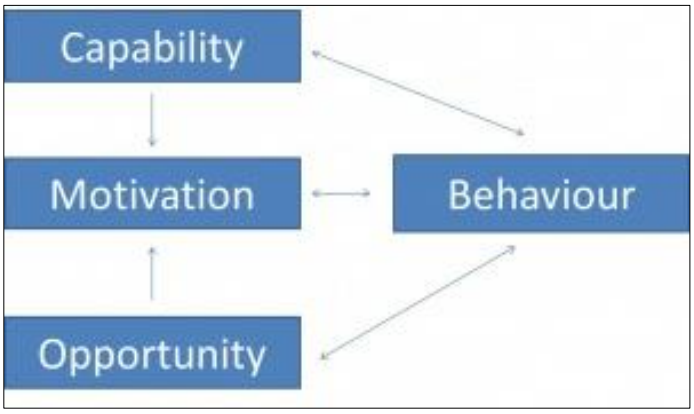
Method

Telephone interviews were conducted with 29 mothers of infants aged two to eleven months who were recruited *via* an advertisement in the Playgroups NSW website. Interview questions were developed around a framework described in behaviour change research and applied to parental feeding practices associated with infant excess or healthy weight gain.

The framework we used to help develop the questions and to inform the analysis was 'Capability Opportunity Motivation Behaviour' (COM-B) [14] (Figure 1) which was developed by Susan Michie and provides a structure in which to explore the determinants of health behaviours. This framework represents the interactions between different components of an individual's behavioural system – capability, opportunity and behaviour where

- Capability (C) is defined as a persons' psychological or physical ability to enact the behaviour (e.g. knowledge, skills)
- Opportunity (O) is defined as the physical or social environment that enables the behaviour (e.g. availability of information, social support), and the individual's
- Motivation (M) is defined as the reflective (including self-conscious planning, analysis and decision-making) and the automatic (involving emotional reactions, drives, impulses and habits) mechanisms that may activate or inhibit behaviour

Figure 1: The components and interactions of the COM-B framework



Source: Susan Michie[14],

The interview questions mapped to the COM-B framework can be found in APPENDIX 1.

Drawing upon the findings from the systematic reviews, the target behaviours and their competing alternatives were developed. These are presented in Table 1.

Table 1 Target behaviours and competing alternatives

Target behaviours	**Competing alternatives**
Initiating breastfeeding	Formula feeding
Prolonging breastfeeding	Replacing breast milk with formula
Best practice formula preparation	Sub-optimal formula preparation
Delaying the introduction of solid foods until around six months of age	Introducing solids earlier than four months of age
Introducing healthy first foods	Introducing unhealthy first foods
Feeding to appetite	Use of non-nutritive (i.e., feeding for reasons other than hunger) feeding

Results

Overall, the interactions between an individual's behavioural system (as represented by the COM-B) were the key determinants of a mother's likelihood to adopt the healthy target behaviours. Importantly though, the results showed that the significance varied for each of the target behaviours. For instance, for some target behaviours such as age of introducing solids, mothers appeared to have the necessary knowledge or skills to perform the behaviour however, their beliefs about the consequences of performing the behaviour was the factor that affected their decision. In terms of the framework, they had the 'Capability' but their 'Reflective Motivation' affected their decision.

For other target behaviours, such as introducing healthy first foods, in contrast 'Capability' (in the form of knowledge) and ''Opportunity' (e.g. advice) were most important. For these target behaviours, mothers were motivated (Motivation) to perform the target behaviour yet were unsure which foods could be safely offered at what age.

A common theme across all target behaviours was the influence of the COM-B element 'Opportunity', which included norms, advice and prompts from peers, health professionals and family members. This is reflected in some of the target behaviours such as initiation of breastfeeding where there appeared to be ample advice offered to mothers from credible sources, whereas for others, such as 'best practice formula feeding', advice was lacking.

While 'using milk to settle' and introducing solids before six months is not recommended in the current guidelines, there is ample evidence that parents do both. This is partly because they do not see any potential negative consequences and also because parents tend to prefer infants who eat a lot, are full and satisfied and heavier. Motivation was an important influence on all of the behaviours whether targeted or competing such as the previous example with 'Reflective Motivation' appearing to have the widest ranging influence on target behaviours with important elements being the mothers' beliefs about the consequences of their behaviours as well as the plans they made. 'Automatic' motivation such as emotions but had less influence on target behaviours.

Others studies have found that parents' beliefs about the consequences of their behaviours are a barrier towards healthy feeding practices[15] and that parents' knowledge about the effects of their feeding behaviours on their infants might alter the effects of interventions[16] and directly affect their choice of feeding or settling behaviour.[17] Therefore, mothers' beliefs about consequences directly affect their decision as to which behaviour to undertake whether it is a target-behaviour or its competing alternative.

In our study, we found that the mothers' motivations were also affected by their infant's characteristics and behaviours and the mother's perceptions of them. Mothers made judgements about what their infant needed and took feedback from their baby's cues in terms of behaviours, sounds and growth (Reflective Motivation). This was usually in

combination with their knowledge or beliefs about what was best for the baby (Capability). Thus at times, the motivation to do the 'competing behaviour' (e.g. feed to settle) was higher than the 'target behaviour' (e.g. feed to appetite).

Models of non-responsive feeding suggest that parents who are less responsive to their infant's hunger and satiety cues use feeding practices such as pressure, coercion and restriction - which are associated with excess weight gain.[18] Our results suggest a possible role for parents' motivations in determining whether parents use these non-responsive feeding practices.

Seeking advice and support online was a common practice with mothers relying upon social networking sites, government and health websites or commercial providers. These sources of advice and support vary considerably in their quality.[19] Consistent with earlier findings,[20, 21] mothers were at times dismissive of the advice and support provided by health professionals because it was seen as impractical or irrelevant to their baby's specific needs.

Previously, other studies have shown that mothers consider advice from family and friends to be of more value than that from health professionals.[15, 21] One reason for this may be that mothers are seeking practical advice on infant feeding that can help to solve a perceived problem and will reject professional advice if it does not work for their infant. Despite this, similar to another study,[22] several mothers in our study also reported not following the advice from older generations family members (mothers and mother in-laws) believing it was out-dated. Therefore, given that mothers are influenced by advice from various sources, the credibility of the source and the accuracy of the advice are vital.

Key Findings from parent interviews

While knowledge is identified as a key a barrier to healthy feeding practices, motivational and external (e.g. social, health professionals) influences are important intervention targets. The data presented in this study suggest that for mothers to practice healthy feeding practices, knowledge and motivation require tailoring to the specific target behaviours of interest.

An important finding of this study was the lack of reliable, timely, practical advice tailored to existing parent motives and varying child characteristics that is framed in motivating ways.

The overarching findings from these interviews were that parents access and rely on information and support from a range of sources when they have questions about feeding their baby - including the internet. Parents suggested that for some infant feeding issues (like breastfeeding) they could access a great deal of information and support but for other topics (like feeding infant formula) information and support was lacking. We found that parents are strongly influenced by their beliefs and by their peers.

The reviews that suggested infant formula feeding may be associated with excess weight gain and the lack of support for parents who are using infant formula suggested a potential focus for the intervention.

PART 2: THE ROLE OF MATERNAL AND CHILD HEALTH NURSES IN INFANT OBESITY PREVENTION

Methods

In this mixed methods study we aimed to explore the extent to which nurses addressed healthy infant feeding practices, healthy eating, active play and limiting sedentary behaviour during routine consultations with young children zero to five years. We also sought to understand the key factors influencing such practices and how they could be best supported.

We conducted a survey that was completed by 56 maternal and child health (MCH) nurses (response rate 85%), in two local government areas (LGAs) in Melbourne. The LGAs were selected as they had a high proportion of disadvantaged communities, based on the socioeconomic index for areas.[23] Nurses were invited to participate *via* email and a final item in the survey asked to if they would participate in an interview to further explore the topic. Sixteen nurses agreed. The survey and interview questions can be found in APPENDIX 2.

Results

Although nurses reported measuring height/length and weight in most consultations, almost one quarter (22%) reported never/rarely using growth charts to identify infants or children at risk of overweight or obesity. This reflected a reluctance to raise the issue of weight with parents and a lack of confidence in how to address it.

The majority of nurses reported providing advice on aspects of infant feeding relevant to obesity prevention at most consultations with around a third (37%) routinely provided advice on formula preparation.

Less than one half of the nurses routinely promoted active play and only 30% discussed limiting sedentary behaviour such as television viewing. Qualitative analysis revealed that parental receptiveness and maintaining rapport with parents was a key driver of MCH nurse's practices related to obesity prevention in infants and children.

Solutions to improving obesity prevention practices may include further developing nurse counselling and behaviour change skills to enable them to raise sensitive issues in a way that engages rather than offends parents and aligning obesity prevention advice with nurses' roles in promoting optimal growth and development. Despite growth monitoring being a central role of MCH nurses, our findings suggest that there is room for improvement in using growth charts to identify infants and children at risk of overweight and obesity. Under-utilisation of charts by paediatric health care providers has predominately been attributed to the perception that parents will react negatively to practitioners raising the issue of their child's weight.

Overall MCH nurses in the study reported high rates of confidence and frequent provision of advice and support to parents on some aspects of infant feeding which they considered central to their role such as breastfeeding and the basics of introducing solids. We also observed that there was scope to improve provision of advice and support around other aspects of infant feeding including best practice formula feeding and parental feeding behaviours shown to be important in preventing obesity such as feeding to appetite, repeated exposure to foods and not using food as a reward. The use of service delivery prompts such as including feeding behaviours in parent education materials may remind nurses to cover these issues as part of overall discussions regarding infant feeding. Most importantly, increasing nurse confidence in behaviour change counselling may help to overcome their concerns about offending parents and lead to more productive and effective parent nurse relationship.

Key findings from nurse survey and interviews

We found that nurses see provision of advice and support around key feeding behaviours as 'core business' and they reported high levels of confidence around some aspects of infant feeding such as those associated with excess weight gain. However, the provision of provision of advice and support could be improved - for example around best practice formula feeding and parental feeding behaviours such as feeding to appetite, repeated neutral exposure to foods and not using food as a reward.

In line with previous research, our findings highlight that parental receptiveness and maintaining rapport with parents is a key concern of MCH nurses and pivotal in influencing practices related to obesity prevention.

Our findings suggest that strategies to improve practice will need to,

1. use service delivery prompts such as body mass index (BMI) charts and parent education materials to assist nurses in creating an opening to raise sensitive issues such as weight and screen time
2. align advice on healthy eating, active play and screen time with child growth and development which is considered central to the nurse role
3. positively frame obesity prevention messages such as screen time limits to promote parental receptiveness
4. promote continuity of care with parents
5. increase nurse skills in behaviour change counselling so they are more confident to approach parents about sensitive topics without fearing this will impact negatively on the nurse-parent relationship
6. provide credible referral options for nurses to recommend to parents.

A resource to reinforce or extend the advice and support from MCH nurses may be timely and the development of content for the Growing Healthy app content was informed by our findings in this study. In particular, we aligned content with the age and stage visits and sought to reinforce key messages provided during those visits. All content aligned with National Guidelines [24]and best practice recommendations which were also important for nurses considering referring parents to the app.

Stage 3: Review of existing apps and websites supporting obesity prevention in young children

Findings from parent interviews indicated that parents were frequently using websites and apps to find health information. Stage 3 of the project aimed to analyse the quality of the websites and apps devoted to infant feeding to determine whether an obesity prevention using m-Health was a viable option for our intervention. This study has been published elsewhere and is summarised below.[19]

Methods

A systematic analysis was conducted to assess the quality, comprehensibility, suitability, and readability of websites and apps on infant feeding using a developed tool. Google and Bing were used to search for websites from Australia, while the App Store for iOS and Google Play for Android were used to search for apps. Specified key words including 'baby feeding', 'breast feeding', 'formula feeding' and 'introducing solids' were used to assess websites and apps providing feeding advice. Criteria for assessing the accuracy of the content were developed using the NHMRC Australian Infant Feeding Guidelines.

Results

After an initial screen of 600 websites and 2884 apps, 44 websites and 46 apps met the selection criteria and were analysed in detail. The majority of the websites and apps on infant feeding were of poor quality. There were two high quality websites that included information completely aligned with the infant feeding guidelines; those rated as fair or poor covered little or no information contained in the guidelines. Two-thirds of the websites (65%) and almost half of the apps (47%) had a readability level above the 8th grade level suggesting a relatively high level of literacy was required.

Low quality scores resulted from authors lacking biomedical backgrounds and a lack of information about the author credibility, which was missing in 75% of the websites and 78% of the apps. Consumers are limited as to how they can determine the credibility of a website and therefore be unable to judge the quality of information on a site. Currently in Australia, only medical apps that are used as diagnostic or monitoring tools require approval from the Therapeutic Goods Administration. General health and well-being apps are not regulated.

Key findings from review of apps and websites

The lack of quality and credibility in readily available apps makes it difficult for primary care providers to recommend m-Health tools as a source of support and information for their clients. Using the findings from our systematic reviews, qualitative work and this analysis of existing m-Health products, we became convinced that an evidence-based app targeting parents would be a useful addition to the resources available for obesity prevention. It would provide a trusted source of online support and advice that parents could be referred to by MCH nurses.

Stage 4: Development and testing of the 'Growing Healthy' app

The Growing Healthy app and website (hereafter referred to as the Growing healthy app) was developed to assist with prevention and management of obesity in families with young children across Australia. It contains high quality, evidence based information, consistent with guidelines informed by our development work with parents and nurses.

In the final stage of the study, we sought to determine the acceptability and feasibility of Growing healthy in the prevention of obesity related infant feeding behaviours in families of young children.

Primary care providers are ideally placed to refer parents to this source of information. It was key that the online offering *complement* and not *replace* the services offered by these providers and that the content strictly follows the same guidelines and schedule as used by the primary health care providers.

THE PROCESS FOR DEVELOPING THE APP

The process for developing the app content was informed by a protocol for developing theory-based and evidence-based health promotion programs called 'Intervention Mapping'.[14] The process of health program planning has six steps which include developing objectives. Intervention mapping entails using theory-based intervention methods with practical strategies as well as having plans for adoption, implementation and evaluation.

The selection of program objectives, methods and practical strategies was based on the views from parents, MCH nurses and nurses in general practice as well literature reviews already conducted as part of this research.

Key determinants (classified as relating to capability, opportunity or motivation) of each of the target behaviours were linked to behaviour change techniques using the Behaviour Change Wheel: a framework for designing and evaluating behaviour change interventions.[25]

AIM OF THE APP

The aim of app was to provide a 'one stop shop' of reliable advice to support infant feeding and to influence feeding behaviours associated with excess weight gain in infants. In summary we sought to

- promote breastfeeding and if breastfeeding is not possible, promote best practice formula feeding
- delay the introduction of solids to around six months of age but not before four months
- promote healthy first foods
- promote healthy infant feeding practices (including feeding to appetite, repeated neutral exposure to healthy food and avoiding using food as a reward)
- optimise infant dietary exposure to fruits and vegetables.

APP CONTENT, FUNCTIONALITY, TESTING AND DEVELOPMENT

Our strategy was to leverage existing expertise and content where possible and to develop content to address gaps. App content was developed by the team and sourced from existing websites including the Infant website (www.infantprogram.org) developed by CI Karen Campbell and under licence from the Raising Children Network (raisingchildren.net.au). The content included written materials and videos. The videos included information and demonstrations of a wide variety of techniques including feeding position, making up bottles

and cooking. A table outlining the content of the app mapped to the aims and objectives can be found in APPENDIX 3. The app landing page is shown in
Figure 2.

Figure 2 Growing healthy app landing page

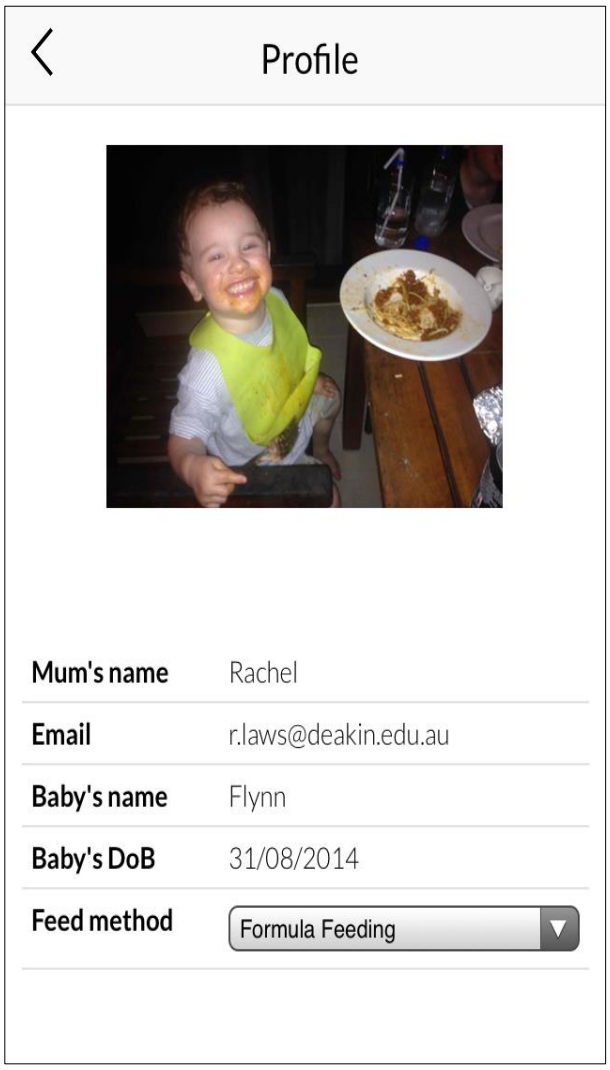
To engage parents and to personalise the intervention, the following functionality was included

- parents indicated whether they were breastfeeding, infant formula feeding or mixed feeding so that they could be directed to appropriate content

the app could include a photo of their baby, their name and their baby's name (as shown in

> Figure 3)

Figure 3 Example of personalising of app

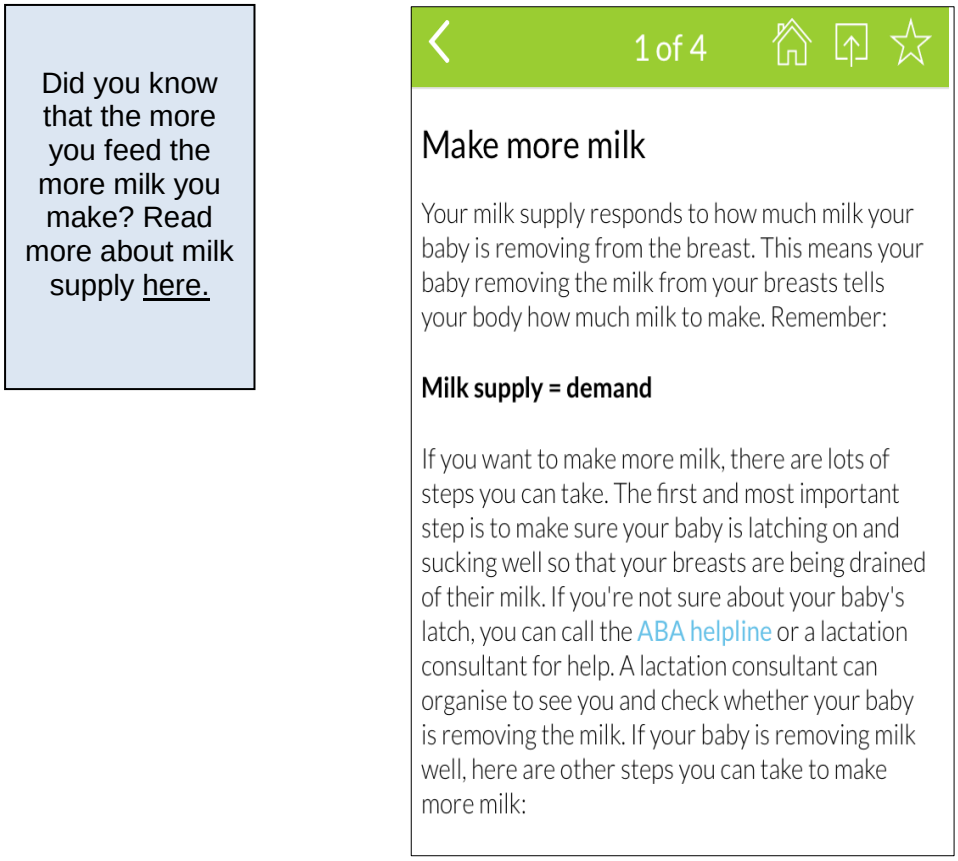


Parents received three push notifications in the app for each week of the intervention. The push notifications prompted users to access the information on the app. The messages were relevant to the age of their infant and tailored to their feeding mode (breast, formula or mixed) with links provided to more information on the app/website. To ensure variety, one notification was about milk feeding, one about sleep and settling (or solid foods when the baby was old enough to eat solid food) and one message was a supportive 'looking after yourself' type message. Push notifications were personalised with the parent and the baby's name. An example of a push notification sent to a parent of a baby aged five weeks and the corresponding section of the app is shown in Figure 4.

In the development phase, we collaborated with an academic from Deakin University's School of Information Technology and Business Analytics who developed the technical aspects of the app. There were a number of key technical decisions made including whether to develop a web-based app compatible with Apple and Android phones or whether to develop an app that was native to one operating system. The trade off in choosing a web-based app was reduced functionality (although the reduction in functionality was not something most users would notice as the impact was predominantly in the 'back end'). While we knew our target audience owned smart phones, we did not know which type of operating system was more popular. Our participants used a mix of phones with many of the

less advantaged participants preferring the cheaper android phones. Our baseline data analysis vindicated our decision to use a web-based app.

Figure 4 Section from link provided in push notification



FOCUS GROUPS

To ensure the app look and content was acceptable to our target audiences we conducted focus group testing. The two key stakeholder groups were parents-because we hoped they would use and trust the app and health practitioners-because we hoped they would be sufficiently confident in the utility and content to refer participants.

Four focus groups were conducted in one of the participating LGAs in Victoria. Participants were from existing first time mothers' groups with babies aged six to eight weeks and were invited by their maternal and child health nurse. Each group contained between six to eight mothers who were asked their views on,

- the look and feel of the app
- the wording of the push notifications
- content they liked and did not like
- anything they'd like to see in an app of this kind.

The groups were attended by members of the research team and feedback suggested that parents preferred,

- information that was timely and specific to them and their infant (e.g. milestone based, or reminders about immunisation)

- notifications two to three times per week
- messages that were positive, affirming and personalised
- messages tailored to their feeding method. For example, mothers who were feeding their babies infant formula suggested they would be ‘turned off’ by breastfeeding content.

We conducted focus groups with practitioners at a staff development day for maternal and child health nurses in one LGA. The nurses were all working in the LGA in which we hoped to recruit participants to the study. Members of the research team facilitated one table of eight to ten nurses and asked their views on the look and feel, app content and alignment with their core messages. The feedback included,

- recommendations on the appearance of the app
- recommendations on the way the content was arranged
- the importance of images contained in the app reflecting current recommendations around infant feeding (pictures of breastfeeding rather than formula feeding) and sleep (positioned on back rather than front or side)
- that the content be consistent with guidelines so that they could be comfortable with recommending the content

After a question and answer session with the research team as a whole group, the nurses agreed to participate in the study and refer parents to the app.

It was recognised that it was important to have the app tested in the ‘real world’ before releasing the app to the parents. Members of the research team and their social media contacts with babies less than one year old tested the app functionality over a four-week period and provided feedback on functionality, performance and technical issues.

Stage 5: Feasibility of the Growing healthy app

This stage tested the feasibility of the 'Growing healthy' app on infant feeding outcomes including

- promotion of breastfeeding and if breastfeeding is not possible, promotion of best practice formula feeding
- delaying the introduction of solids to around six months of age but not before four months
- promotion of healthy first foods
- promotion of healthy infant feeding practices (including feeding to appetite, repeated neutral exposure to healthy food and avoiding using food as a reward)
- optimising infant dietary exposure to fruits and vegetables.

Parents recruited to the study were asked to complete a survey and then download the app. The survey is included in APPENDIX 4.

RECRUITMENT

We aimed to recruit around 200 parent/child dyads with the focus on recruiting parents from socioeconomically disadvantaged regions. We aimed to recruit a similar number in the comparison group. The comparison group, while not randomised, provides a useful point of reference in terms of assessing the impact of the program on infant feeding outcomes.

The eligibility criteria for participating were expectant parents (30+ weeks gestation) or parents with an infant less than three months of age who were

- able to read and understand English
- owners of any mobile phone
- 18 years of age or older
- living in Australia.

The location of general practices and maternal health centres chosen to participate was influenced by the relative level of socioeconomic disadvantage in the surrounding communities. Other factors considered were birth rate, involvement in previous studies and proximity to the study researchers.

We wanted practitioners in primary health services to recruit parents to trial the Growing healthy app and engaged them by providing a face-to-face briefing session. They were asked to promote the program to potential participants using the following methods,

- handing out program brochures at routine appointments
- displaying posters in waiting rooms in participating clinics, centres and practices
- asking interested parents to complete an expression of interest form.

The general practices involved in the study also sent a letter of invitation to women registered in the practice who were in the final trimester of pregnancy or who had an infant less than three months of age.

Online recruitment was added during the recruitment period to help boost numbers enrolling in the trial. This resulted in the recruitment of 50% of the participants. It involved advertising the program on a range of parenting websites and forums including five Facebook status updates aimed at and widely followed by parents of young children and a capped price official Facebook advertising package.

Recruitment results

A total of 909 parents completed the baseline survey during the baseline data collection period. Participants with incomplete surveys, inconsistent date of birth, a baby age ≥15 weeks, a baby with disability that affect infant feeding, or a premature infant born before 37 weeks of pregnancy were excluded from the study. This resulted in a final sample of 646 participants at baseline with 301 in the Growing healthy intervention group and 345 in the control group. Both groups were asked to provide basic demographic data and detailed information on infant feeding. There were no significant differences between the groups in maternal education, marital status or ethnicity at baseline. Mothers in the control group were slightly older on average (31.3 v 30.4 years, P<0.001) and more likely to be breastfeeding (70.7 v 64.8% P=0.017) than mothers in the control group. Participants in the intervention group were more likely to be first time parents (57.8% v 38.5%, P<0.0001) than those in the control group.

We found using online recruitment leveraging social media sites to be the most time and cost effective recruitment strategy used. However, we cannot yet assess whether participants recruited via their primary health providers viewed the app differently in terms of reliability or credibility. Although it is more resource intensive than online recruitment, using primary health care services as a source of recruitment is still a possible strategy given the extent that families with young children rely heavily on primary health care services across all socio-demographic groups.

Baseline characteristics

The characteristics of the parents who were using the app were analysed to determine whether we reached our target audience. Baseline knowledge, behaviours and information with respect to infant feeding were analysed so that changes can be identified over time. We aimed to recruit from areas of relative disadvantage, and also used maternal education as a proxy for socioeconomic status. Baseline data indicates that less than half the sample had a university education, while about 20% of our sample had a high school education or less. The mean age of the babies at baseline was 6.9 weeks for the intervention group and 7.8 weeks for the control. The age at recruitment could impact the intervention's capacity to achieve a key outcome-that is promoting breastfeeding as only two thirds of mothers were breastfeeding with almost 20% mixed feeding and the remaining mothers feeding only infant formula.

GROWING HEALTHY EVALUATION

Participants were contacted via text message and email when their baby was six and nine months old and asked to complete another survey gathering data on key outcomes including questions on breastfeeding, formula feeding, introduction of solids and diet quality, parental feeding beliefs and behaviours, baby length and weight and (in the nine-month survey only), health service usage. Retention was 77% at six months and 69% at nine months. Analysis of the survey data is currently underway but not available for this report as a small number of participants have not yet reached the nine-month time point. We also conducted telephone interviews with participants to further explore key aspects of the intervention. The interview questions can be found in APPENDIX 5.

PARENT INTERVIEWS

There were a lot of outcomes we sought to explore with parents and as we understood that parents of new babies are time poor, we decided to conduct two separate interview studies - one focusing on the milk feeding outcomes and one focusing on the introduction of solids. Parents were only asked to participate in one of the interviews and only if they had indicated their willingness to do so in the surveys.

Interview study #1

Twenty-four parents were interviewed when they had completed the six-month survey about the breast and formula feeding aspects of the intervention. Mothers were invited based on their feeding method and education as we aimed to get a range of views.

Interview study #2

This study was focused on engagement with the app and introduction of solid food. Participants were 20 parents who had completed the nine-month survey. Parents with and without university education were invited to participate to ensure we spoke with our target demographic. All of the participants were mothers.

Summary of findings from parent interviews

Most mothers reported that the app content was trustworthy and reliable with some mentioning that the university branding gave them confidence in the app compared with the much of the information available of the web. Some felt there wasn't enough information provided in the app. However on further exploration, we found that this was an implementation issue. On some phones the content was harder to access because users needed to 'turn the page' rather than scroll to read content.

The mothers felt the app was a convenient source of information and liked that the push notifications were personalised and tailored to their baby's age and feeding method. Mothers who were formula feeding reported that the information was useful, reliable and delivered in a non-judgemental tone. They also appreciated that messages sent to them provided ways of accessing more information within the app relevant to their baby's age. An important finding was that mothers' engagement with the app declined as their confidence in feeding their baby increased. Once they were confident, they didn't feel they needed the app as much.

The technology issues were a problem for some mothers; some stopped using the app entirely and some feeling that the content might not be reliable either. The mothers' confidence in the app content was also influenced by its consistency with advice from their PHC provider - if the advice was consistent, they trusted it more. This reinforced our findings from the development stage.

Some mothers reported delaying introduction of solids to their baby until about six months old as recommended by the app and their PHC provider. Having information provided about readiness for solids was seen as an important motivator to hold off introducing solids to their baby. However, mothers who introduced solids earlier than was recommended reported feeling annoyed and guilty when they received notifications with advice about delaying the introduction of solids.

HOW IS THE APP USED? APP ANALYTICS

The app incorporates data capture technology to help answer questions about the engagement of the participants, management operational issues such as follow-up, sign-up, surveys and program support.

Data captured for app users includes

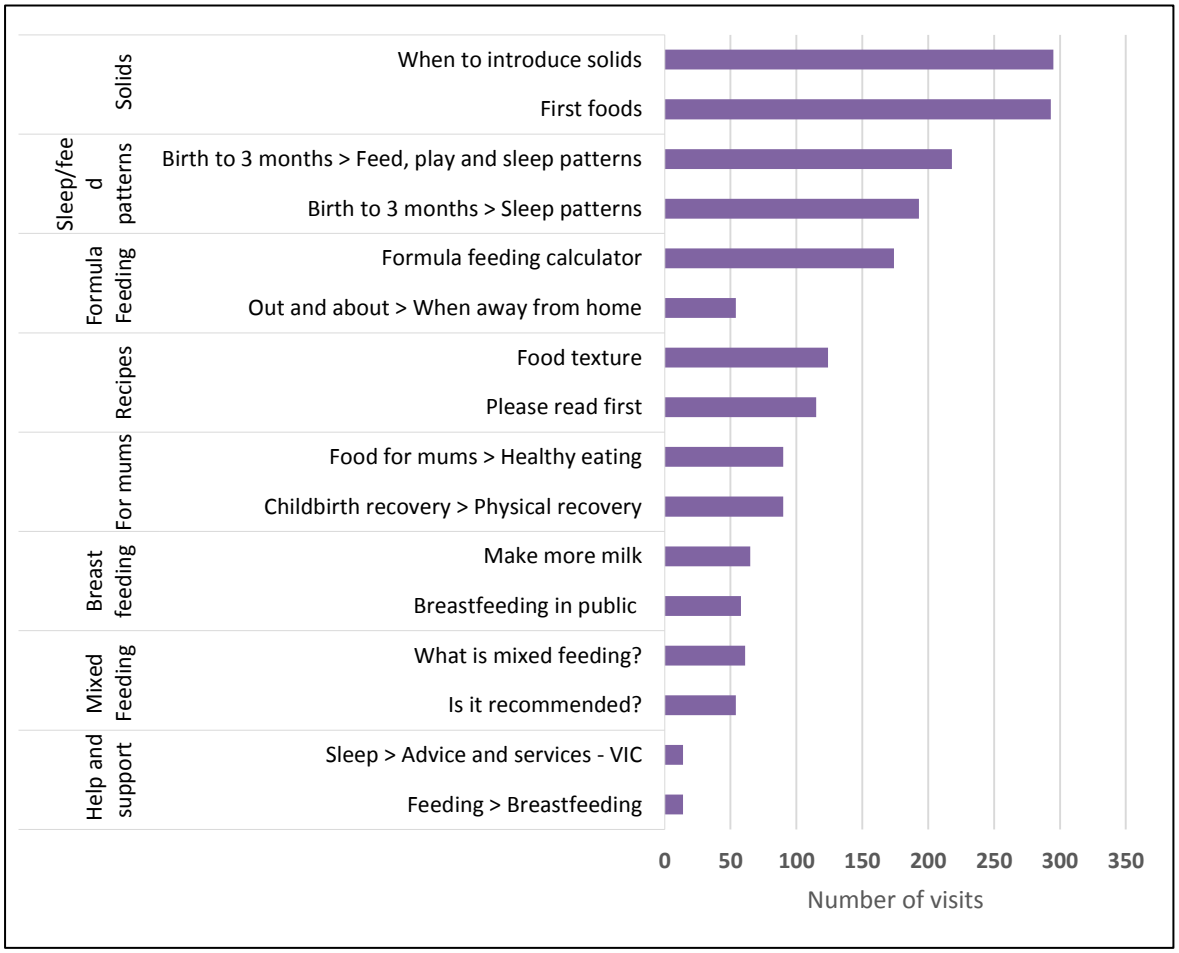
- profile information of participants, including baby's age, mum's contact details and unique activation code that is used to identify a user
- app activities, including when a participant viewed a particular content such as a video or a page in the app, when a push-notification was tapped, and when a survey was started.
- log of app activation

- a database of parents who registered interest to join the program after the birth of their child

The research team is able to see which pages and videos are the most or least popular among the participants and can determine if feeding method or other demographic indicators changed the way the app was used. We can also see which push notifications were most popular and how many push notifications were responded to by each participant.

As participants progressed through the study, the analytics provided insights into how participants engaged with the app. Initial usage data suggest on that on average participants viewed 11 push notifications and the most popular sections are introducing solids and sleep and settling. Subsequent follow up will reveal whether participants who viewed more notifications were more likely to perform the target behaviours. The most commonly viewed pages are summarised in Figure 5.

Figure 5 Most commonly viewed pages on the Growing healthy app per topic



CHALLENGES WITH APP TECHNOLOGY

The technical challenge for the trial was that unexpected systems upgrades to both the Apple and Android operating systems occurred during the course of the study and resulted in the application not working. We were alerted to the problem by parents on the Facebook page and were able to immediately contact our app developer collaborator who instituted a 'fix' to enable the app to resume normal operation. Participants were able to resolve the problem by downloading the app again.

Discussion and implications for policy and practice

The Growing healthy development and feasibility testing highlights several important areas for policy and PHC practice.

MAIN FINDINGS

An opportunity for PHC providers to refer to trusted m-Health applications

Families with young children are frequent users of PHC services and PHC providers see obesity prevention and infant feeding as core business. Many parents, specifically those who use infant formula, feel unsupported and may be practicing feeding behaviours that will lead to over-feeding and excess weight gain. Considering the evidence of an association between some formula feeding behaviours and excess weight gain there seems to be a gap in advice and support for precisely the parents who need it most. The Growing healthy app has the capacity to promoting healthy infant feeding for parents who are breastfeeding but also offers advice and support around key formula feeding practices. Ideally, parents would be offered the app to augment PHC practitioner advice in the antenatal period. This would mean that there is the potential to have an effect on breastfeeding initiation and duration. Given the current recruitment model was limited to recruiting parents in the postnatal period, we were unable to provide support for the parents who had already ceased to breastfeed.

PHC practitioners are busy and a source of reliable information to support their practice could be useful. However an app of this nature needs to be part of routine care- ideally in the antenatal period - to ensure it becomes a natural part of a consultation rather than another thing to remember.

Parents are using m-Health to seek advice about parenting and yet current apps are of mixed and often poor quality. The evidence-based content of Growing healthy was highly valued by parents and an acceptable referral option to PHC providers. This app could provide an ideal option to reinforce key messages from PHC providers and a resource that could be trusted by both parties.

Technology needs to be reliable and keep pace

Parent interviews at the conclusion of the trial suggested that some parents lost confidence in the app and in the content because of technical issues. This was an important lesson during the study and in future versions we will ensure we have technical skills in the research team and better plan for this kind of risk. This was a risk that we had not anticipated or included in our risk strategy.

Other unanticipated issues were that push notifications can be enabled or disabled and some participants did not receive notifications that we had hypothesised would be a key factor in parental engagement. *Via* the Facebook page we were able to alert participants to the need to enable push notifications.

Being able to communicate with the participant using social media was very valuable. As a large proportion of the participants were recruited online, it is fair to assume that they are very comfortable with online notifications about the application – such as advice about solutions to technical problems.

NEXT STEPS

Feedback from parents and practitioners and the app analytics data is being analysed and used to develop a second version of the Growing healthy app. Key changes will include a simplified colour scheme, a change to the landing page so that participants only view content related to their feeding method and the inclusion of section on infant development and play.

The feasibility study suggests that an ideal option would be to partner with a department of health so that the app can be available to all new parents via antenatal and primary health care settings. Making the Growing healthy app a part of routine antenatal and postnatal care would provide support to parents while augmenting advice from PHC providers. The relatively low cost of the app and the potential for high reach make this type of intervention able to be translated into routine care.

LIMITATIONS OF THE GROWING HEALTHY TRIAL

A number of limitations are evident in the Growing healthy trial that limit conclusions.

- We recruited parents in the postnatal period when some infant feeding decisions may have already been made thus limiting the capacity to influence key behaviours like breastfeeding.
- It used a non-randomised concurrent comparison group. The intervention and comparison group were recruited differently, with the latter recruited solely through online sources. A more robust random control trial (RCT) or cluster RCT design was not possible within the study budget and timeframe and thus the aim of the study was to collect data primarily on feasibility to inform a full scale RCT in the future.
- The length of follow up for this study was limited to nine months, again due to study budget and timeframe. Ideally longer term follow up would be preferable to allow for the effect of the intervention to be assessed in later infancy and toddlerhood.

Summary and conclusion

The Growing healthy trial sought to determine the feasibility and acceptability of recruiting mothers to an m-Health intervention targeting infant feeding. Our study suggests that an m-Health program is a feasible method of communicating infant feeding information that aims to promote healthy infant weight gain. Mobile health interventions are low cost and have potential for high reach and translation. Parents are accessing health related information on the web and via app so programs like Growing healthy are a natural fit for their current model of information seeking.

References

1. Laws R, Campbell K, van der Pligt P, et al. The impact of interventions to prevent obesity or improve obesity related behaviours in children (0-5 years) from socioeconomically disadvantaged and/or indigenous families: a systematic review. *BMC public health* 2014; 14(1): 779.
2. Russell CG, Taki, S., Laws, R., Azadi, L., Campbell, K. J., Elliott, R., Denney-Wilson, E. . Effects of parent and child behaviours on overweight and obesity in infants and young children from disadvantaged backgrounds: systematic review with narrative synthesis *BMC public health* 2016; 16(1): 1-13.
3. Gillman MW. Commentary: breastfeeding and obesity—the 2011 Scorecard. *International Journal of Epidemiology* 2011; 40(3): 681-4.
4. Parsons S, Godson JH, Williams SA, Cade JE. Are there intergenerational differences in the diets of young children born to first- and second-generation Pakistani Muslims in Bradford, West Yorkshire, UK? *Journal of Human Nutrition & Dietetics* 1999; 12(2): 113-22.
5. Owen CG, Martin RM, Whincup PH, Smith GD, Cook DG. Effect of Infant Feeding on the Risk of Obesity Across the Life Course: A Quantitative Review of Published Evidence. *Pediatrics* 2005; 115(5): 1367-77.
6. Abraham EC, Godwin J, Sherriff A, Armstrong J. Infant feeding in relation to eating patterns in the second year of life and weight status in the fourth year. *Public Health Nutrition* 2012; 15(9): 1705-14.
7. Worobey J, Lopez MI, Hoffman DJ. Maternal behavior and infant weight gain in the first year. *Journal Of Nutrition Education And Behavior* 2009; 41(3): 169-75.
8. Li R, Fein SB, Grummer-Strawn LM. Do Infants Fed From Bottles Lack Self-regulation of Milk Intake Compared With Directly Breastfed Infants? *Pediatrics* 2010; 125(6): e1386-e93.
9. Huh J, Riggs NR, Spruijt-Metz D, Chou C-P, Huang Z, Pentz M. Identifying patterns of eating and physical activity in children: a latent class analysis of obesity risk. *Obesity* (Silver Spring, Md) 2011; 19(3): 652-8.
10. Cunningham C SF. Indigenous by definition, experience, or world view. *British Medical Journal (Clinical Research Edition)* 2003; 327(7412): 403-4.
11. Hawkins S, Cole T, Law C. Examining the relationship between maternal employment and health behaviours in 5-year-old British children. *Journal of epidemiology and community health* 2009; 63(12): 999-1004.
12. Laws R CK, van der Pligt P, Ball K, Lynch J, Russell G, Denney-Wilson. Obesity prevention in early life: an opportunity to better support the role of Maternal and Child Health Nurses in Australia. *BMC Nursing* 2015; 14(26).
13. Russell CG TS, Azadi L, Campbell KJ, Laws R, Elliott R, Denney-Wilson E. A qualitative study of the infant feeding beliefs and behaviours of mothers with low educational attainment. *BMC Pediatrics* 2016; 16(1).
14. Michie S JM, Francis J, Hardeman W, Eccles M. . From theory to intervention: mapping theoretically derived behavioural determinants to behaviour change techniques. . *Applied psychology* 2008; 57(4): 660-80.
15. Horodynski M, Olson B, Arndt MJ, Brophy-Herb H, Shirer K, Shemanski R. Low-Income Mothers' Decisions Regarding When and Why to Introduce Solid Foods to Their Infants: Influencing Factors. *Journal of Community Health Nursing* 2007; 24(2): 101-18.
16. Spence A CK, Crawford D, McNaughton S, Hesketh K. Mediators of improved child diet quality following a health promotion intervention: the Melbourne InFANT Program. *International Journal of Behavioral Nutrition and Physical Activity* 2014; 11(1): 137.

17. Boyington JA JA. Maternal perception of body size as a determinant of infant adiposity in an African-American community. J*ournal of the National Medical Association* 2004; 96(3).
18. Savage J FJ, Birch L. Parental influence on eating behavior: conception to adolescence. *Journal of Law, Medicine & Ethics* 2007; 35(1): 22-34.
19. Taki S CK, Russell CG, Elliot R, Laws R, Denney-Wilson E. Infant feeding websites and apps: A systematic assessment of quality and content. *Interactive Journal of Medical Research* 2015; 4(3).
20. Karp SM, Lutenbacher M, Dietrich MS. The Associations of Psychosocial Factors and Infant Feeding Beliefs and Practices of Young, First Time, Low Income Mothers. *Issues in Comprehensive Pediatric Nursing* 2010; 33(4): 268-87.
21. Heinig MJ, Ishii KD, Banuelos JL, Campbell E, O'Loughlin C, Vera Becerra LE. Sources and acceptance of infant-feeding advice among low-income women. *Journal of Human Lactation* 2009; 25(2): 163-72.
22. Redsell SA, Atkinson P, Nathan D, Siriwardena AN, Swift JA, Glazebrook C. Parents beliefs about appropriate infant size, growth and feeding behaviour: implications for the prevention of childhood obesity. *BMC public health* 2010; 10: 711-20.
23. Australian Bureau of Statistics. *Socio-Economic Indexes for Areas,* 2011.
24. NHMRC. *Infant feeding guidelines for health workers.* 2013.
25. Michie S, van Stralen MM, West R. The behaviour change wheel: a new method for characterising and designing behaviour change interventions. *Implementation Sciences* 2011; 6: 42.

Appendices

APPENDIX 1: INTERVIEW QUESTIONS BY COM-B FRAMEWORK - PARENT INTERVIEWS

Introduction: (ask to all mothers)

Thank you for agreeing to be interviewed for this study. In this interview, I'd like to hear your story about your experience feeding your baby. Please be assured that there are no right or wrong answers; I would just like to hear about your experiences. If at any time you are unclear about a question, let me know to clarify, and if you don't want to answer a particular question that is also fine.

So when we last spoke, you gave me a few details about yourself and your baby. Your baby is a little boy/girl who is XX months old. Is that correct?

SECTION 1: General information on type of milk feeding (ask all mums)

You've told me that you are breastfeeding/formula feeding/mixed feeding your baby.

If breastfeeding or formula feeding:

a. Can you tell me if you are *only* breastfeeding/formula feeding? Meaning, your baby doesn't receive any other type of milk or fluid or solids?

If mixed feeding:

a. Can you give me an idea of how much breastfeeding you are doing and how much formula feeding you are doing?

   i. *prompts: how many feeds per day are breastmilk/formula, is it a 50/50 split, etc*

SECTION 2: Feeding to appetite (ask all mums)

Let's start with you giving me an idea of a typical day of feeding your baby:

a. What does a typical day for you look like in terms of feeding your baby?
   i. *Prompts: how much do you feed your baby, how long do you feed your baby, how often do you feed your baby?*
b. IF NOT answered from above: How many feeds does your baby have each day?
c. How do you know when to feed your baby?
   i. *Prompts: is it a routine based on the clock or do you do on demand as baby seems hungry?*

ii. If 'on demand': how do you know when your baby is hungry, for example, what signs do you look out for?

d. If formula feeding or mixed feeding: Is there a particular amount that you try to feed him/her each day? Why?
e. If only breastfeeding: Do you breastfeed for a set amount of time or do you let your baby suckle for as long as they like?
f. Have you been provided with **support** or **advice** from anyone or anywhere about how when and how much to feed your baby?
    i. What advice?
    ii. Has it influenced you? (If yes, in what way)

SECTION 3: Initiating breastfeeding (ask all mums)

Let's go back for a moment to when you were pregnant and your baby was first born…

a. Can you remember how you felt about the idea of breastfeeding when you were pregnant?
b. Did you **know** much about breastfeeding? Such as?
c. When you were pregnant did you think about whether you **wanted** to only breastfeed or only formula feed him/her or do both? Why?
d. So you had/hadn't **planned** on how you might feed him/her

    If yes:

    i. When did you make the decision to breastfeed/formula/both?
    ii. If *any* breastfeeding (ie mixed or exclusive): did you have in mind how long you would like to breastfeed for?

    If no:

    i. At what point did you decide how to feed your baby? **(Try to get as specific as possible – e.g. last trimester, at birth, 2 weeks later, antenatal classes, etc)**

e. Was there anything in particular that influenced your desire or **plan** to breastfeed/formula feed
    i. *Prompts: nutrition knowledge, behaviours and development, capability, support from people, antenatal education?*
f. Did you receive any **support or advice** from anyone or anywhere about breastfeeding or formula feeding
    i. Prompts: family, friends, media, antenatal education

    If yes:

ii. Was this before or after the birth of your baby?

iii. What was the advice and support? Did it influence you?

g. Did you feel any differently about your feeding decision once your baby was born?

l. Prompts: did you still want to, what changed your mind about it, what would have helped?

h. Do the mothers that you know usually breastfeed or formula feed?

i. Do you think what they do has influenced you? How so?

SECTION 4. SELF-EFFICACY FOR EXCLUSIVE BREASTFEEDERS OR MIX FEEDERS (skip to Section 4.1 for mothers who started, but stopped breastfeeding, and Section 4.2 for exclusive formula feeders)

a. Do you feel that you **know** how to breastfeed well now *(Prompts: babies' needs met, mothers needs met, comfort)?*

b. Do you feel **confident** about it? Why/why not?

c. Are you still planning to breastfeed for **X** (answer from **Section 3 D(ii)** above)?

d. What sorts of things do you think will influence how long you breastfeed for? *(Prompts: nutritional content, convenience, sleep better with BF or formula, work, friends)*

e. Do you feel well **supported,** practically or emotionally in breastfeeding your baby? *(Prompts: health professionals, media/websites, family)*

i. If yes: why/how?

i. If no: why/how

f. Which do you think is easier: breastfeeding or formula feeding? Why?

g. What has influenced you to **continue** breastfeeding? *(Prompts: what attribute success to? Partner support, ease of breastfeeding, desire to want to do it, cost savings, etc)*

For mothers that are mix feeding, go to section 4.2; For mothers exclusively breastfeeding, ddddgo to section5.

SECTION 4.1 WHY STOPPED BREASTFEEDING

a. You mentioned you breastfed for X days/weeks/months? What was the main reason for stopping then?

b. What influenced your decision to stop? (prompts: support, confidence, nutritional content, other people)
c. Was stopping something you **wanted** to do?
d. Was stopping at that time something you had **planned** on doing?
e. Were you provided with any **advice** from anywhere to stop breastfeeding?

Is there anything that you think would have made you want to / be able to continue breastfeeding for longer? *(Prompts: support, confidence, what would've helped)*

SECTION 4.2 EXCLUSIVELY FORMULA FED OR MIX FED

You've mentioned that you are feeding your baby formula

a. Do you usually buy the same type of formula for your baby?
b. What influences the type of formula you buy? (cost, type, what friends/others use, etc)
c. How do you **know** how to make up the formula?
d. Do you always follow this amount? Why/why not?
e. Do you feel confident with formula feeding now?
f. Do you add anything else to your baby's bottle?
g. Do you put baby to bed with their bottle?
h. Are there any issues around formula feeding that you would like more advice on or feel unclear about?

SECTION 5. MILK FOR NON-NUTRITIVE PURPOSES (Ask all mothers)

I would like to move on and talk about what you would do when your baby is unsettled - when he/she is crying or fussing - and you don't think that they are hungry.

a. What strategies would you usually use when he/she is unsettled?
b. How do you decide on what strategy to use?
c. Have you been provided with any support or advice from anyone about settling your baby? *(Prompt: what advice, did it influence you? How? What help would of you liked?)*

If milk doesn't fall on the list at all: Do you ever use milk to help settle your baby?

If yes:

iii. Do you find it effective?
iv. Is there anything else in particular that has influenced you to use milk to settle your baby when they are unsettled rather than using other techniques like patting, swaddling or rocking?

SECTION 6. AGE OF INTENDED INTRODUCTION OF SOLID FOODS (ask all mothers)

Now let's talk about foods and drinks other than breastmilk and formula.

i. Have you thought about or planned when you would like to first introduce solids to your baby?
    a. **If yes:** When do you plan on introducing solids?
    b. What's helped you make this decision? (Prompts: other people, baby shows interest in food, baby doesn't seem satisfied with milk, etc)

    c. **If no:** What kinds of things do you think will help you decide when is the right time? (Prompts: other people, baby shows interest in food, baby doesn't seem satisfied with milk, etc)

j. With the mothers that you know of, have most of them started their babies with solids at a particular age? Do you think that has/will influence you?

k. Did you receive any support or advice from anyone or anywhere about when to introduce solids foods to your baby?
    a. **If yes:** Who?
    b. What was the advice?
    c. Has it influenced you?

l. The government has put out a recommendation that babies should start solids food at around 6 months of age. How do you feel about this recommendation? Do you think it is realistic?

SECTION 7. FIRST FOODS (ask all mothers)

Thinking about when your baby starts to eat solids…

a. Do you **know** what foods you would like to introduce to him/her first?

b. Have you been provided with any **support or advice** from anyone or anywhere about which foods to introduce to your baby first?
    - what?
    - Has this influenced you?)

c. Are there any foods that you particularly want or don't want for your baby to have initially? Why?

SECTION 8. USE OF THE INTERNET AND PERSPECTIVES ON INTERVENTION CHARACTERISTICS (ask all mothers)

In this very last part of the interview I'd like to ask you some questions about how you use the internet and your phone.

m. Do you use the internet? If yes, continue:

n. Do you own any of the following devices?

   a. Mobile phone - *What kind of phone is it, is it web and app enabled*

   b. Laptops/computers – does it have access to the internet?

   c. Note book, iPad – does it have access to the internet?

o. How do you access the internet? (Prompts: on a computer, on a phone, on a tablet)

p. Where do you access the internet? (Prompts: at home, library, other location)

q. How often do you access the internet? (Prompts: less than once a week, once a week, two to three times a week, everyday, several times a day)

r. Do you use any particular websites for baby information? If yes, list top 3.

s. Do you use Facebook, Twitter, Instagram or any baby apps or online parenting forum?

t. If there were a free service that sent information using the internet to you about feeding your baby, would you sign up?

   a. If yes: How often would you like to receive a message? Daily, 2-3 per week, Weekly, Fortnightly, monthly

   i. If yes: how would you prefer to receive information? (website, blog, email notification, text message notification, app)

ii. If yes: what information do you think the service should offer? I will read you some options:

   i. Examples and videos of other people doing things (mums, health professionals etc)

   ii. Information, for example on which foods to give to your baby, when and how, recipes on preparing solids for infants

iii. Tracking and monitoring devices (e.g. plotting of your child's diet or weight)

i. Information that can be shared with other family members
ii. Social support and connection with other mums
iii. Help with planning a developing strategies to overcome difficulties in feeding

b. What sorts of features would you not like to see in such a service? (Prompt: what do you think would not be useful?)

1. Weight concerns and beliefs: (ask to all mothers)

Now I would like to discuss concerns that mums might have about their baby's weight - whether it be too much or too little.

a. How do you feel about your baby's weight? For example, are you happy with your babies weight or concerned that they are underweight/ growing too slowly or overweight/growing too quickly?
b. Would you prefer your child to be heavier or lighter than they currently are?
c. Do you think that a baby's weight is something that parents can influence? How? Why do you say that?

Wrap up

That is all the questions I have, is there anything else that you would like to add? Thank you and wrap up.

APPENDIX 2: SURVEY AND INTERVIEW QUESTIONS FOR PHC NURSES PRE-INTERVENTION

The 24 question survey took around 15 to 20 min to complete and included questions on:

a. the number and type of consultations currently conducted with young children
b. the frequency with which nurses undertook various activities related to the promotion of healthy eating and active play in young children in a typical consultation (five point Likert scale anchored by never (0 % of consultations) to most of the time (>75 % of consultations),
c. Perceived confidence in undertaking activities described in (b), (five point Likert scale anchored by 'not confident at all' and 'extremely confident,')
d. Views and knowledge regarding infant feeding and TV watching in young children (four point Likert scale anchored by 'strongly disagree' and 'strongly agree')
e. Current use of government guidelines to inform nurse practice on infant feeding, healthy eating, active play and sedentary behaviour
f. Perceived ease of access to relevant support materials and referral services
g. Perceived barriers to promoting healthy weight gain (rating a list of predefined barriers on a three point Likert scale anchored by 'not a barrier at all' and 'substantial barrier')
h. Training received in the past two years on a predefined list of topics related to obesity prevention as well as future training needs (open response).

An interview guide was developed to explore the survey responses in more detail. In particular, factors influencing the obesity prevention practices of MCH nurses, and opportunities to support such practices were expanded upon.

APPENDIX 3: APP CONTENT MAPPED TO AIMS AND OBJECTIVES

1. Promote Breastfeeding			
Program Objectives (target behaviours)	**Key Determinants (theoretical domain)**	**Sample Strategies (intervention function)**	**Push Notification/Text Message**
a. Mother exclusively breastfeeds until the introduction of solid foods	Able to breastfeed without pain/problems Getting appropriate help when needed BF frequently (enough to maintain milk supply) Having enough milk Believing have enough milk (confidence) Not introduce formula early / supplement with formula Commit to breastfeeding exclusively (plan / intend) Be able to breastfeed in public as needed Avoid introducing dummy early / correct dummy use Continuing breastfeeding after returning to work Manage realistic expectations Supportive partner / family / peers	Training (latch, dummy use) Education (breastmilk as normal food for babies, milk supply cycle, checking if baby is getting enough) Support (providing contact numbers for help, information on realistic expectations) Motivate (via messages to set breastfeeding goals, to continue breastfeeding, to seek help and support)	Do you want to breastfeed [y] but find it painful? Ask for help! Most problems can be worked through with the right help. Find help here. (Links to help, baby age 2 weeks) If you are thinking of trying a dummy- Try waiting 1 more week till you set up your milk supply, and learn the best way to use one here. (Links to information on dummies, baby age 3 weeks) Did you know that the more you feed the more milk you make? Read more about milk supply here. (Links to information on milk supply, baby age 5 weeks) How is breastfeeding going? It gets easier as your baby gets older! Focus on your successes knowing you're doing the best thing for your baby (links to information on why to breastfeed, baby age 6 weeks)
b. Mother continues breastfeeding alongside introduction of solid foods and other liquids – for the duration of the intervention (9 months)			
c. Mother provides breast/formula combination over formula exclusively before and after the introduction of solid foods ('mixed feeding')			

2. Best practice formula feeding

Program Objectives (target behaviours)	Key Determinants (theoretical domain)	Sample Strategies (intervention function)	Push Notification/Text Message
a. Mother chooses the most appropriate formula for the infant b. Mother prepares formula correctly (follows instructions on tin for loosely packed, level scoop, correct number of scoops, uses correct scoop, add water first) c. Mother does not add anything else to the bottle (e.g. cereals, honey) d. Mother uses appropriate feeding practices (i.e. cradles baby throughout feed, no bottle cropping, doesn't put baby to bed with bottle) e. Initiates feeding according to baby's hunger level. Does not force baby to start feeding. f. Stops feeding according to baby's hunger level. Doesn't force continuation (stops feeding when infant loses interest, not when formula is finished or a certain volume is consumed) g. Mother does not use milk to sooth infant h. Mother does not give infant formula to promote sleep (by reducing hunger)	Formula if often incorrectly prepared (capability) Cereal is added to formula to promote sleep (motivation) Feeding is used to settle baby or promote sleep and often first response to infant crying (motivation/capability) Baby is put to bed with a bottle to promote sleep (motivation/capability)	Model correct formula preparation using a video (modelling) Educate that adding cereal to the bottle will not help baby sleep (educate) Demonstrate settling strategies (training) and provide information on how to promote better sleep for baby (educate) without use of milk for settling Demonstrate hunger, fullness and sleep cues (education/training) Provide information on baby's ability to self-regulate appetite (education) Provide information on dangers of putting baby to bed with bottle (educate) and strategies to promote better sleep (training) Provide information on dangers of bottle propping (education) and benefits of holding baby while feeding (incentivisation)	Able to make formula in your sleep? Don't forget – always add the water THEN the powder when making up a bottle. More on making formula here (link to step by step instructions and video – baby age 5 weeks) When [y] is crying do you find yourself reaching for the bottle sometimes? Read here for other ways to manage the crying (baby age 4 weeks) Does [y] drink different amounts of formula on different days? This is normal! Read more on how much to feed here (baby age 13 weeks) Tempted to put [y] to bed with a bottle [x]? It's best not to if possible. Find out why here (baby age 27 weeks) Tempted to prop [y] up with a bottle? This can be unsafe and you'd miss the chance for a cuddle! Read more on bottle feeding here (baby age 16 weeks)

3. Delay introduction of solids to around 6 months but not before 4 months

Program Objectives (target behaviours)	Key Determinants (theoretical domain)	Sample Strategies (intervention function)	Push Notification/Text Message
a. Mother begins regular (regular = more than twice a week for several continuous weeks) feeding of solid foods (i.e. anything other than breast milk or formula) around 6 months of age	Belief that introduction of solids will help baby sleep through the night (motivation) Normative influence – everyone else seems to be starting solids at 4 months (motivation)	Provide information and demonstrate skills to promote sleep and settling without non-nutritive feeding (education/training) Provide information about consequences of early introduction of solids and benefits of delaying to 6 months (persuasion) Provide information about signs of readiness to introduce solids (education) Provide support in managing other people's expectation to start solids before 6 months (enablement)	Been told different advice on when to start solids? You're not alone. Watch the advice a dietitian gives a mum experiencing the same here (16 weeks) Did you know starting solids early can affect your baby's health? Until 6 months, milk is all [y] needs! See more on starting solids (baby age 13 weeks) Did you know that introducing solids before 6 months probably won't help [y] sleep at night? See some tips on sleep here (baby age 14 weeks) Wondering if it's finally time to introduce solids? There are a few things that [y] might start doing when it's time – see here (baby age 20 weeks)

4. Healthy first foods

Program Objectives (target behaviours)	Key Determinants (theoretical domain)	Sample Strategies (intervention function)	Push Notification/Text Message
a. Mother introduces healthy iron rich foods as first foods (e.g. infant rice cereal, vegetables) (first foods defined as those foods that infants are given in the first month of eating solids) b. Mother doesn't introduce unhealthy high caloric, energy dense foods and drinks (e.g. processed foods) as first foods c. Appropriate transition to family foods	Lack of cooking skills and reliance on commercial baby food Lack of knowledge about high iron foods and how to prepare them	Demonstration cooking videos and recipes on how to prepare meals for baby based on family meals (education/training) Provide information on high iron foods and how they can be prepared (education /training) Provide information about and demonstrate with cooking videos how to change texture of foods for baby	Guess what [x]? It's time to start [y] on solids! First foods should be high in iron, like meat, fish or lentils – read more (baby age 22 weeks) How are the solids going? Remember to keep on trying different healthy foods and to avoid those high in fat, sugar or salt. Some options here (baby age 25 weeks) Isn't [y] growing quickly? Make sure you change [y]'s food texture to help develop chewing and swallowing muscles. Read more here (baby age 29 weeks) Are you stuck on what to feed [y] at each meal? Tap here for a recipe idea, you can use for the whole family! (baby age 33 weeks)

5. Promotes infant feeding practices for healthy growth

Program Objectives (target behaviours)	Key Determinants (theoretical domain)	Sample Strategies (intervention function)	Push Notification/Text Message
Mother exposes child to healthy new foods (exposure) a. Mother repeatedly exposes child to healthy foods, even if such foods are initially rejected by the child (repeated exposure). b. Mother feeds to appetite, i.e. does not pressure child to eat more than s/he wants (pressure to eat)	• Lack of knowledge about food preference development and addressing 'fussy eating' (capability) • Parents not aware of infants innate ability to self-regulate (capability) • Concern that baby is not getting enough milk/food for growth or sleep (motivation)	• Normalise food rejection and provide strategies to manage (education/training) • Provide information about baby sleep patterns and non-feeding approaches to promoting sleep education/training)	Does [y] spit out new foods? This is normal! It can take 10–15 tries for babies to eat new foods – keep going! More on food rejection (baby age 26 weeks) Wondering how much you should feed [y]? Tap here to learn about 'Parents Provide, Babies Decide' (baby age 33 weeks)

APPENDIX 4: BASELINE QUESTIONNAIRE

SECTION A: ABOUT YOUR BABY

QA1 What is your baby's date of birth?

_____/_____/20_____ **(dd/mm/yyyy)**

QA2 Was your baby born before the due date? Yes / No

If 'yes' how many weeks was she/ he born before the due date _____

QA3 Is your baby a: (Please select *one* response only.)

Boy	O1	Girl	O2

QA4 Is your baby of Aboriginal or Torres Strait Islander origin? (Please select *one* response only.)

No	O1
Yes, Aboriginal	O2
Yes, Torres Strait Islander	O3
Both Aboriginal & Torres strait islander	O4

QA5 Is this your first born baby?
(Please select *one* response only.)

Yes	O1	No	O2

QA6 Does your baby have a disability? (Please select *one* response only.)

Yes	O1	No	O2

If YES, please specify: _____
_____

QA7 How long after your baby was born was he/she placed in skin-to-skin contact with you? *(Please select one response only.)*

Immediately or within a few minutes	○ 1
More than a few minutes and up to half an hour	○ 2
More than half and hour and up to one hour	○ 3
More than one hour and up to two hours	○ 4
More than two hours and up to 24 hours	○ 5

QA8 Looking at your baby's Child Health Record (green/blue book), please go to My *Birth, Details and My Growth and Health record* sections (Green Book) or the *Birth and Newborn* and *6-8 week check* (Blue Book) and copy figures for weight, height and head circumference, at the ages listed, into the table below.

When measures taken	**Date**	**Weight (g)**	**Length(cm)**	**Head circumference(cm)**
Birth				
Most recent				

QA9 Compared with other children, I think my child is: (Please select *one* response only.)

Much easier than average	○ 1
Easier than average	○ 2
Average	○ 3
More difficult than average	○ 4
Much more difficult than average	○ 5

QA10 Do you think your baby is: (Please select *one* response only.)

Underweight	○ 1
About right	○ 2
Overweight	○ 3

QA11

(a) About how many hours/minutes does your baby sleep in total DURING THE NIGHT?
_____hours & _____minutes

(b) About how many hours/minutes does your baby sleep in total DURING THE DAY?
_____hours & _____minutes

QA12 During a typical week, is your baby cared for by someone other than you or your partner?
(Please select *one* response only.)

Yes	O1	Go to QA13
No	O2	Go to QA14

QA13 Approximately how many hours per week is your baby cared for by someone other than you or your partner?

_____hours

QA14 How old was your baby when he/she first regularly used a dummy or pacifier?
(Please record the age of your baby in weeks or months. *Note: a dummy or pacifier is a rubber, plastic, or silicone nipple given to young children to suck upon. It has a teat, mouth shield, and handle.*

O1 _____weeks or _____months

O2 My baby has not used a dummy

SECTION B: FEEDING YOUR BABY

QB1 Has your baby ever had breast milk? (Please select *one* response only.)

Note: Include colostrum, expressed breast milk and breast milk from a donor or donor milk bank

Yes	O1	GO TO QB2
No	O2	GO TO QB3

QB2 Apart from breast milk, has your baby ever had any other fluids or food? (Please select *one* response only.) *Note:* This includes any water, infant formula products, other milks and solids, but NOT oral rehydration solution, or drops/syrups of vitamins, minerals or medicines.

Yes	O1	GO TO QB3
No	O2	GO TO QB6

QB3 What was your baby's age in weeks when you first provided infant formula and/or other food/fluids? (Please enter number. If started at birth write '0').

O1 I gave my baby infant formula when s/he was about …… weeks old

O2 I gave my baby other food/fluids when s/he was about …… weeks old

Note –people do not need answer both of these if not applicable

QB4 What were your <u>main reasons</u> for supplementing or replacing breastmilk with infant formula or other food/fluids (please tick the main reasons that apply):

Breastfeeding was painful	○ 1
I did not have enough breastmilk for baby	○ 2
My baby was not growing well	○ 3
I was not planning to exclusively breastfeed	○ 4
Breastfeeding was too time consuming	○ 5
Breastfeeding was harder than I expected	○ 6
I was not enjoying breastfeeding	○ 7
My baby refused the breast	○ 8
I thought it would help my baby to sleep	○ 9
My baby was unsettled on breastmilk alone	○ 10
I was not comfortable breastfeeding	○ 11
I was not confident breastfeeding	○ 12
My baby was not attaching properly	○ 13
My baby lost interest	○ 14
Mastitis	○ 15
I was uncomfortable breastfeeding in public	○ 16
I was returning to work or had other commitments	○ 17
It did not fit with my social life	○ 18
My baby was old enough to stop	○ 19
It was time for my baby to have other foods	○ 20
Infant formula is as good or almost as good as breastmilk	○ 21
It is more convenient to give infant formula than to breastfeed	○ 22
I wanted to share feeding roles with my partner	○ 23
My partner was supportive of using formula	○ 24
My partner was not supportive of breastfeeding	○ 25
My family was supportive of using formula	○ 26
My family was not supportive of breastfeeding	○ 27
My friends were supportive of using formula	○ 28
My friends were not supportive of breastfeeding	○ 29
Medical reasons for mother – please specify	○ 30
Medical reasons for baby – please specify	○ 31
I planned to formula feed my baby	○ 32
Other, please specify	○ 33

QB5 Since your baby was born, how often has he/she been fed infant formula milk / other foods or fluids? *If your pattern of using infant formula milk or other foods/fluids has varied, please select the answer you feel comes closest to describing your situation.*

	Infant formula	Other foods/fluids
All or almost all feeds	O 1	O 1
About half of all feeds	O 2	O 2
One or two feeds a day	O 3	O 3
A few feeds a week, but not every day	O 4	O 4
A few feeds since he/she was born, but not every week	O 5	O 5
Only once or twice since he/she was born	O 6	O 6

QB6 How are you currently feeding your baby? (Please select *one* response only.)

Breastfeeding exclusively (no other food or fluids, except oral rehydration solution, vitamin/mineral drops/syrup, medicine)	O1 GO TO QB12
Breastfeeding with occasional water or juices, but nothing else	O2 GO TO QB12
Infant formula only	O3 GO TO QB7
Combination of breastmilk and infant formula	O4 GO TO QB8
Combination of breastmilk and solids and water or juices	O5 GO TO QB12
Combination of infant formula and solids and water or juices	O6 GO TO QB7
Combination of breastmilk, infant formula and solids and water or juices	OGG7GO TO QB8 GO TO QB8

G go to QB8

Formula feeding your baby

QB7 How old was your baby when he/she stopped receiving any breastmilk? (Note: include the weaning period, please record age in completed weeks or months. For example, if your baby was 3 and a half months or 12 and a half weeks, record as 3 months OR 12 weeks.)

….. months

or

….. weeks

Never received breastmilk: ○

QB8. Formula feeding your baby

Which brand, and type of formula milk do you usually use? (please fill both boxes)	Brand _____	Type _____
In a typical 24 hour period, how much formula milk does your baby have? (please fill both lines. Please exclude any left over milk)	Amount of formula milk per feed (ml/oz please specify) _____	Number of formula feeds per day _____
Most of the time, how much milk is left in the bottle when your baby has finished feeding? (please select *one* response only)	None ○1 A little ○2 A lot ○3	

QB9 If you make up formula milk from powder… (please select *one* response on each row).

Are the scoops usually?	Rounded/heaped ○1	Flat ○2
Are the scoops usually?	Loosely packed ○1	Tightly packed ○2
What do you add to the bottle first	Powder first ○1	Water first ○2
How many scoops of the formula you currently use to you add per feed	____ number of scoops per feed	

QB10 The following questions ask you about the ways in which you feed your baby formula.

	Never	Rarely	Some-times	Mostly	Always
Do you add more formula powder than is recommended on the tin?	○ 1	○ 2	○ 3	○ 4	○ 5
Do you put infant cereal in his/her bottle so s/he sleeps longer at night?	○ 1	○ 2	○ 3	○ 4	○ 5
Do you hold him/her when giving him/her a bottle?	○ 1	○ 2	○ 3	○ 4	○ 5
Do you put cereal in his/her bottle so s/he stays full longer?	○ 1	○ 2	○ 3	○ 4	○ 5
I believed it is important for him/her to finish all of the formula in his/her bottle.	○ 1	○ 2	○ 3	○ 4	○ 5

If answered c or f in QB6 (infant formula only), skip to QB13 (Other feeding)

Mixed feeding

QB11 When supplementing breastmilk with infant formula do you / did you:

	Never	Rarely	Sometimes	Mostly	Always
Let your baby's appetite guide you about how much formula to give	○ 1	○ 2	○ 3	○ 4	○ 5
Offer the breast before giving formula	○ 1	○ 2	○ 3	○ 4	○ 5
Give extra breastfeeds or expressed breastmilk	○ 1	○ 2	○ 3	○ 4	○ 5
Express breastmilk regularly to boost your breast milk supply					
Give formula feeds to replace breastfeeds	○ 1	○ 2	○ 3	○ 4	○ 5
Give formula feeds in between breastfeeds	○ 1	○ 2	○ 3	○ 4	○ 5
Offer formula feeds straight after breastfeeds	○ 1	○ 2	○ 3	○ 4	○ 5

Breastfeeding your baby

QB12. For each of the following statements, please indicate how much you agree or disagree by circling the number that most closely corresponds to your opinion (1= strongly disagree, 2=disagree, 3= neutral, 4=agree, 5= strongly agree). You may choose any number from 1 to 6.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Not applicable
	1	2	3	4	5	6
I am able to latch my baby on to my breast well	1	2	3	4	5	6
I get professional help when I encounter breastfeeding problems	1	2	3	4	5	6
I have enough breastmilk for my baby	1	2	3	4	5	6
My baby is growing well	1	2	3	4	5	6
I plan to breastfeed my baby exclusively (no other food or fluids) until introducing solid foods	1	2	3	4	5	6
I feel comfortable breastfeeding in public	1	2	3	4	5	6
I plan to keep breastfeeding after I return to work	1	2	3	4	5	6
Breastfeeding is harder than I expected it to be	1	2	3	4	5	6
I am satisfied with my breastfeeding experience	1	2	3	4	5	6
I enjoy breastfeeding	1	2	3	4	5	6
I am confident I can breastfeed well	1	2	3	4	5	6
My partner supports my breastfeeding	1	2	3	4	5	6
My family supports my breastfeeding	1	2	3	4	5	6
My friends support my breastfeeding	1	2	3	4	5	6

About other feeding (all to complete)

QB13 Does your baby have any drink other than breast milk, formula milk or water? e.g. juice, cordial, cow's milk, goat's milk, tea etc. (please shade *one* response).

Yes	○ 1	If yes, please describe _____
No	○ 2	

QB14 The following questions ask you about the ways in which you feed your baby.

	Never	Rarely	Some-times	Mostly	Always
Do you let him/her eat/feed whenever he wanted to?	○ 1	○ 2	○ 3	○ 4	○ 5
Do you worry that s/he is not eating enough?	○ 1	○ 2	○ 3	○ 4	○ 5
Do you only allow him/her to eat/feed at set times?	○ 1	○ 2	○ 3	○ 4	○ 5
Do you let him/her decide when s/he is finished eating/feeding?	○ 1	○ 2	○ 3	○ 4	○ 5
Do you feed him/her extra just to be sure s/he gets enough to eat?	○ 1	○ 2	○ 3	○ 4	○ 5
When s/he gets fussy, is feeding him/her the first thing you do?	○ 1	○ 2	○ 3	○ 4	○ 5
Do you worry that s/he is eating/feeding too much?	○ 1	○ 2	○ 3	○ 4	○ 5
Is it a struggle to get him/her to eat/feed?	○ 1	○ 2	○ 3	○ 4	○ 5
Do you get upset if s/he eats/feeds too much?	○ 1	○ 2	○ 3	○ 4	○ 5
To make sure that s/he does not get fussy, do you feed him/her even if you do not think s/he is hungry?	○ 1	○ 2	○ 3	○ 4	○ 5
Do you talk or sing to your son/daughter when you fed him/her?	○ 1	○ 2	○ 3	○ 4	○ 5
Do you get upset if s/he does not eat enough?	○ 1	○ 2	○ 3	○ 4	○ 5
Does s/he want more than just formula and/or breast milk?	○ 1	○ 2	○ 3	○ 4	○ 5
If you saw a baby who was the same age as your son/daughter, but weighed more, do you feel like you are not doing a good job feeding your son/daughter?	○ 1	○ 2	○ 3	○ 4	○ 5
If I did not encourage him/her to eat/feed, then s/he would not eat/feed enough.	○ 1	○ 2	○ 3	○ 4	○ 5
Feeding him/her is the best way to stop his/her fussiness.	○ 1	○ 2	○ 3	○ 4	○ 5
I know when s/he was hungry.	○ 1	○ 2	○ 3	○ 4	○ 5
S/he eats enough.	○ 1	○ 2	○ 3	○ 4	○ 5
Feeding him/her is the best way to get him/her to sleep longer.	○ 1	○ 2	○ 3	○ 4	○ 5
I am worried that s/he would become underweight.	○ 1	○ 2	○ 3	○ 4	○ 5

I know when s/he was full.	○ 1	○ 2	○ 3	○ 4	○ 5
S/he knows when s/he is hungry.	○ 1	○ 2	○ 3	○ 4	○ 5
I am worried that s/he would become overweight.	○ 1	○ 2	○ 3	○ 4	○ 5
S/he knows when s/he is full.	○ 1	○ 2	○ 3	○ 4	○ 5

SECTION D: ABOUT YOU

All to complete

QD1 What is your date of birth? / / 19 (dd/mm/19yy)

QD2 What is your current postcode? ____ _____ _____ ____

QD3 Please provide your postal address. This is so we can send you a $20 retail gift voucher upon completion of this survey. This information will be kept confidential and separate from the rest of your survey information

Postal address:

_____

QD4 Please provide your email address. This is so we can contact you again when your baby is 6 and 9 months old. This information will be kept confidential and separate from the rest of your survey information

Email address: _____

Confirm email address _____

QD4 How would you rate your health? (Please select *one* response only.)

Poor	Fair	Good	Very good	Excellent
○1	○2	○3	○4	○ 5

QD5 Which of the following best describes your current smoking status? (Please select *one* response only.)

I have never smoked	I used to smoke	I now smoke occasionally	I now smoke regularly
○1	○2	○3	○4

QD6 In which country were you born? (Please select *one* response only.)

Australia	UK	New Zealand	Other
O1	O2	O3	O4

\Other, please specify:_____

QD7 Which of the following best describes your current relationship status? (Please select *one* response only.)

Living in a registered marriage	Living in a defacto relationship	Separated	Divorced	Widowed	Never married
O1	O2	O3	O4	O5	O6

QD8 What is the HIGHEST qualification you, and your spouse/partner, have completed? (Please select *one* response on each line: one for you, and one for your spouse/partner. If you do not have a spouse/partner please select that response below.)

	No formal qualifications	Year 10 or equivalent (e.g. School Certificate)	Year 12 or equivalent (e.g. High School Certificate)	Trade/ apprentice-ship (e.g. hairdresser, chef)	Certificate/diploma (e.g. child-care, technician)	University Degree	Higher University degree (e.g. Graduate Diploma, Masters, PhD)	I do not have a spouse/ partner
Self[a]	O1	O2	O3	O4	O5	O6	O7	
Spouse/ Partner[b]	O1	O2	O3	O4	O5	O6	O7	O8

QD9 Which of the following BEST describes your current MAIN DAILY activities and/or responsibilities, and those of your spouse/partner? (Please select *one* response on each line: one for you, and one for your spouse/partner. If you do not have a spouse/partner please select that response below.)

	Working full-time	Working part-time	Unemployed or laid off	Keeping house and/or raising children full-time	Studying full-time	Retired	I do not have a spouse/ partner
Self[a]	○1	○2	○3	○4	○5	○6	
Spouse/ Partner[b]	○1	○2	○3	○4	○5	○6	○7

The following question asks about your income. This is an important question because income can be related to people's eating, physical activity and health.

QD10 What is the average gross (before tax) income that you and your household receive each WEEK, including wages, salary, pensions and allowances? (Please select *one* response in each column: one for yourself and one for your household.)

	Self[a]	Household[b]
a. No income	○1	○1
b. $1-$119 per week ($1-$6,239 annually)	○2	○2
c. $120-$299 per week ($6,240-$15,999 annually)	○3	○3
d. $300-$599 per week ($16,000-$31,999 annually)	○4	○4
e. $600-$799 per week ($32,000-$41,999 annually)	○5	○5
f. $800-$999 per week ($42,000-$51,999 annually)	○6	○6
g. $1,000-$1,499 per week ($52,000-$77,999 annually)	○7	○7
h. $1,500-1,999 per week ($78,000-$99,999 annually)	○8	○8
i. $2,000 or more per week ($100,000 or more annually)	○9	○9
j. Don't know	○99	○99
k. Don't want to answer	○98	○98
l. Household income is the same as mine		○97

QD11 Do you have a Health Care Card (from CentreLink)? (Please select *one* response only)

Yes	O1
No	O2

QD12 What is your height? ____cm or ___ft/in

QD13 What was your weight prior to the birth of this baby? _____ kg

SECTION E: JOINING THE GROWING HEALTHY PROGRAM

QE1 How did you find out about the Growing Healthy program? (please tick one box only)

☐1 General Practitioner

☐2 Practice Nurse

☐3 Maternal and child health nurse

☐4 Brochure /poster in waiting room

☐5 Brochure in letter from council

☐6 Brochure in pack of information provided by maternal and child health nurse

☐7 Friends

☐8 Family

☐9 If **other** please specify _____

QE3 What type of mobile phone do you own? (this will help us determine how to deliver the Growing Healthy program to you, either via an app or website)

Samsung Galaxy, S3, S4 and S5 GO to QE4

Nexus 5 GO to QE4

HTC One GO to QE4

iPhone 4, 4s, 5, 5s, 5c (with iOS 6 and above – Click [here] to check your iOS version) GO to QE4

Other, please specify: _____ GO E5

QE4 Would you like your partner or another person who looks after your baby to also have access to the Growing Healthy app:

☐1 No

☐2 Yes

If yes, who would you like to have access to the app?

☐ Partner

☐ Grandparent

☐ Your child's carer

☐ Other, please specify_____

QE 5 IF OTHER: As your mobile phone will not support the app, we would like to offer you the website component of the program. This means that you will receive 3 text messages per week on your mobile phone along with a weekly email which will link you to the sections of the website relevant to your baby's age and stage of development. You will receive a confirmation email following completion of this survey, please click on the link to confirm your participation

Please provide your mobile phone number so we can send you text messages:

Mobile phone number _____

QE6: To enable the messages you receive as part of Growing Healthy to be personalised, please provide:

Your first name:_____

Your baby's first name: _____

QE7 Would you like to join the Growing Healthy Facebook page to connect with other parents participating in the program, as well as the project team? (this will be a private Facebook group only open to parents participating in Growing Healthy. The page will be used to post messages to participants on feeding your baby and provide an opportunity to share experiences with other parents)

☐$_1$ Yes

☐$_2$ No

If yes, please provide the following details so we can send you a 'friend request':

Your name as it appears in Facebook:_____

Email address you use for Facebook: _____

END OF SURVEY

APPENDIX 5: GROWING HEALTHY EVALUATION: TELEPHONE INTERVIEWS

Good morning/ Good afternoon (mothers' name) this is Sarah from the University of Technology Sydney calling in regards to the study about your thoughts on the Growing healthy app. We have organised the interview for today on xxx (INSERT DATE of initial contact), are you still ok to go ahead with it now?

IF YES

1. *Remind them that the interview will be recorded if they agree and information will be kept anonymous and de-identified*

start recording

2. *Go through consent form with the participant and get verbal consent.*
3. *Mention the approximate length of the interview (30-40 minutes)*

Did you have a chance to read the information sheet?

***Explain purpose of the interviews** – I have been asked by the Growing healthy team to do these interviews because they wanted to find out peoples' opinion what they thought about the program. There are no right or wrong answers. Just to remind you the interview will go for approximately 30-40 minutes if you do need to leave at any point please do let me know. Are you happy for us to tape record the interview for the purposes of analysis? We will not identify your name or your babies name in the reporting of the interview findings. Also I was wondering if it was possible to have the app/website open in front of you which might help to discuss some questions that I will ask.*

1. Do you remember how you found out about Growing healthy?
2. What was it that made you think you would like to participate?
    a. Did it meet your expectations?
3. What are your overall impressions the 'Growing healthy' app?

SECTION A: *Usability*

There are so many apps out there these days and people have used apps for different reasons. Could you tell me about your experiences using the Growing healthy app

1. In in what situations did you find yourself using the app? **(Metric: sessions)**
    a. for example did you browse the app
    b. did you use it during particular moments
2. How easy was the app to use?
    a. were you able to find you find the information you were looking for?

3. Was there anything you thought should be in the app that was not in there? (information or features?)

1. Aside from GH are there any other apps or websites that you have previously used or are currently still using?
2. When using online sources how do you figure out what information is best to use? (prompt: trustworthy, practical?)
    a. Are there any sources that you found trustworthy more than others?
    b. What about the trustworthiness of the information on the Growing healthy app? Do you find the information realistic/ unrealistic?
3. Can you tell me about any technical difficulties that you experienced using the app? (Prompt: time for page to load, loading the videos, opening the push notifications, receiving push notification)
        a. Did these technical difficulties change the way you used the app? (prompt: did it stop you from using the app?

SECTION B: *specific feeding advice*

We know there is a lot of confusing advice about when to introduce solids to your baby

4. Do you remember at what age you introduced solid to your baby?
5. What were the main reason about why you introduced solids at that particular time?

I will just get you to open the app now…can you see the home page of the app?

6. Have you used the solids section of the app at all?
    a. can you tell me how you used this section of the app?
    b. In what way if any did this section of the app help you?
    c. Do you have any suggestions on how we can improve any parts of this section (prompt: Simpler language, dot points, images, goal setting, more/less information, other kind of information)
    d. Was there anything that wasn't covered in the solids section of the app you would've liked?
    e. Before looking at the app did you ***know*** much about when you should introduce solids to your baby?
        i. What things if any, did you learn from looking at this section of the app about when you should introduce solids to your baby
        ii. In what way if any did this influence what you did?
        iii. How did you know, where did you get that information from?

If didn't use:

a. Was there any particular reason why you didn't look at that section?
b. Was there another section that you used?
c. can you tell me how you used this section of the app?
d. In what way if any did the app help you in the [area of feeding]?
e. Do you have any suggestions on how we can improve any parts of this section (prompt: Simpler language, dot points, images, goal setting, more/less information, other kind of information)
f. Was there anything that wasn't covered in **(that section)** of the app you would've liked?

SECTION B: *Delivery service and features*

There are a variety of features that were offered on Growing healthy to the users which I would like to discuss your thoughts on.

B1. Push notifications

As part of the Growing healthy program you were sent three push notifications that were developed to suit your babies' age and current feeding behaviour.)

7. Do you remember getting any push notifications?
   If used PNs:
8. Can you tell me about how you used the push notifications? (prompts: did you usually read or ignore the notifications, why)
9. What did you think of the messages? (Relevant, helpful, frequency etc..)
10. What would make you tap on a push notification? (prompt: content? Timing of the notification)

B2. Facebook

While signing up to the Growing healthy program you were offered to join the Facebook group. Do you remember if you joined up or not?

If they didn't:

a. Is there a particular reason why you did not want to join the FB group?

If they did:

b. What was your experience in using the Facebook group? (what did you think of it?)
c. How useful did you find the posts on FB? (why/why not)
d. What other things would you of like to see posted on Facebook?

B3. App access to another carer

If you remember you were also provided with the option to share the app with another carer. Meaning that you would receive another code so that the other carer would also have access to the app as well as the push notifications that you receive

11. Did you take the option of having your partner or another carer to have access to the app?
    a. Who else used the app?
    b. How did you find that?

If didn't use

Was there a reason why you didn't take it up?

B4. Interconnectivity – Sharing information

If you would like to open the app again and tap on any section of the app, you will notice there is a symbol on the top right hand corner that is a box with an arrow pointing up. This is another feature on the app which allows you to share any of the information to friends and family that use other social networking apps like Whatsapp, Facebook, Telegram etc…

12. Have you ever used this feature on the app?
13. How useful do you think this feature is?

B5. Videos

There were a couple of videos that were available in the app.

14. Did you watch any of the videos?
15. How useful did you find the information from the videos'?
16. What other videos would you of liked to see around feeding?

SECTION C: Quality

I would now like to discuss your thoughts on the quality of the Growing healthy app/website. So if you have closed the app would you please be able to open it again and I would like to get your thoughts around a few quality aspects of the app.

C1. Design

We know that the font, images and colours can have an impact on whether the app would appeal to some people. So I would like to get your thoughts around that.

17. What did you think of the look of the app?
18. Do you think we can improve the look of the app in any way? Which sections? What aspects (font, colours, images)

Thank you very much for your time and patients in this interview. I do have one last question that I would love to ask you.

C2. Navigation

I'll get you to open up the home page of the app again.

19. What do you think about the way the app was set out?

20. Were there any times you struggled to find the information you wanted?

That are all the questions that I have for you today. Is there anything else that you would like include about the app or anything to do with Growing healthy before I do let you go?

Thank you for your time taken for this interview and sharing your thoughts with us about the Growing Healthy program we really appreciate it.