HEALTH SCIENCE Public Health - Parent Infant Feeding Initiative: Evaluating the effectiveness of a socially connected breastfeeding smartphone application targeting fathers

Summary of Proposed Research Program for Doctor of Philosophy

Title

Parent Infant Feeding Initiative: Evaluating the effectiveness of a socially connected breastfeeding smartphone application targeting fathers

Abstract

Breastfeeding is universally recognised as the optimal way for babies to receive nutrition. Despite concerted effort in areas such as policy, research and community and hospital practice, breastfeeding rates in Australia at six months, and in particular rates of exclusive breastfeeding, remain low. The influence of the father has been identified as one of the most significant factors influencing the breastfeeding behaviour of the mother.

This thesis is part of a broader research project, the Parent Infant Feeding Initiative (PIFI). The PIFI is a four-arm parallel randomised control trial funded by a Healthway Research Project Grant (grant number: 24023) and further develops the work of the Fathers Infant Feeding Initiative (FIFI) implemented by Curtin University researchers in 2008-09 (1). The aim of the PIFI is to develop, implement and measure the effectiveness of three interventions of differing intensity and duration, designed to increase breastfeeding duration and exclusivity, targeted at couples but channelled through the father. It will build on and improve strategies trialled and tested in the FIFI in addition to new innovative strategies.

This PhD study will focus on the development, implementation and evaluation of a socially connected smartphone application. The study will measure the effectiveness of the application in increasing the duration of breastfeeding. The application will be delivered to fathers in two of the study arms. This study will provide insights into the use of mobile technology in health promotion initiatives, and the effectiveness of specific components of the application in effecting outcomes.

Research objectives

Aim

To develop, implement and measure the effectiveness of a socially connected mobile application designed to impact on attitudes, beliefs and self-efficacy of fathers in terms of their ability to offer support to their breastfeeding partners.

Research question

Do mothers whose partners participate in a social support intervention delivered by a smartphone application breastfeed for longer than mothers whose partners do not participate in the intervention?

***Objectives*:**

Objective 1: To determine the impact of the smartphone application intervention on duration of exclusive and any breastfeeding, and psychosocial determinants, up to 26 weeks.

Objective 2: To use process evaluation to determine which design components of the application are effective in reaching and engaging the target group.

Objective 3: To determine which specific design components of the application are associated with outcome measures.

Background

The Parent Infant Feeding Initiative

The PIFI aims to recruit 1200 couples to participate in the study (each arm will have 300 couples). The couples will be randomly assigned to one of the following four arms:

- Control group – Access to the usual hospital administered services
- Medium intervention 1 (M1) – Specialised male-facilitated antenatal class for fathers with take home materials
- Medium intervention 2 (M2) – Social support intervention delivered via smartphone application

- High intervention (HI) – Will receive both M1 and M2.

The smartphone application intervention to be delivered to the father in M2 and HI is the focus of this doctoral research.

Breastfeeding

Breastfeeding is the best nutritional start for infants. The health benefits for infants and mothers associated with breastfeeding are well-documented (2, 3). For infants, breastfeeding offers protection from diarrhoeal and respiratory tract infections, gastrointestinal infections and allergies, as well as some protection from obesity, chronic disease and mental health issues later in life (2, 4-7). For mothers, health benefits include weight loss, protection against ovarian and premenopausal breast cancer, improved blood glucose readings in women with gestational diabetes and improvement in bone remineralisation levels post lactation (8, 9). Breastfeeding can also help promote attachment development between mother and baby by the regular intimate interaction it requires (10).

Despite strong evidence and the recommendation from the National Health and Medical Research Council of Australia that mothers breastfeed exclusively for the first six months and continue to breastfeed after the introduction of other foods, Australians consistently fall short of this target. Breastfeeding initiation rates are generally good, with 96% of Australian women initiating breastfeeding, however rates decline steadily after this, with only 15% of babies exclusively breastfed at 5 months (11).

Targeting fathers

Support from fathers has been identified as a particularly important factor in breastfeeding duration (12-15). In their 2004 paper, Rempel & Rempel found that the beliefs of the father predicted breastfeeding behaviour to a greater extent than the mother's intentions (16). While fathers typically indicate they are supportive of breastfeeding (17-20), a literature review has highlighted a number of factors that can impact on their level of support. These factors fall into the following categories: social support, knowledge, empowerment and specific barriers (see Table 1).

Table 1: Factors effecting support fathers offer to breastfeeding fathers

Social support (17, 19-26)	**Knowledge** (17-20, 23, 24, 27-29)

- Men feel they do not receive enough social support
- Men are often excluded from family support programs
- Lack of opportunities to learn and share
- Lack of peer support
	Gaps in knowledge exist in:
	- Expectations
	  - How life changes after baby
	  - Breastfeeding expectations
	  - Bonding with baby
	- Support services available, for mothers and fathers
	- Health and other benefits of breastfeeding
	- Practical suggestions to help family

Empowerment (17, 20, 21, 24, 28, 30)	**Barriers (17, 18, 20, 21, 24, 25, 28, 30-33)**
- Lack of recognition of paternal role - Lack of understanding of importance of paternal support for breastfeeding - More information and practical advice needed on how men can better support their family	- Bonding - Concerns around having to postpone bonding with baby until breastfeeding has finished, or on other ways to bond with baby besides feeding - Public breastfeeding - Feeling left out of the relationship (with their partner, with the baby, and with their new family).

While it is widely acknowledged that the inclusion of fathers in parenting programs is ideal, a systematic review published in 2014 found that fathers are often excluded from such programs, and evidence from programs that have included fathers is typically of a low quality (34). There is much research on the important role fathers play in breastfeeding success, but there are few thoroughly evaluated programs that have targeted fathers (35). With the

exception of the FIFI, the few programs that have specifically targeted fathers of breastfed babies have mostly done so solely in the antenatal period, through an antenatal class or a specific education session (35). This is despite the need for broader social support commonly identified by men themselves (17, 19-26).

Use of smartphone technology

The use of smartphones has become virtually ubiquitous in Australia; Australians are particularly enthusiastic adopters of mobile technology (36). In a report released in July 2014, Deloitte put Australian ownership of smartphones for those aged 14 years and over at 81%, with tablet ownership at 53% (37). The growth in smartphone penetration is expected to continue, with ownership in the 15-65 year age group expected to reach 93% by 2018 (38). The number of Australians downloading mobile applications to their devices increased by 85% from 2011 to 2012 (39), with those in the 18-44 year age group being particularly engaged users (36). Recent data from the US reveal that Android and iOS phone users are spending 65% more time using applications than they did two years ago, equating to 30 hours and 15 minutes for each month per user (40).

Perhaps the most marked change in information delivery is the way people view and use the Internet. From 2012 to 2013 the number of webpage views from mobile devices increased by 95% (41). Australians now spend more time accessing the internet from their mobile devices than they do from their PCs (42). As this penetration into the community increases, there are opportunities for health promoters to incorporate technology in program design and delivery.

Smartphone technology in health promotion

Smartphone technology has been incorporated into health promotion programs targeting a number of health behaviours. Some of these include initiatives targeting: new parents (43); physical activity and nutrition (44-47); alcohol (48); suicide prevention (49); and mental health (50, 51). The use of smartphones offers specific benefits in terms of engagement with users (52), one of the most unique of these is the opportunity to deliver Ecological Momentary Interventions (EMI) (53). EMIs are interventions that occur as people participate in their daily lives and happen in real-time (53). Other engagement strategies used in smartphone interventions include the use of social connectivity and gamification, these are described in sections 6.2.2, and 6.2.3.

Technological breastfeeding interventions

While a recent review did not identify any technological breastfeeding interventions targeted at fathers that evaluated breastfeeding outcomes (54), there has been such research targeted at mothers. In 2014, Giglia and Binns conducted a systematic review of breastfeeding website research and found only one eligible study for inclusion in their review (55). They've since reported some positive results from their own Internet intervention (56). The use of SMS has also been implemented with some positive results in interventions targeting mothers including the MumBubConnect project here in Australia (57), and a study in Shanghai, China (58). There is currently research in the UK investigating the efficacy of a breastfeeding application targeting women (59).

Fathers participating in the FIFI identified barriers to support services such as accessibility and flexibility (particularly the need to balance work commitments) and the use of information technology to overcome these barriers was one recommendation (19, 20). A comprehensive formative research study of Western Australian families carried out in 2013 found that parents expressed a need for clinically approved information from trusted, credible sources delivered via smartphone applications (60). The output of this research was the Ngala Healthy Baby, Healthy You application (43).

Social cognitive theory

Social Cognitive Theory (SCT) is a social learning model that operates at the interpersonal level, assuming an interaction between the social environment, the psychosocial determinants of behaviour and

the individual (61, 62). In seeking to understand and predict human behaviour, the theory can help to inform strategies for interventions to motivate and enable people to adopt healthier behaviours (63, 64).

The concept of reciprocal determinism is a key concept in health promotion. The factors that impact on fathers' decisions and capacity to support breastfeeding are broad and include a combination of environmental and personal influences. Recognising this, SCT has been recommended in the literature as a useful framework for breastfeeding interventions that target fathers (24, 65). Combined with the Health Belief Model (66) and Gender Theory (67), it formed part of the theoretical basis of the FIFI (19). There are a number of key constructs that influence behaviour according to SCT. These are described in relation to this research in Table 2.

Table 2: Social cognitive theory concepts in relation to this study (table adapted from *Theory at a glance: guide for health promotion practice* (68).

Concept	Definition	PIFI change strategy
Behavioural capability	Having the skills and knowledge needed about a specific behaviour.	The mobile application intervention will offer targeted information that will aim to increase knowledge and skills.
Expectations	In order to learn the behaviour, people need to understand the potential outcomes.	Participants have the opportunity to learn (both from the information provided, as well as from others) how they can support their partner and their family, and how breastfeeding will benefit their baby.
Self-efficacy	The belief the individual has in their ability to do something.	Self-efficacy will be developed via the social support network and information, and conversation posts specifically targeting empowerment and the barriers identified by men.
Observational learning	Learning occurs through observation and modelling from others	Through the social network embedded within the application, participants will have the opportunity to learn from and engage with other men and to act as a role model, or to support others.
Reinforcements	Idea that people take control of, and evaluate their own behaviour in response to reinforcements they receive	Gamification techniques (refer section 6.2.3) within the intervention are designed to increase motivation with reinforcement given both from the technology, and from other fathers within the social network. Men will be encouraged to communicate with their partners.
Reciprocal determinism	The way in which the individual, the environment and the behaviour interact.	As men become more positive about breastfeeding, their role in the breastfeeding triad and their ability to work with their partners as a team, they will further model peer supportive behaviours through the application and increase the strength of the social network. This will help to challenge some of the perceived negative social norms around breastfeeding, and increase their support to their partners (64).

The development of the smartphone application will utilise constructs described in SCT and aim to connect individuals with a focus on observational learning to impact on self-efficacy. The consideration of environmental factors, including the engagement strategies contained within the application and the influence of perceived social norms around issues such as public breastfeeding, as well as the aforementioned personal factors (see Table 1) will help guide the research and evaluation of behavioural outcomes.

In his 2004 paper, *Health Promotion by Social Cognitive Means*, Bandura (63) describes how interactive technologies can be applied to enhance health promotion projects using SCT. Providing individualised interactivity and facilitating social support interventions designed to increase self-efficacy can be ways of enhancing health promotion interventions. Bandura goes on to describe *social mediated pathways*, where media are used to link participants to social support networks and to provide guidance, motivation and the social support needed to achieve the change. The paper highlights a number of specifically designed video game programs that have been successful in increasing self-efficacy in health promotion interventions. One of these is a diabetes game for children where they complete a series of tasks and become better equipped to manage their diabetes (69).

Significance

A paper published in June 2014 included a review of articles from six academic databases, spanning the years 1999 to 2013, using the keywords father, breastfeeding and support (54). The paper reviewed 40 articles, none of which included intervention research with a sample size comparable to the PIFI. Based on these findings, it appears that the PIFI study will be the largest male-partner focused experimental breastfeeding intervention conducted to date.

To our knowledge, there has not been a study that has aimed to use a socially connected, mobile application to deliver targeted support and information to the father with the aim of increasing breastfeeding duration. The use of gamification as an engagement tool for social connectivity is a relatively new approach. Outside of the breastfeeding outcomes we will be evaluating the social design strategies within the app, and examining associations between application usage and various outcomes. This innovative, multi-faceted approach will provide guidance to a boarder public health audience looking to incorporate mobile technology into health promotion projects.

Research method

Phase one: Formative evaluation

This formative evaluative phase will be used to inform the content of the application, as well as the optimal means of engaging with the target group. By investigating the mobile device usage behaviour of participants, as well as asking a series of questions about their experiences with using applications and their needs as new fathers, we will better understand how best to engage fathers with the M2 intervention. Formative evaluation will be carried out via focus groups with members of the target group (new or expectant fathers) and stakeholders (members of the Breastfeeding Stakeholders Interest Group, Fathers and Families Research Program as well as clinicians from the hospital sites).

This formative research phase with fathers will aim to:

- help determine framing for the intervention
- investigate the acceptability of the social design strategies
- ensure content is appropriate and credible
- ensure that the approach is appropriate.

This information will be presented also to stakeholders at one of two separately conducted consultative sessions. This stage will be important in:

- ensuring content is relevant and appropriate ensuring there is broad agreement and understanding of the content
- ensuring any emerging, current issues are included
- engaging staff from the recruitment sites to encourage a sense of ownership of the project.

Participants who agree to be involved in the focus groups will be given the information sheet and required to sign a consent form. Basic demographic information will be collected via a short questionnaire. The focus groups will be recorded by the researcher, who will also take notes for initial emerging themes. The data from the sessions will be transcribed, coded and analysed.

Two to three focus groups will be run with fathers with each aiming to engage eight to ten men. This number is consistent with other studies involving men in breastfeeding focus groups (54). To be eligible to participate, men will either be expecting a child, or have a child under six months of age.

Phase two: Development of the smartphone application

The intervention builds on the findings of the FIFI, incorporating improvements, modifications and a significantly increased sample size. The proposed M2 intervention has been designed based on the FIFI process evaluation and the literature review around what partners of breastfeeding women want and need to enable them to support their partner. Findings from FIFI show social support strategies need to be innovative and targeted (19). Findings and recommendations from the literature (see background section) will be used to inform the development of a smartphone application for the M2 intervention, which will aim to provide information and socially connect men around the central theme of breastfeeding.

The software developer who has been engaged to build the application is a father of young children himself, as well as being a public health researcher, and a developer of a previous evidence-based breastfeeding application. Having a father of very young children provide input into the development and design of the application will help, along with the formative evaluation, to ensure we are building an appropriate, engaging and relevant application.

The application will provide information and support for the antenatal and postnatal periods. It is anticipated that providing a platform for men to discuss, share, and support each other through the breastfeeding journey will impact on the support they can offer their partners. Recognising that there is a need to make the application attractive, useful and of value to men, we have incorporated three main engagement strategies, the use of push notifications, social connectivity and gamification. The proposed application format is included as Appendix 1.

Push notifications

Push notifications are a means by which mobile applications can send information or alerts to users. These notifications will be used to send out discussion topics and polls, inviting users to participate in the conversation. Compared with other notification methods, like email, push notifications are immediate and quick to act upon; swiping the notification takes the users directly to the application, and even into the specific context referenced by the notification. Notifications remain in a list until they are acted upon or removed, meaning they can potentially act as triggers for later action. Use of push notifications means that the onus is not solely on a participant to remember to engage with the service; to some extend the service comes to them.

Socially connectivity

Social connection via technology has a different meaning than it did even 10 years ago. Increasingly people want to interact with technology and use it to socially connect rather than simply using it to receive information (70). People are now socially connected throughout the day, and over a range of platforms. Australians are enthusiastic users of social media with 87% of those aged 14-40 years using at least one social network (71).

Health promotion programs have successfully used socially-connected mobile applications to positively impact mental health, physical activity and nutrition (46, 47, 50, 51, 72). Evaluation of Aurora, a mental health application, reported success in encouraging people to reach out to each other, and in offering social support through the application itself (50). Evaluation of an application for overweight adults suggested that social support networks that create a virtual community are the primary component in creating a successful healthy lifestyle application (72). Vivospace is a gamified online social network that utilised a number of social design strategies to engage users, with promising results (73).

The concept of social support has been used in health promotion initiatives in many different contexts. Social support can be peer-driven or professional in nature; it can happen in a group situation or one-to-

one, delivered face-to-face or over the phone (74). In 1990, Koeske and Koeske investigated the buffering effect social support can have on parental stress and they concluded that the level of social support can impact on self esteem of parents and their reported satisfaction with their parental role (75). Father support is especially important and having a supportive partner may contribute to improved maternal and child health and wellbeing (76, 77)

Gamification

Gamification is the process of using elements of gaming to motivate and encourage people in non-game contexts (78). One of the first mobile applications to successfully use gamification was Foursquare. In this application users 'checked-in' to places they visited regularly and gained points for doing so. In some cases companies offered real world prizes as the popularity of the application increased (for example, Starbucks rewarded application users with free coffee or queue-jumping privileges) the real incentive was the rewarding of virtual accolades, and the competition with others (79).

Gamification elements include badges, leaderboards, points and level challenges (79). Popular applications such as Fitocracy, Runkeeper and Zombie Run have incorporated these game elements to make achieving health goals more engaging and fun. As most popular health applications are commercial in nature, there is little evaluation on the impact of these applications in impacting health behaviour. A recent Australian study of the mental health of young men suggested that gamification may be of value in enhancing engagement and enjoyment with using technology (80).

Gamification is expected to become increasingly popular in health applications (78). Although a number of studies have looked at the application of gamification in health applications (73, 81-83), few have formally evaluated its impact on behaviour change. One study evaluating a gamified diabetes application for adolescents reported improved blood glucose monitoring (84), while another reported greater medication adherence in seniors (82). A review of 132 physical activity and nutrition applications found that the use of gamification was widespread, but that behaviour change theory was not widely incorporated and there was no industry standard for developers (83). Several studies, including the aforementioned review, have called for further investigation of the potential for gamified health applications to impact on behaviour change (81, 83, 84).

Phase three: Application testing

The experimental application will undergo beta testing (rigorous testing to identify and eliminate errors in the software), and will be tested with fathers of infants whose partners have breastfed for usability and appropriateness. This will allow time for adjustments and changes. The use of think-aloud walk throughs are a common methods for user-based testing (85). Using this method, users will verbalise their thoughts as they use the application. Four or five participants will be purposively recruited to this phase. This number is anticipated as being sufficient to identify approximately 75% of usability issues (86). Each participant will also be asked to complete a short questionnaire asking about other features including design, content and the design strategies. Participants will be expectant fathers or fathers of infants six months or under.

Phase four: Intervention

Recruitment and Sites

Recruitment of participants will take place via hospital run antenatal classes in Perth, Western Australia. The proposed sites are: Swan Districts Hospital, Osborne Park Hospital, Rockingham Hospital and Armadale Hospital. The research team are currently working to secure other sites including the St John of God campuses. For couples to be eligible they must have Internet access and own a compatible smartphone (iOS or Android). These two platforms combined account for 95% of the smartphone market share (87). They must also reside within WA, both partners must intend to participate in the rearing of their child and have sufficient English language skills to engage with the intervention. Couples will be ineligible where existing medical conditions in the mother are likely to inhibit the initiation of breastfeeding or exclusive breastfeeding.

A sample size of 300 fathers is required in each arm to enable a 10% or greater difference in prevalence of breastfeeding to be detected at 80% power, at a 5% level of significance. Allowing for a 25% attrition rate, a total of 400 fathers will be recruited to each arm. It is anticipated that recruitment will take approximately 18 months.

Intervention
Once participants have been briefed on the research, given the information and have consented to participate, they will be randomised into one of the four arms. Cluster randomisation will be via the antenatal group, as opposed to the individual, to avoid contamination.

Groups randomised into M2 and HI will receive the smartphone application. As the application will not be made available on the App or GooglePlay stores due to a need to control access, the participant will be emailed instructions on how to install the application on his smartphone. This process is relatively simple, and the researcher has used the method in the past while testing applications for research purposes with very little difficulty experienced by users. The research team and developer will be available to troubleshoot over the phone, or in person if need be.

Phase five: Evaluating the intervention
Figure 1. PIFI study design

		Social support smartphone intervention	
		No	Yes
Male facilitated Antenatal class	No	Control	Medium 2 (M2)
	Yes	Medium 1 (M1)	High Intervention (HI)

The following comparisons will be tested to measure the effect of the application on outcomes (Objective 1):

- Is usage of the application associated with outcome variables in groups M2 and HI, and does receiving antenatal education change the associations?
- Is the application effective overall? Does breastfeeding duration differ between groups M2 and HI (both receive the application) and control and M1?
- Is the application effective in the groups receiving no antenatal education? (M2 cf. Control)
- Is the application effective in the groups who did receive antenatal education? (HI cf. M1)

SCT constructs which mediate the breastfeeding behaviour for example breastfeeding self-efficacy, social support received from the partner, comfort with public breastfeeding, breastfeeding attitudes and knowledge will be tested against the application.

Evaluation of technological interventions requires a multi-layered approach as there are many unique factors that can impact on the outcome. The use of smartphone technology in health promotion Australia is increasing (53, 60, 88), and there remains a need for comprehensive evaluation (89, 90). O'Grady et al. propose an evaluation schema specifically for collaborative adaptive interactive technologies, such as a socially connected smartphone application (90). This framework identifies five areas of evaluative need: People; Content; Technology; Computer Mediated Technology and Health Systems Integration. Evaluation of the application (Objectives 2 and 3) will include consideration of all of these factors; a detailed evaluation plan is included as Appendix 2.

Data collection
Both parents will complete questionnaires at baseline and at 6 weeks and 26 weeks post birth and short breastfeeding status enquiries will be conducted at 12 and 18 weeks with mothers. The questionnaire will be developed as part of the broader PIFI intervention with input from the research student from that project. The following validated measures which measure constructs of the SCT will be considered for use: Iowa Infant Feeding Scale, the Breastfeeding Self Efficacy Scale, the Co-Parenting Scale and the Depression Anxiety Stress Scale (DASS-21).

The questionnaire will measure both the breastfeeding outcomes, as well as the psychosocial factors that may have impacted on any change in breastfeeding behaviour. Evaluative questions about the application will be incorporated into questionnaires for the men to be conducted at 6 and 26 weeks and will be based on SCT and will allow us to test the efficacy of the application on both behaviour, and some of the psychosocial constructs of SCT. Baseline data will be collected using self-completed paper-based questionnaires and follow-up data (weeks 6 and 26) will be collected via online or telephone surveys using Qualtrics software.

Data analysis

Analysis of the efficacy of the application intervention on breastfeeding outcomes will be measured using multivariable survival and logistic regression analysis (Objective 1). Analysis of the efficacy of the application will be also be assessed via comparison of application usage and other outcome variables (Objectives 2 and 3). Usage of the application will be expressed as: time using the app (including time using specific features); number of comments posted; ranking of subjects on the leaderboard (based on number and quality). Correlations between the usage and the outcomes variables (see Section 6.5) will be conducted via Pearson's and Spearmann's Correlation tests, and by comparison of correlations between the groups.

Ethical Issues

Curtin Ethical clearance has been approved for the PIFI project (HR 82/2014) with clearance currently being sought from each of the hospital sites. An additional low risk (Form C) ethics form will be submitted for the formative component of this research.

Facilities and Resources

Office space and equipment will be provided by the School of Public Health. The research project is funded by Healthway (Grant number: 24023) and all costs of application development are covered within this grant. Other costs including focus groups, travel reimbursement and other incidental costs will be covered by the student consumable allowance. A detailed budget is attached as Appendix 3.

Data Storage

Data collected from the application will be stored on a password secured server, accessible only by the research team, and the application developer. Data from the remote server will be regularly backed up, encrypted and stored securely. Personal identifiable information and de-identified questionnaire data will be retained separately for seven years in locked storage. De-identified databases will be kept on the Curtin IT system and will be password restricted with access restricted to the investigators.

Dissemination of findings

A number of opportunities to publish on the proposed research have been identified along with corresponding relevant journals. These are included as Appendix 4.

Timeline

A timeline has been prepared taking into account the requirements of the wider project, as well as this research. Writing will continue throughout the 3.5-year period. A detailed timeline is included as Appendix 5.

Year One: Formative evaluation, application development and testing
Year Two: Recruitment, intervention trial, data collection
Year Three: Recruitment, intervention trial, data collection, data analysis
Year Four: Data analysis, thesis preparation.

References

1. Maycock B, Binns CW, Dhaliwal S, Tohotoa J, Hauck Y, Burns S, et al. Education and Support for Fathers Improves Breastfeeding Rates: A Randomized Controlled Trial. Journal of Human Lactation. 2013 November 1, 2013;29(4):484-90.
2. National Health and Medical Research Council. Infant Feeding Guidelines. Canberra: National Health and Medical Research Council, 2012.
3. World Health Organisation. Global Strategy for Infant and Young Child Feeding, The Optimal Duration of Exclusive Breastfeeding. Geneva: World Health Organisation, 2001.
4. Horta B, Victora C. Long-term effects of breastfeeding: a systematic review. Geneva: World Health Organization, 2013.
5. Labbok MH, Clark D, Goldman AS. Breastfeeding: maintaining an irreplaceable immunological resource. Nature reviews Immunology. 2004 Jul;4(7):565-72. PubMed PMID: 15229475.
6. Monasta L, Batty GD, Cattaneo A, Lutje V, Ronfani L, Van Lenthe FJ, et al. Early-life determinants of overweight and obesity: a review of systematic reviews. Obesity Reviews. 2010;11(0):695-708.
7. Oddy W, Kendall G, Li J, Jacoby P, Robinson M, de Klerk N, et al. The Long-Term Effects of Breastfeeding on Child and Adolescent Mental Health: A Pregnancy Cohort Study Followed for 14 Years. 2009.
8. Labbok MH. Effects of breastfeeding on the mother. Pediatric clinics of North America. 2001 Feb;48(1):143-58. PubMed PMID: 11236722.
9. Ip S, Chung M, Raman G, Chew P, Magila N, DeVine D, et al. Breastfeeding and maternal and child health outcomes in developed countries. Rockville, MD: Agency for Healthcare Research and Quality, 2007.
10. Gribble KD. Mental health, attachment and breastfeeding: Implications for adopted children and their mothers. 2006.
11. Australian Institute of Health and Welfare. 2010 Australian National Infant Feeding Survey: indicator results. Canberra: AIHW, 2011.
12. Scott J, Binns C, Aroni R. The influence of reported paternal attitudes on the decision to breast-feed. J Paediatr Child Health. 1997;33:305-7.
13. Scott JA, Oddy WH, Binns CW, Graham KI. Temporal changes in the determinants of breastfeeding initiation. Birth. 2006;33:37-45.
14. Wolfberg A, Michels K, Shields W, O'Campo P, Bronner Y, Beinstock J. Dads as breastfeeding advocates: results from a randomised controlled trial of an educational intervention. American Journal of Obstetrics and Gynecology. 2004;191:708-12.
15. Kong SKF, Lee DTF. Factors influencing decision to breastfeed. Journal of advanced nursing. 2004;46(4):369-79.
16. Rempel LA, Rempel JK. Partner Influence on Health Behavior Decision-Making: Increasing Breastfeeding Duration. Journal of Social and Personal Relationships. 2004;21(1):92-111.
17. Brown A, Davies R. Fathers' experiences of supporting breastfeeding: challenges for breastfeeding promotion and education. Maternal & Child Nutrition. 2014:n/a-n/a.
18. Sherriff N, Hall V, Pickin M. Fathers' perspectives on breastfeeding: ideas for intervention. British Journal of Midwifery. 2009;17(4):223-7. PubMed PMID: 2010265192. Language: English. Entry Date: 20090605. Revision Date: 20091218. Publication Type: journal article.
19. Tohotoa J, Maycock B, Hauck Y, Howat P, Burns S, Binns C. Supporting mothers to breastfeed: the development and process evaluation of a father inclusive perinatal education support program in Perth, Western Australia. Health Promot Internation. 2011 Sep;26(3):351-61. PubMed PMID: 21156662. English.
20. Tohotoa J, Maycock B, Hauck YL, Howat P, Burns S, Binns CW. Dads make a difference: an exploratory study of paternal support for breastfeeding in Perth, Western Australia. International breastfeeding journal. 2009;4:15. PubMed PMID: 19943958. Pubmed Central PMCID: 2788531.
21. Halle C, Dowd T, Fowler C, Rissel K, Hennessy K, Macnevin R, et al. Supporting fathers in the transition to parenthood. Contemporary Nurse: A Journal for the Australian Nursing Profession.

2008;31(1):57-70. PubMed PMID: 2010185697. Language: English. Entry Date: 20090327. Revision Date: 20120309. Publication Type: journal article.
22. Hannula L, Kaunonen M, Tarkka M-T. A systematic review of professional support interventions for breastfeeding. Journal of Clinical Nursing. 2008;17(9):1132-43.
23. Hearn L, Miller M, Fletcher A. Healthy mothers, healthy families: An online resource for perinatal mothers Perth: ECU Child Health; n.d. Available from: http://www.healthnetworks.health.wa.gov.au/docs/Healthway_HealthyMothers-HealthyFamilies.pdf.
24. Mitchell-Box K, Braun K. Fathers' Thoughts on Breastfeeding and Implications for a Theory-Based Intervention.(Report). Journal of Obstetric, Gynecologic, & Neonatal Nursing. 2012;41(6).
25. Schmied V, Myors K, Wills J, Cooke M. Preparing expectant couples for new-parent experiences: a comparison of two models of antenatal education. The Journal of perinatal education. 2002;11(3):20.
26. Scott J, Landers M, Hughes R, Binns C. Factors associated with breast feeding at discharge and duration of breast feeding amongst two populations of Australian women. Journal of Paediatrics and Child Health. 2001;37:254-61.
27. Cohen R, Lange L, Slusser W. A description of a male-focused breastfeeding promotion corporate lactation program. Journal of human lactation : official journal of International Lactation Consultant Association. 2002;18(1):61-5.
28. Rempel LA, Rempel JK. The breastfeeding team: the role of involved fathers in the breastfeeding family. Journal of human lactation : official journal of International Lactation Consultant Association. 2011 May;27(2):115-21. PubMed PMID: 21173422.
29. Susin LR, Giugliani ER. Inclusion of fathers in an intervention to promote breastfeeding: impact on breastfeeding rates. Journal of Human Lactation. 2008 Nov;24(4):386-92; quiz 451-3. PubMed PMID: 18784322. English.
30. Nyström K, Öhrling K. Parenthood experiences during the child's first year: literature review. Journal of advanced nursing. 2004;46(3):319-30.
31. Gamble D, Morse JM. Fathers Of Breastfed Infants: Postponing and Types of Involvement. Journal of Obstetric, Gynecologic, & Neonatal Nursing. 1993;22(4):358-69.
32. Jordan PL, Wall VR. Breastfeeding and Fathers: Illuminating the Darker Side. Birth. 1990;17(4):210-3.
33. Shaker I, Scott J, A,, Reid M. Infant feeding attitudes of expectant parents: breastfeeding and formula feeding. Journal of advanced nursing. 2004;45(3):260-8.
34. Panter-Brick C, Burgess A, Eggerman M, McAllister F, Pruett K, Leckman J. Practitioner Review: Engaging fathers – recommendations for a game change in parenting interventions based on a systematic review of the global evidence. Journal of Child Psychology and Psychiatry 2014.
35. Mitchell-Box KM, Braun KL. Impact of Male-Partner-Focused Interventions on Breastfeeding Initiation, Exclusivity, and Continuation. Journal of Human Lactation. 2013 November 1, 2013;29(4):473-9.
36. Australian Communications and Media Authority. Mobile apps: putting the 'smart' in smartphones. AMCA, 2013.
37. Deloitte. Media Consumer Survey 2014. Deloitte, 2014.
38. Frost & Sullivan. Australian mobile device usage trends. Frost & Sullivan, 2013.
39. Australian Communications and Media Authority. Smartphones and tablets. Uptake and use in Australia. Canberra: Australian Communications and Media Authority, 2013.
40. Neilsen. Smartphones: So many apps, so much time. Media and Entertainment [Internet]. 2014 21/9/2014. Available from: http://www.nielsen.com/us/en/insights/news/2014/smartphones-so-many-apps--so-much-time.html.
41. Neilsen. Australian online landscape review. February 2013: Neilsen; 2013. Available from: http://www.nielsen.com/content/dam/corporate/au/en/reports/2013/nielsen-au-online-landscape-review-february-2013.pdf.

42. Neilsen. The Australian Online Landscape Review. August 2014. http://www.nielsen.com/content/dam/nielsenglobal/au/docs/reports/online-landscape-review/nielsen-landscape-review-august-2014.pdf: Neilsen, 2014.
43. Hearn L, Miller M, Lester L. Reaching perinatal women online: the Healthy You, Healthy Baby website and app. Journal of obesity. 2014;2014:573928. PubMed PMID: 24872891. Pubmed Central PMCID: 4020447.
44. Ahtinen A, Mattila E, Vaatanen A, Hynninen L, Salminen J, Koskinen E, et al. User experiences of mobile wellness applications in health promotion: User study of Wellness Diary, Mobile Coach and SelfRelax. 2009. p. 1-8.
45. Kirwan M, Duncan MJ, Vandelanotte C, Mummery WK. Design, Development, and Formative Evaluation of a Smartphone Application for Recording and Monitoring Physical Activity Levels: The 10,000 Steps "iStepLog". Health Education & Behavior. 2013 April 1, 2013;40(2):140-51.
46. Dantzig S, Geleijnse G, Halteren A. Toward a persuasive mobile application to reduce sedentary behavior. Personal and Ubiquitous Computing. 2013;17(6):1237-46.
47. Klasnja P, Consolvo S, McDonald DW, Landay JA, Pratt W. Using mobile & personal sensing technologies to support health behavior change in everyday life: lessons learned. AMIA Annual Symposium proceedings / AMIA Symposium AMIA Symposium. 2009;2009:338.
48. Weaver ER, Horyniak DR, Jenkinson R, Dietze P, Lim MSC. Let's get wasted! and other apps: Characteristics, acceptability, and use of alcohol-related smartphone applications. Journal of Medical Internet Research. 2013;15(6).
49. Shand FL, Ridani R, Tighe J, Christensen H. The effectiveness of a suicide prevention app for indigenous Australian youths: study protocol for a randomized controlled trial. Trials. 2013;14.
50. Gay G, Pollak J, Adams P, Leonard JP. Pilot study of Aurora, a social, mobile-phone-based emotion sharing and recording system. Journal of diabetes science and technology. 2011;5(2):325.
51. Proudfoot J, Parker G, Hadzi Pavlovic D, Manicavasagar V, Adler E, Whitton A. Community attitudes to the appropriation of mobile phones for monitoring and managing depression, anxiety, and stress. Journal of medical Internet research. 2010;12(5):e64.
52. Klasnja P, Pratt W. Healthcare in the pocket: Mapping the space of mobile-phone health interventions.(Report). Journal of Biomedical Informatics. 2012;45(1):184.
53. Heron KE, Smyth JM. Ecological momentary interventions: Incorporating mobile technology into psychosocial and health behaviour treatments. British Journal of Health Psychology. 2010;15(1):1-39.
54. Sherriff N, Hall V, Panton C. Engaging and supporting fathers to promote breast feeding: A concept analysis. Midwifery. 2014 6//;30(6):667-77.
55. Giglia R, Binns C. The Effectiveness of the Internet in Improving Breastfeeding Outcomes: A Systematic Review. Journal of Human Lactation. 2014 May 1, 2014;30(2):156-60.
56. Giglia R, Cox K, Zhao Y, Binns C. Exclusive Breastfeeding Increased by an Internet Intervention. 2015.
57. Russell-Bennett R, Gallegos D, Previte J. A digital social marketing approachto breastfeeding. MumBubConnect - A pilot program. University of Queensland and Queensland University of technology, 2011.
58. Jiang H, Li M, Wen LM, Hu Q, Yang D, He G, et al. Effect of short message service on infant feeding practice findings from a community-based study in shanghai, china. JAMA Pediatrics. 2014;168(5):471-8.
59. British Psychological Society. Mobile app to help breastfeeding mums. The British Psychological Society, [Internet]. 2014. Available from: http://www.bps.org.uk/news/mobile-app-help-breastfeeding-mums.
60. Hearn L, Miller M, Fletcher A. Online healthy lifestyle support in the perinatal period: what do women want and do they use it? Australian Journal of Primary Health. 2013;19:313-8.
61. Bandura A. Social foundations of thought and action : a social cognitive theory / Albert Bandura. Englewood Cliffs, N.J.: Englewood Cliffs, N.J. : Prentice-Hall; 1986.

62. Luszczynska A, Schwarzer R. Social Cognitive Theory. In: Conner M, Norman P, editors. Predicting health behaviour : research and practice with social cognition models 2nd ed.. ed. Maidenhead: Maidenhead : Open University Press; 2005.
63. Bandura A. Health Promotion by Social Cognitive Means. Health Education & Behavior. 2004;31(2):143-64.
64. Bandura A. Cultivate Self-efficacy for Personal and Organizational Effectiveness. In: Locke E, editor. Handbook of Principles of Organizational Behavior: Indispensable Knowledge for Evidence-Based Management, 2nd Edition. United Kingdom: John Wiley & Sons Ltd; 2009. p. 179-200.
65. Sharma M, Petosa R. Impact of Expectant Fathers in Breast-Feeding Decisions. Journal of the American Dietetic Association. 1997;97(11):1311-3.
66. Abraham C, Sheeran P. The Health Belief Model. In: Norman MCaP, editor. Predicting Health Behaviour : Research and Practice with Social Cognition Models. Maidenhead: Open University Press; 2005.
67. Connell RW, Messerschmidt JW. Hegemonic masculinity rethinking the concept. 2005. p. 829-59.
68. US Dept of Health and Human Services. Theory at a glance : guide for health promotion practice. National Cancer Institute NCI, National Institutes of H, Health USDo, Human S, editors2005.
69. Brown SJ, Lieberman DA, Gemeny BA, Fan YC, Wilson DM, Pasta DJ. Educational video game for juvenile diabetes: Results of a controlled trial. Informatics for Health and Social Care. 1997;22(1):77-89.
70. Hanson C, Thackeray M, B,, Neiger B, McIntyre E. Integrating Web 2.0 in health education preparation and practice. American Journal of Health Education. 2008;39(3):157- 66.
71. Sensis. Yellow social media report. Sensis, AIMIA, 2013.
72. Fukuoka Y, Kamitani E, Bonnet K, Lindgren T. Real-time social support through a mobile virtual community to improve healthy behavior in overweight and sedentary adults: A focus group analysis. Journal of Medical Internet Research. 2011;13(3).
73. Kamal N, Fels S, Fergusson M. Online social networks for health behaviour change: Designing to increase socialization. Computers in Human Behavior. 2014 (0).
74. Hogan BE, Linden W, Najarian B. Social support interventions: Do they work? 2002. p. 381-440.
75. Koeske GF, Koeske RD. The buffering effect of the social support on parental stress American Journal of Orthopsychiatry. 1990;60(3):440-51.
76. Tanner Stapleton LR, Schetter CD, Westling E, Rini C, Glynn LM, Hobel CJ, et al. Perceived partner support in pregnancy predicts lower maternal and infant distress. Journal of Family Psychology. 2012;26(3):453-63.
77. Dennis CL, Ross L. Women's perceptions of partner support and conflict in the development of postpartum depressive symptoms. Journal of advanced nursing. 2006;56(6):588-99.
78. King D, Greaves F, Exeter C, Darzi A. 'Gamification': Influencing health behaviours with games. J R Soc Med. 2013;106(3):76-8.
79. Zichermann G. Gamification by design : implementing game mechanics in web and mobile apps / Gabe Zichermann and Christopher Cunningham. Cunningham C, editor. Sebastopol: Sebastopol : O'Reilly; 2011.
80. Ellis LA, Collin P, Hurley PJ, Davenport TA, Burns JM, Hickie IB. Young men's attitudes and behaviour in relation to mental health and technology: implications for the development of online mental health services.(Research article). BMC Psychiatry. 2013;13:119.
81. Miller AS, Cafazzo JA, Seto E. A game plan: Gamification design principles in mHealth applications for chronic disease management. Health Informatics Journal. 2014:1460458214537511.
82. Oliveira R, Cherubini M, Oliver N, editors. Exploring persuasive techniques of medication compliance. Proceedings of the 12th ACM international conference on Ubiquitous computing; 2010; New York.
83. Lister C, West JH, Cannon B, Sax T, Brodegard D. Just a Fad? Gamification in Health and Fitness Apps. Journal of Medical Internet Research, Serious Games. 2014;2(2).

84. Cafazzo JA, Casselman M, Hamming N, Katzman DK, Palmert MR. Design of an mHealth App for the Self-management of Adolescent Type 1 Diabetes: A Pilot Study. Journal of Medical Internet Research. 2012;14(3):e70.
85. Jaspers MWM. A comparison of usability methods for testing interactive health technologies: Methodological aspects and empirical evidence. International Journal of Medical Informatics. 2009;78(5):340-53.
86. Nielsen J. Estimating the number of subjects needed for a thinking aloud test. Int J Hum-Comput Stud. 1994;41(3):385-97.
87. Mackay M. Australian mobile phone lifestyle index. 9th Edition - Special topic: Mobile retail. http://www.aimia.com.au: AIMIA, 2013.
88. Wei J, Hollin I, Kachnowski S. A review of the use of mobile phone text messaging in clinical and healthy behaviour interventions. Journal of Telemedicine and Telecare. 2011 January 1, 2011;17(1):41-8.
89. Dennison L, Morrison L, Conway G, Yardley L. Opportunities and Challenges for Smartphone Applications in Supporting Health Behavior Change: Qualitative Study. Journal of Medical Internet Research. 2013;15(4 e(86)).
90. O'Grady L, WItteman H, Bender J, Urowitz S, Wiljer D, Jadad A. Measuring the impact of a moving target: Towards a dynamic framework for evaluating collaborative adaptive interactive technologies. Journal of Medical Internet Research. 2009;11(2).