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# Developing an Online Resource to Support Parents' Search for Apps in The First Year of Parenthood

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Developing an Online Resource to Support Parents' Search for Apps in The First Year of  
Parenthood

by

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A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES  
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## Abstract

### Background

Parents' mobile application (app) use is on the rise due to the affordability of smartphones and the convenience of accessing parenting support 24 hours a day. While apps can assist in parenting, it is hard for parents to find good quality apps that meet their expectations. Therefore, the purpose of this study was to co-create a parenting app directory to support parents' search for apps in the first year of parenthood and co-design a user interface to feature the directory.

### Methods

Spinuzzi's (2005) stages of the participatory design methodology guided this study and the project was divided into three phases. *Phase one*, parenting app review, was conducted to gain insight into the available apps for parents. *Phase 2*, focus group discussions with 18 first-time Canadian parents (15 mothers, 3 fathers) allowed researchers to understand parents' needs and preferences. *Phase three*, design sessions were conducted with three parents (two fathers and one mother) to learn about parents' preferred design elements.

### Results

In *phase one*, app review, 4,300 apps were identified on the initial search, of which only 16 (0.4%) apps met the quality criteria reflecting the extent of the problem parents face in finding quality parenting apps. The quality apps were further reviewed by parents in *phase two*, focus group discussions, to finalize the selection of apps and resulted in the co-development of the partnering app directory. The focus group discussions also explored parents' needs and preferences and the inductive thematic

analysis resulted in four themes. *Phase three*, design sessions, led to the co-creation of a user interface to feature the app directory.

## **Conclusion**

Despite the availability of evidence-based apps, parents continue to report difficulties in finding desired quality apps. The app directory is one of the solutions that establishes easy access to quality parenting apps. Initiatives should be taken within the healthcare system to equip frontline nurses and other healthcare professionals with adequate knowledge and training to support contemporary parents' needs via digital means.

## Preface

This dissertation is a combination of manuscripts and chapters written to fulfill graduate studies thesis requirement. It includes two published manuscripts (Chapters 3 and 4), two unpublished manuscripts (Chapter 2 and 5) as well as an introductory and concluding chapter. The first author, Anila Virani, developed all four manuscripts with the guidance of her supervisor and supervisory committee members and played a key role in the preparation and publication of the manuscripts at all stages. All authors participated in the final manuscript review and provided intellectual contributions. One supervisory committee member Dr. Stroulia chose not to participate in the final manuscript review, however, she was part of the project concept, design, and provided feedback in the successful completion of the project. Thus, her contribution was recognized in the acknowledgments section of each publication.

- **Chapter 1 (Introduction):** Overview of the study background, purpose, methodology, study phases, significance, and contribution of the research.
- **Chapter 2 (Manuscript 1):** Virani, A. Duffett-Leger, L. & Letourneau, N. Parents' use of mobile applications in the first year of parenthood: A narrative review of the literature. *Internet Research*. (under review-submitted May 2020).
- **Chapter 3 (Manuscript 2):** Virani, A. Duffett-Leger, L. & Letourneau, N. (2019). Parenting apps review: In search of good quality apps. *mHealth*, 5(44). doi:10.21037/mhealth.2019.08.10. The following link can be used to access the publication <http://mhealth.amegroups.com/article/view/29870/pdf>.

- **Chapter 4 (Manuscript 3):** Virani, A. Duffett-Leger, L. & Letourneau, N. (2020). Parents' perspective of parenting app use. *Journal of Informatics Nursing*, 5(1). 8-18.
- **Chapter 5 (Manuscript 4):** Virani, A. Duffett-Leger, L. & Letourneau, N. Developing an online resource to support parents' search for mobile apps. *Journal of Mobile Technology in Medicine* (under review-submitted March 2020).
- **Chapter 6 (Conclusion):** Overall discussion of the results and implications for nursing policy, education practice, and research.

## Acknowledgments

The long journey of starting to completion of this doctorate degree was full of challenges especially with a change of three supervisors and two major life events: marriage and having a child. However, these challenges made me stronger, humble and creative to turn situations into my favor and proved that a leap of faith, a strong desire, and hard work always help you bounce back no matter how difficult the circumstances are. “In order to complete our amazing life journey successfully, it is vital that we turn each and every dark tear into a pearl of wisdom, and find the blessing in every curse” (Anthon St. Maarten).

First of all, I would like to thank my husband. Many times, during the process, I lacked motivation and felt like quitting but his incredible support always kept me going. He gave me the courage to move and get back to speed. He always listened to my ranting, lent me a shoulder to cry, and kept saying “I know you can do it”. I am also thankful to my sweet three-year-old daughter for her hugs and kisses, and the understanding of the importance of this achievement in my life to the best of her abilities. She is my angel and the inspiration for this project.

A big thanks to my parents, Ahmed Virani and Naseem Virani, for lovingly taking care of my daughter so I could study and achieve my dreams. I appreciate their love, prayers, understanding, and sacrifices from the bottom of my heart. I would not be able to complete this doctoral degree if they did not support me with my household and parental responsibilities. Just saying a thank you will never be enough to express my gratitude for my parents-in-law (Navroz Nanji and Naseem Nanji), Daulat Nanji, Shams

uncle, my sister Feroza, my niece Urooj and all of my friends for their love, kindness, support, and understanding.

Finally, I would like to thank my previous supervisors: Dr. Green, and Dr. Ewashen for their kindness and support during tough times, my current supervisor Dr. Linda Duffett-Leger and my supervisory committee members Dr. Nicole Letourneau and Dr. Eleni Stroulia for their guidance and support in achieving my goals. I am blessed to have such great support from my supervisor who is a mother of three and achieved her degrees while fulfilling her parenting responsibilities. She very well understood the pressures I felt as a first-time mother while pursuing this degree. Thank you very much, Dr. Linda, for the incredible support. You are an amazing mentor!

## **Dedication**

I dedicate this dissertation to my amazing husband Zeeshan Nanji and to my loving daughter Akira Malika Nanji for making my life beautiful and blessed. I love you very much and I cannot imagine my life without you two.

I would also like to dedicate this dissertation to all the parents of young children who dare to achieve their career dreams while nurturing their little angels. Keep moving and always remember Impossible says I-M-Possible.

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## Chapter 1: Introduction

### Background

First-time parents commonly feel overwhelmed, tired, and fatigued during the first year of their infants' lives. Adjusting to a new role and adapting to infant care demands, especially feed/sleep cycles and physical challenges associated with breastfeeding can be exhausting. Parents tend to redefine self, and their social and professional relationships to meet the expectations of parenthood while managing their household responsibilities. Persistent sleep deprivation and lack of socialization can further pose physiological, psychological, and social strains on parents' lives. While many parents adapt well to these changes, some parents may find it difficult to cope with these challenges and suffer from adverse effects such as postpartum anxiety and depression (Letourneau et al., 2012; Parfitt & Ayers, 2014; Murphey Carter, Price, Champion, & Nichols, 2017).

Most researchers have focused on mothers' struggles and transitions to parenthood, leaving fathers out of the parenting process (Matusicky & Russell, 2009; Pater, 2011; St. George & Fletcher, 2011). Fathers' role has changed in the past couple of decades due to increase in dual-income families, and women's involvement in higher education and paid employment. Fathers are increasingly sharing household responsibilities and participating in infant care (Statistics Canada, 2017). In a qualitative study of 10 first-time Canadian fathers, fathers reported feeling invisible to healthcare professionals and indicated the healthcare system was not ready to support them in their role as first-time fathers (Pater, 2011). In another study, 12 fathers reported inequality

between fathers and mothers for the support provided by nurses (Hrybanova, Ekström, & Thorstensson, 2019).

Early postpartum discharges from hospitals; lack of support from healthcare professionals especially for fathers; and increased affordability and availability of smartphones and the Internet have given rise to the widespread use of mobile applications “apps” among parents (Asiodu et al., 2015; Waters, Dailey, Lee, & Lyndon, 2015, Danbjørg Wagner, & Clemensen, 2014; Orr et al., 2017). In 2018, it was estimated that Canadians owned 38.6 million digital devices, which exceed the estimated number of Canadians (36.5 million) and in three years app usage increased by 74%, with Canadians spending 85% of their online time on apps (Briggs, 2018; Wood, 2017). One study on Canadian parents revealed three out of four Canadian parents own a digital device and reported smartphones as the most preferred device for leading their daily lives (Brisson-Boivin, 2018).

Parents are increasingly using apps to conveniently utilize parenting material around the clock. Parents commonly use informational, tracking, and social support apps to survive the challenges of parenting. Informational apps equip parents with the required knowledge to cater to their infants’ developmental needs while tracking apps allow parents to learn about their infants’ feeding and sleep patterns and identify changes that may require medical attention (Asiodu et al., 2015; Burgess, Watt, Kimble, & Cameron, 2018; Chaudhry, 2016; Houle, Atkinson, Paradis, & Wilson, 2017).

Infant care demands, lack of sleep, fatigue, and disrupted personal and social relationships can make many parents feel depressed and isolated after childbirth (Leahy-Warren, McCarthy, & Corcoran, 2012; Murphey et al., 2017). Parents use social

networking apps to attain support on parenting matters and to regain control over their social lives by connecting with family, friends, and other parents in their own time.

Duggan, Lenhart, Lampe, and Ellison (2015) found that 74% of parents used social media to get parenting support. Another study reported parents used networking apps to make “baby friends” and to join parenting support groups and events (Toombs et al., 2018, p.4). Parents also use apps to edit and share baby photos and play lullabies on their phones to soothe their crying infants. In short, apps have become a crucial part of parents’ lives in supporting their needs (Lupton & Pedersen, 2016; Mindell, Leichman, Puzino, Walters, & Bhullar, 2015).

### **Statement of the Problem**

Despite the widespread use of apps among parents and the launching of several evidence-based apps by research /academic institutions, parents continue to report difficulty in finding quality apps. As a result, they tend to use poor-quality and/or commercial apps that may introduce them to unauthentic content and privacy/security risks (Lupton & Pedersen, 2016; Taki et al., 2015; Zhao et al., 2017a). Researchers have shared three main concerns about the availability and utilization of the good-quality, evidence-based apps that may prevent parents from finding and using such apps. Firstly, while evidenced-based apps are secure and scientifically authentic they may lack appealing features that deter parents from using such apps. Secondly, due to their longer turnaround time (the stringent process of development and testing) compared to poor-quality and/or commercial apps, evidence-based parenting apps are largely unavailable on app stores for public use. Thirdly, these high-quality apps are very low in number, and

finding an evidenced-based app from a pile of poor-quality apps is like looking for a needle in a haystack (Hingle & Patrick, 2016; Jake-Schoffman et al., 2017).

Many parents lack the patience to search through hundreds of apps and tend to select an app from the first few choices, thus finding themselves trapped in a cycle of installing and uninstalling due to issues with functionality, engagement, and design. This situation creates frustrations, wastes time, and exposes parents to issues such as privacy and security of their data and unauthentic information (Hingle & Patrick, 2016; Jake-Schoffman et al., 2017; Lupton, 2016; Zhao et al., 2017a). Many researchers have recognized parents' struggles with app quality and have taken initiatives to support parents by creating awareness regarding the mindful selection of apps, and evaluating app quality by using self-administered tools. However, these approaches are time-consuming and require a higher level of comprehension skills therefore inadequate in supporting parents' use of quality apps (Henson, David, Albright, & Torous, 2019; Lupton & Pedersen, 2016; Moshi, Tooher, & Merlin, 2018; Stoyanov, Hides, Kavanagh, & Wilson, 2016).

### **Study Purpose**

The problem of identifying quality apps is not limited to parents. Many people struggle to locate quality apps and researchers have developed app directories in response to this global issue. Examples of such directories are the NHS (National Health Service) App Library (NHS, 2020), the European Directory of Health Apps (Madelin, 2013), and the Addiction and Mental Health Mobile Application Directory (Alberta Addiction & Mental Health Research Partnership Program, 2019). These directories provide a list of quality apps, narrowing down the search for apps to a few; however, to date, there is no

parent-specific app directory to help parents find good-quality apps. Therefore, the purpose of this study was to co-create easy and efficient access to quality parenting apps in a way that is preferred by parents.

The app directory can be used by any parent; however, first-time parents are selected for this study to provide a better understanding of parents' needs. First-time parents are new to parenting and are adjusting to this new role by learning parenting skills every day such as diaper changing, infant bathing, feeding, and so on. Their unfamiliarity to common parenting situations produces numerous gaps in their knowledge and they seek support more often compared to the parents who have already been exposed to these skills when they had their first child (Barnes, 2013; Krieg, 2007).

Parents of sick infants require additional and disease-specific informational and emotional support compared to healthy families therefore this study was restricted to healthy parents and healthy infants. In this study, serious physical or mental health condition referred to a condition that carries a risk of death or severely impairs parents/infants' daily functioning or quality of life (Kelley & Bollens-Lund, 2018; Richardson et al., 2019).

### **Theoretical Foundations**

The aim of this study was to co-create an interface featuring a parenting app directory thus establishing easy access to quality apps for parents. To co-design a relevant and appealing interface, Participatory Design (PD) methodology was selected. The purpose of PD research is to provide an insight into the users' context and gain a practical understanding of participants' technology use. The idea is to bridge the gap between technical design knowledge and practical uses of the product to-be-developed to produce

workable designs. Bringing researchers/designers and users together shortens the communication distance, allows researchers/designers to access participants' practical knowledge and develop an end product that is appealing to users (Frauenberger, Good, Fitzpatrick, & Iversen, 2015; Simonsen & Robertson, 2013). Therefore, PD methodology was used in this study to co-create a usable, relevant and appealing parenting resource.

PD is derived from participatory action research in which researchers involve community members to identify research needs and develop practical solutions to improve the quality of their lives. Drawing on the basic premise of participatory action research, PD is explicitly concerned with integrating users' voices into the design of technology (Frauenberger et al., 2015; Spinuzzi, 2005). PD is defined as "a set of theories, practices, and studies related to end-users as full participants in activities leading to software and hardware computer products and computer-based activities" (Muller & Druin, 2012, p. 3). Researchers have situated PD in theories of Human Computer Interactions (HCI), design theories, and constructivist theory (Kautz, 2011; Spinuzzi, 2005; Devisch, Huybrech, Ridder, & Martens, 2018) but what makes PD stands out amongst other similar methodologies is the level of users' participation, therefore, participation theory is discussed here in relation to PD and its basic tenets.

The origin of participation theory is dated back in the 1950s and 1960s, an era of rapid industrialization, growth of technology, and an influx of scientific knowledge. Participation was practiced as a top-down approach: experts were responsible for teaching and transferring technological knowledge to users. In the 1970s the participation theory further evolved with initial experimentations of involving users in response to frustrations associated with the ineffectiveness of products developed by experts. Several

participatory traditions emerged to give voice to end-users. PD is one of the methodologies that originated in Scandinavia as a result of labor unions' efforts to democratize the workplace. In the 1980s the form of participation changed from top-down to bottom-up approach to acknowledge the voices of local people and to develop sustainable and usable products. In the 1990s funding bodies started to deem user participation as a condition for funding giving rise to user involvement (Arnstein, 1967; Binder, Brandt, Ehn, & Halse, 2015; Chambers, 1995; Claridge, 2004; Midgley, Hall, Hardiman, & Narine, 1986).

To understand PD, it is very important to unpack the notion of participation. Damodaran (1996) presented three forms of participation: *informative* when users provide information regarding an issue; *consultative* when users provide feedback regarding a predefined or developed product; and *participative* in which users are involved in the design process and influence the design decisions and such form of user involvement is what makes PD different from other methodologies that include users in designing products. Democratic participation that empowers users is at the heart of PD methodology. Democracy in PD research is defined as people who are affected by technology should have an opportunity to have their say in the design process. Together these voices create a common understanding that has an impact on design decisions. Empowerment is associated with users having the power to modify or change the existing situations to improve one's quality of personal, family, or work life. PD researchers/designers allow users to express their views in a safe and respectful environment and make them feel heard. They treat them as partners and appreciate their contribution to designing. They make decisions based on consensual agreements thus making users' feel

valued and empowered (Bjerknes, 1995; Ehn, 1993; Ertner, Kragelund, & Malmberg, 2010).

Prototyping methods are the description of using PD in practice and encouraging users' active participation in the process of designing a new technology (Simonsen & Robertson, 2013). A prototype ensures that the idea works for users and can be used without major issues. If a prototype does not work well it is easy and cheap to discard. Modifying a prototype during iterations is easy compared to redoing or modifying codes in an already-developed Website. Therefore, prototypes are considered a better option to explore, develop, and test new ideas with users to ensure the development of a viable product (Snyder, 2003).

Prototyping methods can be broadly defined as high-fidelity and low-fidelity. High-fidelity methods use computer-based online simulation and communication strategies to engage users in designs. Low-fidelity methods are based on paper mock-ups and use tangible stuff such as office supplies, to depict design decisions (Walker, Takayama, & Landay, 2002). The fidelity of the prototypes explains how close it looks and feels to the real design. A high-fidelity prototype interacts with users through clickable tabs and responds to users' commands compared to a low-fidelity prototype that is static. If needed, a person can play the computer to mimic responses to users' clicks. The look and feel of high-fidelity prototypes are very close to the real product; whereas, paper or low-fidelity prototypes may look like a black and white sketch (Pernice, 2016).

Walker and colleagues (2002) suggested low- and high-fidelity prototypes are equally good at identifying users' preferences and issues with the design. The researchers should choose the fidelity which best suits their practical needs, design goals, and

availability of resources. Therefore, in this study, the student researcher utilized a high-fidelity approach where participants were connected remotely via SMART kapp™ technology due to the inability of parents to be physically present at the design sessions. The interactive prototypes were co-created using Wix, a free Website builder in an iteration of three design sessions, and were further modified via email communication with the participants. The interactive prototypes allowed parents and the student researcher to remotely discuss the prototypes and make design decisions.

### **Brief Overview of the Study and PD Research Process**

Ethics approval for this study was obtained from the Conjoint Health Research Ethics Board (CHREB). (CHREB ID: REB17-2077). The project was designed based on three stages of PD research presented by Spinuzzi (2005).

**Stage 1- initial exploration of work.** This stage implies observing and exploring the user's context, their use, needs, concerns, and preferences regarding the issue under investigation. In the exploratory stage, a review of parenting apps was conducted to gain insight into available parenting apps for normal, healthy Canadian parents of infants (birth to one year). The app review supported the answer to the question: *What types of apps are available to parents to support their parenting in the first year?*

**Stage 2- discovery processes.** This stage is marked by the clarification of users' goals and agreement on desired outcomes through group interactions among users and researchers. Focus group discussions were conducted to understand parents' needs and app use preferences and co-develop a parenting app directory with parents. This phase assisted in answering two questions: *What are the app features that encourage and*

*discourage app use among parents of infants? and Which parenting apps should be included in the parenting app directory?*

**Stage 3- prototyping.** During this stage users and researchers iteratively design the agreed-upon technology. A high-fidelity prototyping technique was used to co-create Webpages prototypes with parents. In phase three, researchers led design sessions with parents to develop the user interface hosting the directory in an effort to answer the following question: *What are the parents' preferred user interface design elements?*

### **Structure of the Dissertation**

This dissertation is a hybrid of stand-alone chapters (Chapter 1 and 6) and manuscripts (Chapter 2, 3, 4, and 5). Chapter 2 (Manuscript 1) presents a review of the literature and Chapter 3, 4, and 5 (Manuscript 2, 3, and 4) explains the three phases of the project: app review, focus group discussions, and design sessions. Two of these manuscripts are already published, and two are under review- submitted for publications. Finally, Chapter 6, the concluding chapter, provides the overall results, and implications for policy, education, practice, and research.

All manuscripts were prepared according to journal guidelines and had different referencing and in-text citation styles. To ensure consistency of this dissertation, all manuscripts are converted into APA style. Permissions for the two published manuscripts are included in Appendix A and B and for unpublished manuscripts, permission form co-authors are included in Appendix C.

**Manuscript 1: literature review.** This chapter is a submitted manuscript and is currently under review for publication in the Internet Research journal. The abstract of this manuscript will also be presented at a conference in the near future.

Manuscript number one provides a narrative review of the literature describing parents' app use from diverse disciplines such as nursing, medicine, health, psychology, and sociology. This chapter draws on exiting literature on parents' use of apps to support their parenting in the first year of parenthood and sets the foundation for the study. The results of the narrative review are categorized using inductive thematic analysis. Four themes emerged: (1) increased app use related to shifts in parenting trends; (2) types of apps available to parents; (3) apps to overcome the digital divide; and (4) factors encouraging and discouraging app use.

The literature review indicated increased use of apps by parents due to evolving circumstances such as shorter postnatal hospital stays; evolving parenting roles and responsibilities; increased geographical distance among families; and the rise of scientific parenting. (Asiodu et al., 2015; Danbjørg et al., 2014; Hearn, & Lester, 2014; Statistics Canada, 2017). Parents used apps to fulfill their infant care, personal, and relationship needs. It was interesting to note that most researchers developed apps to support infant care needs while little attention was given to parents' physical, mental, and social wellbeing.

It is argued that apps and other online resources create a digital divide between people based on demographics and access, however, when it came to parenting apps, the researchers reported the successful use of apps to support vulnerable and disadvantaged parents. For example, the evaluation of the Baby Buddy app, which was created especially for young mothers (under 25 years of age) revealed that it was well-received by the target population and was effective in reducing health disparities (Spiro, 2015).

The literature review also allowed researchers to explore different factors that affect parents' use of apps and dig further into the problems of difficulty in finding good quality apps despite the availability of several evidenced-based apps. It was intriguing to note that parents preferred the functionality and usability of apps over security and content credibility. Several app reviews were found during the literature review critiquing parenting apps but none presented the list of quality apps that can be used by parents thus leaving parents alone to explore good quality apps by themselves. Therefore, the first phase of this project included a review of apps that provided a list of quality apps that parents can use. The app review details are discussed in the second manuscript.

**Manuscript 2: app review.** Chapter 3, app review, is a published manuscript titled *Parenting Apps Review: In Search of Good Quality Apps* in mHealth journal in September 2019. The following link can be used to access the publication <http://mhealth.amegroups.com/article/view/29870/pdf>. The abstract of this app review was also presented at the American Academy of Pediatrics National Conference & Exhibition: Council on Clinical Information Technology, United States in October 2019.

The parenting app review was conducted on the Google Play store to gain insight into currently available apps for parents and find quality apps for the directory. Google Play store was searched mainly due to student investigator's familiarity and access to the Android devices. Mobile App Rating Scale (MARS) was used to appraise the quality of the apps. The MARS is freely available to the public through this link [https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4376132/bin/mhealth\\_v3i1e27\\_app2.pdf](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4376132/bin/mhealth_v3i1e27_app2.pdf) While it is simple and easy to use the scale, the MARS researchers have also provided a

training video on YouTube to support its use that can be accessed via this link

<https://www.youtube.com/watch?v=25vBwJQIOcE>.

The MARS scores an app on four objective assessment domains: engagement, functionality, aesthetics, and information quality. It contains 23 items rated on a 5-point scale (1=inadequate, 2=poor, 3=acceptable, 4=good, and 5=excellent) or not applicable (Stoyanov et al., 2015). Apps that were rated 4 or above were included in the review. Four out of 11 apps received an overall highest score of 4.5/ 5 on the MARS scale. The included apps rated high on functionality and ease of use domain with the lowest score of 4.2 and the highest score of 5/5.

The app review permitted researchers to visualize the extent of the problem. On the initial search, 4,300 apps were found. Out of which only 16 (0.4%) apps met the quality criteria reflecting the scarcity of quality apps compared to poor quality and irrelevant parenting apps. The app review also shed light on the issues that parents face while retrieving parenting apps such as inadequate information/features, lack of credible information/sources, insufficient free features, navigation issues, excessive advertisements, and unnecessary personal information request. The apps review revealed several parenting app categories and allowed researchers to develop an understanding of the types of apps available to parents. These categories were tracking, information, sleeping-aid, and photo sharing.

The *tracking apps* category included apps that allowed parents to record their infants' basic activities and ranged from monitoring a single activity such as growth to all aspects of infant care such as feeding, sleeping, urination, bowel movement, and so on.

While screening, many apps were considered ineligible in this category as the developers

were withholding infant data without any notice after a few days of use, forcing parents to pay to regain access to their data. Only three apps qualified for this category that had most tracking features free for life and apps developers mentioned the paid features to the users in advance.

The second category was *information apps*. Information on feeding, solid food, safe sleep, first aid, and strategies to meaningfully engage with infants were common topics in such apps. However, the major issue found during the screening process with such apps was the lack of credible information. Only five apps were included in this category; out of which, three were developed by a neuroscientist, health ministry, and Red Cross. The other two were HON (Health On Net) certified. HON is a health information review organization that endorses transparent and reliable online health information via certification (Torrey, 2019).

The third category was *sleeping-aid apps* that played lullabies and white noises to soothe the crying infants or to create a sleep routine. The major issues found with such apps were limited access to free lullabies/ white noises and a lack of options to personalize the app. Only three apps were included in this category that had at least more than 20 free unlimited lullabies/ white noises with the option of mixing white noises to create personalized sound mixes for better sleep and soothing. The final category was *photo sharing apps* that were used by parents to privately share their parenting moments with loved ones. However, there were very few free apps in this category and only two met the quality criteria with most free features.

The app review provided the groundwork for the focus group discussions, the next phase of this project, and manuscript number three presents the details of the focus

group discussions and the analysis. The issues that were experienced by the student researcher during app screening guided focus group discussions; the 16 quality apps that met the inclusion criteria were evaluated by parents during the focus groups to finalize the selection of the apps for the directory.

**Manuscript 3: focus group discussions.** Chapter 4, focus group discussions, is a published manuscript titled *Parents' Perspective of Parenting App Use* and was published in the *Journal of Informatics Nursing* in April 2020. The abstract was also presented at the Canadian Nursing Informatics Association Conference, University of New Brunswick, Canada in June 2019.

Eighteen Canadian parents (15 mothers and 3 fathers) participated in four focus group discussions. Discussions were conducted in public library meeting rooms and lasted approximately two hours. Parents were recruited from public libraries, Alberta Health Services perinatal program, and community centers. The discussion guide was comprised of seven questions and two activities exploring parents' app use, their struggles with app search, and preferences. See Appendix D for the focus group discussion questionnaire. Focus group discussions were conducted until data saturation was achieved.

The focus group discussion method was selected over individual interviews to generate a rich understating of participants' attitudes, beliefs, and views on parenting app use. The group dynamics allow researchers to access participants' vocabulary of the issue and the context in which these issues affect their everyday lives. Group interactions stimulate and encourage participants to make connections to various concepts by asking questions, clarifying concerns, and exchanging idea which may not occur during

individual or one on one interviews (Draper & Swift, 2010; Krueger, 2006). Krueger and Casey (2015) shared five features of a focus group “(1) a small group of people who (2) possess certain characteristics, (3) provide qualitative data (4) in a focused discussion (5) to help understand the topic of interest” (p. 6). Focus group discussions are suitable for the issues that are exploratory in nature and target populations’ opinions and motivations provide the qualitative data to understand the issue from participants’ perspectives. Therefore, in this PD research, focus group discussions were incorporated to explore parents’ ideas regarding app use in their everyday lives, their preferences of the parenting apps, and desired app features.

Focus group discussions were transcribed verbatim and analyzed using NVivo 12, qualitative data management software. Thematic analysis of the data was conducted using Clarke and Braun’s (2014) six phases of the thematic analysis process. These phases include (1) familiarizing self with the data through careful reading and rereading of the transcripts; (2) systematically assigning codes, descriptive or conceptual labels that capture potentially meaningful parts of the transcripts, to the data; (3) identifying themes by searching for deeper meaning and recurring patterns across the coded data; (4) revising identified themes by ensuring that the themes capture the essential notion of the dataset and provide data relevant to the overall topic; (5) naming and defining each theme and its relation to other themes and overall topic; and (6) developing the report by finally refining the themes and preparing the data to provide a rich and complex description embedded within participants’ thoughts and perceptions.

Braun and Clarke’s (2006) 15-Point Checklist of Criteria for Good Thematic Analysis and Guba and Lincoln’s criteria to establish trustworthiness (credibility,

dependability, confirmability, and transferability) was used to ensure rigor in this study. In PD research, the power of decision making is shared with users. Researchers' biases are challenged on an ongoing basis during the interactions with participants throughout the process. The interactions of people's values, beliefs, experiences, and understanding regarding the issue and developed product mutually shape the prototype. The rigor in PD research relies on the face validity of the findings that fit reality in the form of a prototype (Badger, 2000; Frauenberger et al., 2015; Guba, 1981; Guba & Lincoln, 1994; Halskov & Hansen, 2015).

Focus group discussion analysis indicated four themes: (1) process of searching for apps; (2) gender variations and app use; (3) commonly used apps, and; (4) alternatives to parenting apps. The analysis revealed although parents' needs are similar, their preferences are different and a *one size fits all* approach is not suitable when it comes to developing an online parenting resource. Parents varied in their app searching patterns. Some parents downloaded all the free apps, explored each app, and only kept a few that worked for them. On the other hand, some parents explored app attributes in detail before downloading. Some parents preferred tracking all activities of the infants whereas, some found constantly recording all activities burdensome and only used tracking apps in times of concerns. Some parents exclusively used apps as they found it convenient while some used multiple online platforms to access parenting support such as Websites, podcasts, and YouTube. Fathers also shared their struggle with adjustment to their new role and lack of support from apps as the language used in the apps primarily addressed mothers unrecognizing fathers' struggles with transitions to parenthood. Fathers and mothers, both

shared the scarcity of quality apps for fathers and advocated the need for apps to assist them in their new role as parents.

Manuscript number three exclusively provided details regarding parents' perceptions of app use, their app searching patterns, and their preferences. Focus group discussions also explored the viability of the idea of the parenting app directory and allowed the selection of apps for the directory which was discussed in manuscript number four. The manuscript number four also highlights the co-creation of user interface and analysis of design sessions, the final phase of the study.

**Manuscript 4: design sessions.** Chapter 5 is the fourth and final manuscript titled *Developing an Online Resource to Support Parents' Search for Mobile Apps*. The manuscript was submitted to the Journal of Mobile Technology in Medicine in March 2020. The abstract was also approved for the Sixteenth International Conference on Technology, Knowledge, and Society, Chicago, USA. The abstract was supposed to be presented in March 2020, however, the conference was postponed until further notice due to the COVID-19 pandemic.

The manuscript number four has two parts, one part shares the focus group discussions analysis regarding the viability of the idea and the co-development of the directory, and the second part discusses the co-creation of a user interface to feature the directory. Participants appreciated the idea of having a parenting app directory because of their frustrating experiences of finding quality apps. Parents shared that due to their tiring schedules of infant feed/sleep and diaper change cycles they could only focus on the current issues and lacked time to explore potential concerns and strategies to support their parenting. A directory would help them focus on quality parenting apps, save time, and

help them identify additional parenting apps. For example, a few parents shared their excitement during focus group discussions when they discovered a sign language app that they had not realized was freely available.

One of the focus group activities was related to the selection of apps on the directory. Parents were given a few apps and asked to pick an app or two they liked. Parents reviewed the app(s) for 5-10 minutes and shared their feedback with the group. The group then mutually decided whether the app should be part of the directory through consensus.

Maintenance of the directory is a major challenge in sustaining this intervention. The app market is volatile. Hundreds of apps are launched everyday which makes it a time-consuming process to screen and evaluate new apps and add them to the directory. Further, app updates require constant upkeep of the directory with new/modified features of the included apps. The ongoing maintenance of the directory makes it impossible for this solution to sustain on its own. If not maintained, after some time the directory will no longer support parents' search for apps, instead, it will create frustrations due to outdated information. To overcome this challenge the student researcher collaborated with an existing Canada wide parenting Website that offers support to parents from birth to eight years. Thereafter the Website will be referred to a host Website throughout this thesis. The developed prototypes to feature the directory will be integrated into the host website and the website managing committee will be responsible for its maintenance.

After the focus group discussions, three design sessions were conducted with three parents (two fathers and one mother); two parents (one father and one mother) had also participated in focus group discussions. In a series of three sessions, parents and student researcher co-designed prototypes of two Webpages to feature the directory including landing page providing the list of apps and app description page, offering a detailed description of the app.

For the design session, participants were given a designing space mimicking the layout of the host Website. They were connected remotely via the SMART kapp™ app where they could see real-time updates on the whiteboard created by the researcher to capture their feedback. After each session, the researcher developed and/or modified the interactive prototypes using Wix, a free Website builder, and discussed the prototypes in subsequent sessions. For example, during design sessions parents revealed that their busy infant care schedules did not leave much time for them to search resources in detail. Therefore, parents stressed the need for time-saving design elements such as an organized user interface, less but best choices, and reduced number of clicks to find the desired app as quickly as possible. The iterative design sessions led to the co-development of two Webpages prototypes.

### **Contributions**

The findings from this research project will potentially impact the existing body of literature, and researchers and healthcare professionals' practices by setting new directions for research and disseminating and mobilizing knowledge to potential users.

**Involving parents as co-researchers and including fathers in research.** This research is one of the very few studies in the field of parent use of online resources that

engages parents as co-researchers and involves both parents' (mothers and fathers) perspectives. Challenges associated with recruiting and retaining parents make many researchers include parents in either identifying needs or evaluating the resource. Further, many researchers exclusively recruit perinatal women/mothers leaving fathers out of the research process. However, in this study, researchers used PD, a user inclusive methodology, to engage parents in every step of the process and co-created a resource that reflects parents' preferences. The inclusion of parents throughout the process and involvement of fathers make this research as one of the very few studies conducted in the field of parents' use of online resources, therefore, adding meaningfully to the body of existing literature.

**Setting a new direction for future app reviewers.** The literature around parenting apps mostly consists of the critique of existing apps. The literature lacks recommendations for quality apps that parents can use and clinicians can recommend. The app review done for this project, published in mHealth journal, adds significantly to the body of literature by providing the list of quality apps and setting a new direction for future app reviewers.

**Dissemination of the research and knowledge mobilization.** Dissemination of the research to other researchers, policymakers, and healthcare professionals leads to increased awareness of the research. Dissemination maximizes the impact by reducing the research to practice gap and facilitating research uptake in decision-making processes and clinical practice thus improving the health outcomes of the target population. The student researcher presented her doctoral work in several local, national, and international conferences and published manuscripts to disseminate the research findings to the wider

audience. One of the published manuscripts was selected as a CNE (Continuing Nursing Education) credit activity for nurses by the Journal of Informatics Nursing. This is an example of knowledge mobilization which goes beyond just disseminating research. Frontline nurses and clinicians are a link between research and target population. They apply information in a practice setting and put research to use. The CNE activity will engage nurses and provide ways to mobilizing knowledge from an academic journal to potential users of knowledge. Please see below the complete list of conference presentations and manuscripts that are used to disseminate the research.

1. Virani, A., Duffett-Leger, L. & Letourneau, N. (2019). Parenting apps review: In search of good quality apps. *mHealth*, 5(44). doi:10.21037/mhealth.2019.08.10.

The following link can be used to access the publication

<http://mhealth.amegroups.com/article/view/29870/pdf>.

2. Virani, A., Duffett-Leger, L. & Letourneau, N. (2020). Parents' perspective of parenting app use. *Journal of Informatics Nursing*, 5(1). 8-18.

This article was featured as Continuing Nursing Education 1.2 Contact Hours.

3. Virani, A., Duffett-Leger, L. & Letourneau, N. Developing an online resource to support parents' search for mobile apps. *Journal of Mobile Technology in Medicine* (under review-submitted March 2020).
4. Virani, A., Duffett-Leger, L. & Letourneau, N. Parents' use of mobile applications in the first year of parenthood: A narrative review of the literature. *Internet Research*. (under review-submitted May 2020).
5. Virani, A., Duffett-Leger, L. & Letourneau, N. (March 2020). Developing an Online Resource to Support Parent's Mobile Applications (App) Search. To be

presented at *the Sixteenth International Conference on Technology, Knowledge, and Society, United States*. (Postponed due to Covid19)

6. Virani, A., Duffet-Leger, L., Letourneau, N., & Stroulia, E. (October 2019). *Review and Evaluation of Mobile Applications (Apps) for Parents*. Paper presented at the American Academy of Pediatrics (AAP) National Conference & Exhibition: 2019 Council on Clinical Information Technology (COCIT). New Orleans, Louisiana, United States.
7. Virani, A., Duffet-Leger, L., Letourneau, N., & Stroulia, E. (June 2019). Parents' Mobile Applications Searching Behaviors: A Focus Group Study. Paper presented at the *Canadian Nursing Informatics Association Conference*, University of New Brunswick, Fredericton, Canada
8. Virani, A. & Duffet-Leger, L. (February 2018). *Developing an Online Resource to Support Parents' Information-Seeking with Mobile Applications (apps)*. Paper presented at the Peer Beyond Graduate Research Symposium, University of Calgary, Alberta, Canada.

## **Conclusion**

The purpose of this study was to co-design a user interface featuring the app directory to support parents' search for apps. The literature review and app review manuscripts included in this dissertation provided the foundational support for the research. The literature review manuscript presented an overview of the available literature on parents' app use from seven academic databases. The second manuscript, app review, sheds light on the available apps for parents on Google Play store, and issues that parents face while searching for apps. The app review also offered a list of quality

apps that were further reviewed by parents in focus group discussions. Manuscript number three shared the parents' perspectives of app use, app searching patterns, and their preferences. The final manuscript contains the process of app directory development and analysis of design sessions. It provides details regarding the co-creation of Webpages prototypes and parents' preferred design elements. The study highlights the PD process for engaging parents in co-developing an interface showcasing the parenting app directory to support their search for apps.

**Chapter 2: Parents' Use of Mobile Applications in the First Year of Parenthood: A  
Narrative Review of the Literature**

Virani, A., Duffett-Leger, L. & Letourneau, N. Parents' use of mobile applications in the first year of parenthood: A narrative review of the literature. *Internet Research*. (under review-submitted May 2020).

## **Abstract**

### **Background**

Increased availability and affordability of digital devices and the Internet make it convenient for parents to use mobile applications “apps” to get social support on parenting matters. While limited, evidence-based apps have been developed by researchers, however, parents continue to report using commercial and/or poor-quality apps.

### **Methods**

A narrative review of the literature and thematic analysis of the eligible articles was used to provide a comprehensive overview regarding the characteristics of available research on parents’ app use, the types of apps available to parents in the first year of parenthood and the factors that encourage and discourage app use among parents.

### **Results**

Forty-one articles were included based on prespecified eligibility criteria. The majority (n=30) discussed a parenting app or mHealth intervention that included an app. Most studies (n=15) recruited women as participants and were conducted in Australia (n=10). Thematic analysis of the eligible articles (n=41) revealed four themes: (1) increased app use related to shifts in parenting trends; (2) types of apps available to parents; (3) apps to overcome the digital divide; and (4) factors encouraging and discouraging app use.

### **Conclusion**

A constant increase in parents’ app use demands that healthcare professionals and researchers find alternatives to standardized means of delivering and developing

parenting social support. Suggesting quality apps to parents and involving parents in developing apps is becoming crucial in supporting contemporary parents' needs.

**Keywords:** Parenting apps; Narrative review; Evidence-based apps, mHealth

First-time Parents

Digital health

## **Introduction**

The birth of a child is filled with joy and excitement for parents however, adaption to the new role, infant care responsibilities, and changes in spousal and social relationships can be stressful. Social support including informational and emotional support can help parents cope with the challenges of parenting. *Informational support*, defined as the provision of advice, guidance, suggestions, or other useful information, in response to someone's needs. *Emotional support* refers to the offering of empathy, compassion, and genuine concern to support individuals' emotional needs such as connecting with someone, talking about stressors and concerns, and seeking reassurance. A combination of informational and emotional support improves parents' wellbeing and assists with their parenting concerns (Dehoff, Staten, Rodgers, & Denne, 2016; Gottlieb & Stewart, 2000; Letourneau et al., 2015).

Mobile applications "apps" have the potential to provide information and emotional social support to parents 24 hours a day, seven days a week. Parents have consistently used apps to connect to other parents and healthcare professionals such as nurses, pediatricians, breastfeeding experts, and sleep training consultants. Social networking, online forums, live chat, texts, and video calls were some of the app features, parents desired to seek informational and emotional support on parenting matters (Lupton, Pedersen, & Thomas, 2016; Duggan et al., 2015). Apps provide an anonymous venue to discuss and seek advice on sensitive issues, such as the resumption of sexual activities after childbirth, which some parents might not be comfortable sharing in person with family and friends. The anonymity of the Internet allows parents to share their

experiences, feelings, concerns, and intimate details regarding their childbirth experiences more openly and freely without feeling judged (Johnson, 2015).

### **Purpose**

While researchers around the world have introduced several apps to support parents in the first year of an infant's life (Franciscovich et al., 2015; Morse, Murugiah, Soh, Wong, & Ming, 2018), parents continue to face difficulty finding good-quality apps that meet their expectations for social support and therefore are relegated to employ low-quality apps (Colliver, Hatzigianni, & Davies, 2019; Richardson et al., 2019; Virani, Duffett-Leger, & Letourneau, 2020). There is a need to better understand parents' app use preferences and factors that encourage and discourage their apps' use. Therefore, the purpose of this narrative review of the literature is to provide a comprehensive overview of the multidisciplinary research on the parents' use of apps in the first year of parenthood and highlight significant areas of research. This review aims to address the following research questions:

1. What are the characteristics of literature on parents' app use in the first year of parenthood?
2. What types of apps are available to parents that support their parenting in the first year?
3. What are the factors that encourage and discourage parents' app use?

### **Methods**

The study combines a narrative review method and thematic analysis of the eligible articles to capture the novelty of the topic, as well as the breadth and diversity of the available research. This technique is suitable when addressing a broad area of

research and the purpose is to describe the literature to expand the understanding of the topic (Mays, Pope, & Popay, 2005; Snyder & Engstrom, 2016). The thematic analysis enables researchers to identify patterns and to describe various facets of the data (Clarke & Braun, 2014).

**Search strategy.** Academic databases were searched for articles related to the topic using prespecified eligibility criteria. Articles were screened based on a reading of the abstracts. In cases where an abstract was not available, articles were scanned briefly and if relevant to the review topic, an analysis of the full text was conducted. Due to the novelty of this topic, and in an effort to present a comprehensive review of the literature, conference presentations, master's/doctoral theses, and relevant documents such as reports and viewpoints were also included in the search.

The following search terms were combined with the Boolean search operators AND, OR and NO: “Mobile Application” OR App OR Smartphone OR mHealth AND Parent OR Parenting OR Parenthood OR Parental OR Mother OR Mom OR Mum OR Motherhood OR Maternal OR Father OR Dad OR Daddy OR Fatherhood OR Paternal OR Infant OR Child OR Baby NOT Pregnancy OR Toddler OR Preschool OR Adolescent. The search from multiple disciplines such as nursing, medicine, psychology, and sociology was conducted using the following academic databases: CINAHL Plus with Full Text, MEDLINE, SocINDEX with Full Text, PsychINFO, Academic Search Complete, Web of science, and Google Scholar.

**Eligibility criteria.** Inclusion criteria were full-text English language articles between January 2000 and December 2019 relating to parents’ use of apps in the first year of infants’ lives including reviews of parenting apps and apps that were developed to

support parents. Articles were excluded if they were: duplicates (n=50); published in a language other than English (n=7); exclusively for children or parents of children above the age of one year (n=110); targeting sick/preterm infants or their parents (n=83); exclusively for pregnant parents (n=13); targeting apps for healthcare professionals or used by healthcare professionals and researchers to collect data (n=38); and, not relevant to the topic (n=455). A total of 79 articles met the initial eligibility criteria and were reviewed by the primary author. Articles were further excluded if the full text was not available (n=5); were related to mHealth intervention other than apps (n=26); and, series of articles on the same intervention/app (n=7) (in this case the most relevant article was selected and rest were considered ineligible).

### **Characteristics of Included Studies**

Of the 835 articles identified in the initial search, a total of 41 met the eligibility criteria and included published research papers (n=29), conference presentations (n=5), unpublished master's thesis (n=2), and documents such as viewpoint articles and reports (n=5). A majority of the articles were related to an app or mHealth intervention that contained within an app (n=30), including a focus on informational and emotional support needs around infant care (n=25), self-care (n=4), and couple relationships (n=1). The remaining 11 articles described parents' use of apps (n=5) and parenting app reviews (n=6).

The majority of studies targeted women (including pregnant women and mothers) exclusively (n=13) or in combination with healthcare professionals (n=2). Very few studies focused exclusively on male participants (n=2) or in combination with healthcare professionals (n=1). Some researchers studied couples and families or parents of children

under the age of 5 years (n=5) while a few studied parents and healthcare professionals (n=2), as well as app development team members and app users (n=1). Most studies were conducted in Australia (n=10), followed by the United States of America (n=5) and the United Kingdom (n=3) and one each in Canada, Denmark, Jordan, Uganda, Thailand, China, and Taiwan.

Articles varied in their nature as some articles focused on social support needs about parenting, whereas others described the app development, deployment, and dissemination. Similarly, a wide variety of theoretical models were used (n=10), of which only social cognitive theory (Bandura, 1986) was mentioned twice. Other theories included: unified theory of acceptance and use of technology (Venkatesh, Morris, Davis, & Davis, 2003); technology acceptance model for mobile service (Kaasinen, 2008); behavior change wheel (Michie, Stralen, West, 2011); capability, opportunity and motivation model of behavior change (Michie et al., 2011); theory of planned behavior (Ajzen, 1985); fun theory (Volkswagon, 2009 as cited in Kernot, Olds, Lewis, & Maher, 2014); theory of change (Kirkpatrick, 1959 as cited in De Silva et al., 2014); national extension relationship and marriage education model (Futris & Adler-Baeder, 2013); family life course development theory (Bengston & Allen, 1993); black feminist theory (Collins, 2008); analyzing children's creative thinking framework (Robson, 2014); taxonomy of play (Hughes, 2002); and health belief model (Rosenstock, 1966).

### **Results of Thematic Analysis of the Eligible Articles**

The analysis revealed four overarching themes and ten subthemes: 1) increased app use related to shifts in parenting trends; (2) types of apps available to parents; (3)

apps to overcome the digital divide; and (4) factors encouraging and discouraging app use.

**Theme #1. increased app use related to shifts in parenting trends.** The literature review findings revealed that the inability of the healthcare system to support parents; evolving parenting roles due to increased participation of women in higher education and paid work; geographical distances between parents and their families; and the ubiquitous availability of scientific parenting material have greatly increased contemporary parents' app use. Three subthemes emerged: (i) shorter postnatal hospital stays; (ii) evolving parenting roles and responsibilities; and (iii) increased geographical distance among families and the rise of scientific parenting.

*Shorter postnatal hospital stays.* Circumstances have changed over the last two decades contributing to the rise of app use among contemporary parents. Parents turn to apps in a quest for finding answers for common parenting needs due to healthcare systems changes that restrict postpartum hospital stays. Many first-time parents are not mentally ready to absorb all the information presented to them in the brief period immediately after giving birth, and commonly leave the hospital with numerous questions about their self-care and the needs of their newborn (Bond et al., 2019; Kuo, Lu, & Chang, 2012; White et al., 2016b). In a study, postpartum parents reported feeling most vulnerable in the middle of the night when they could not contact family, friends, or clinicians (Danbjørg et al., 2014). While support services such as parenting helplines, public health nurses' visits, and community centers are available in most communities, many parents reported reluctance contacting clinicians post-discharge due to concerns they were interrupting nurses' busy schedules to address their simple questions (Asiodu

et al., 2015). On the other hand, apps act as a convenient medium for parents to fill their informational, and emotional support needs around-the-clock. Researchers in Denmark designed an app in collaboration with postpartum nurses in an effort to address the issue of shorter hospital stays and found the app to be an efficient source of parenting informational support. In fact, findings revealed that parents preferred the app over typical sources, such as pamphlets and consulting nurses via phone (Danbjørg et al., 2014).

***Evolving parenting roles and responsibilities.*** In western societies, women are increasingly participating in higher education and paid employment. Stay-home fathers and dual-income families are increasing, giving rise to fathers' involvement in care and practical distribution of household responsibilities between working spouses. However, healthcare systems that are typically designed to support stay-home mothers often make fathers feel left out of the parenting process (Dhumal, Kumbhar, Tak, & Shaikh, 2016; Lee & Walsh, 2015). Fathers and working parents often turn to apps for information due to the inability of the healthcare system to adequately support the changing trends and shifts in parental responsibilities. While apps such as Milk Man, mDad, and DadTime, assist fathers in their parenting roles (Balu, Lee, & Steimle, 2018; Lee & Walsh, 2015; White et al., 2016a), tracking apps allow working parents to remotely monitor their infants' care synchronously with caregivers (Chaudhry, 2016; Dhumal et al., 2016; Fonseca, Horta, Sendra, Rodrigues, & Moutinho, 2014).

***Increased geographical distance among families and the rise of scientific parenting.*** Increased mobilization among contemporary parents to avail better career opportunities has led to a geographical disconnect between new parents and their

extended family support systems. Thus, young parents living abroad are increasingly using communication apps to connect with families (Marsh et al., 2018; Nansen, 2015). Further, increased availability and awareness of scientific information have giving rise to scientific parenting, defined as parenting practices that are based on best evidence (Letourneau & Joschko, 2013). Zhao et al. (2017a) reported mothers are veering away from simply providing physical care to their infants, turning to apps that scientifically support their child-rearing practices and decision making in health-related matters.

**Theme #2. types of apps available to parents.** Parents actively seek apps to adjust to their new role and there are several types of apps available to parents that can assist in meeting their social support needs. These needs can be categorized under the following two subthemes: (i) apps supporting infant care; and (ii) apps focusing on self-care and couple relationships.

*Apps supporting infant care.* First-time parents, in particular, have numerous concerns about the overall well-being of their infants. The following infant care needs have received researchers/app developers' attention: overall infant care; feeding/nutrition; growth and vaccination tracking; and Sudden Infant Death Syndrome (SIDS) prevention.

Parents desired apps that provided informational support to fulfill basic infant care needs, such as bathing an infant and care for the umbilical cord, in the initial postpartum months. For example, the app Newborn Baby Care Support was created to allow parents to consult nurses 24/7 during the postpartum period (Kuo et al. 2012). Similarly, Danbjørg and colleagues (2014) developed the app called Me & My Baby that allowed parents to consult nurses via text, images, and videos and provided customized messages every 12 hours from the time of birth. Apps that provided support in dealing

with other infant care such as infant cognitive and psychosocial development and parent-infant bonding were also valued by parents. Examples of such apps found were: Vroom (Galinsky, Bezos, McClelland, Carlson, & Zelazo, 2017); BabyMind (Larkin, Oostenbroek, Lee, Hayward, & Meins, 2019); DadTime (Balu et al., 2018); and mDad (Lee & Walsh, 2015).

Providing a healthy diet is an important aspect of infant care, and parents often report questions about breast or bottle feeding, the introduction of solids, and food allergies. Of all nutrition concerns reported by parents, by far breastfeeding received the most attention from researchers (Balaam, Comber, Jenkins, Sutton, & Garbett, 2015; Biediger-Friedman, Silva, & Smith, 2018; White et al., 2016b), possibly due to declining rates of breastfeeding (White et al., 2016a). The most common issues related to breastfeeding mentioned in the literature were sore/crack nipples and latching problems, as well as lack of support from partners/family and breastfeeding in public. A few apps were created to deal with common breastfeeding concerns. The Telelactation app delivers new parents 24/7 breastfeeding assistance from lactation consultants via video chat (Kapinos et al., 2019) while the MoomMae app provides feeding/pumping tracking and information on feeding rooms in public places (Wang, Chaovalit, & Pongnumkul, 2018). Recognizing the supportive role of a spouse in breastfeeding, White et al. (2016a) developed the cleverly titled Milk Man app that encourages fathers to act as a support for their breastfeeding partners. A few apps were developed to support parents' choices regarding healthy nutritious foods for infants such as the WIC Nutrition Education app (Biediger-Friedman et al., 2018), the Pregnancy and Infant Encyclopedia app (Anggraini, Soedjono & Sianipar, 2015) and the Growing Healthy app (Laws et al., 2018).

Tracking infants' basic activities, growth, and vaccinations were another reason parents use apps. The literature review revealed a few apps that assist parents in tracking infant development and vaccines. The Baby Feed app, for example, allows parents to record and track infants' basic activities such as feeding, urination/defecation, growth, and medications (Chaudhry, 2016). The Infant Growth Calculator app enables parents to calculate the growth rate (height, weight, and head circumference) of infants and compares results with the World Health Organization growth rate standard percentiles (Gesse, 2019). Using the CANImmunize app, parents can record immunizations for multiple family members and generate customized reminders for their next vaccination appointments (Houle et al., 2017).

SIDS prevention is another common concern of parents, and the focus of three articles found in this literature review (Dhumal et al., 2016; Fonseca et al., 2014; Lopez, Lopez, & Guerrero, 2013). Apps that come with a sensing device (attachable to the infant's clothing or surroundings) assist parents in detecting abnormal infants' physiological parameters and take action in time. However, Bonafide, Jamison, and Foglia (2017), presented a critique of SIDS prevention apps and indicated that there is no evidence these apps are useful in preventing SIDS; rather, these apps appear to create a sense of insecurity among parents, heightening fears that they are incapable to keep their infants safe.

*Apps focusing on self-care and couple relationships.* Personal care and relational activities enhance parents' feelings of well-being and social support. Many parents seek informational support regarding self-care and couple relationships such as postpartum diet and exercise, resumption of sexual activities, and suggestions for maintaining a

healthy spousal relationship. However, the literature review findings indicated that parents' self-care and spousal relationship needs received very little attention in the research (n=5) compared to infant care needs (n=25). Apps that were developed to support self-care included a social network-based physical activity app (Kernot et al., 2014); a maternal mental health app (Bond et al., 2019); a maternal lifestyle and weight management app (Hearn et al., 2014); and an app to increase maternal self-efficacy (Deave et al., 2019). Only one app, Love Every Day (Lucier-Greer, Birney, Gutierrez, & Adler-Baeder, 2018), was found to promote couple resilience.

**Theme #3. apps developed to overcome the digital divide.** The term digital divide is commonly used to denote barriers in online information access. Inequalities based on age, income, education, availability of devices and the Internet, as well as comfort level and skills required to use technology, prevent some people from using the Internet and apps, creating a divide between technology and non-technology users (Dworkin, Connell, & Doty, 2013). Despite the prevalence of some degree of the digital divide, however, contemporary parents are increasingly using apps to fulfill their informational and emotional support needs (Hearn et al., 2014; Lupton, 2016). Given the increase in online health information, several healthcare professionals and researchers have designed apps to improve access to health services and information for parents who are difficult to reach through typical methods (pamphlets, consultations, and classes) due to geographical barriers, time constraints and stigma (Asiodu et al., 2015; Danbjørg et al., 2014; Lucier-Greer, 2018). This literature review found several apps that were specifically developed for disadvantaged or vulnerable populations such as mothers living in rural and remote areas (Kapinos et al., 2019); high-risk mothers (Deave et al.,

2019); military and low-income fathers (Lee & Walsh, 2015); parents with low socioeconomic status (Burgess et al., 2018; Galinsky et al., 2017; Laws et al., 2018; Vanosdol et al., 2019); refugees (Khader et al., 2019); and areas of low internet connectivity (Pérez, 2014).

**Theme # 4. factors encouraging and discouraging parenting app use.** The abundance of poor-quality parenting apps was mentioned as a major barrier in the effective utilization of apps. Several researchers have performed parenting app reviews and mentioned most apps were of poor quality. (Scott, Gome, Richards, & Caldwell, 2014; Davis et al., 2017; Taki et al., 2015). For example, Virani, Duffett-Leger, & Letourneau (2019), reported out of 4,300 parenting apps reviewed, only 16 (0.4%) were relevant and of high quality. The majority of app reviews have suggested five areas to improve app quality to make them more appealing to parents, categorized under the following five subthemes: (i) functionality, (ii) visual appeal, (iii) interactive features, (iv) content credibility, and (v) privacy and security (Jabrayilov et al., 2018; Lupton, 2016; Nansen, 2015).

**Functionality.** Functionality refers to app performance, ease of use, and navigation. Apps that are difficult to navigate, freeze, or crash can frustrate users. Many users delete dysfunctional apps within a few minutes after installation due to issues with navigation. The seamless functioning of apps is very important in utilization (Biediger-Friedman et al., 2018; Kernot et al., 2014; Laws et al., 2018).

**Visual Appeal.** Often referred to as look and feel, visual appeal is an important aesthetic aspect that allows users to enjoy their experience. The app icon and logo

provide the first impression of an app that communicates its quality even before users decide to download and test its functionality (Taki et al., 2015; Virani et al., 2019).

***Interactive features.*** Interactive features of an app are crucial in engaging parents, improving control, ensuring effortless ongoing access to desired parenting social support. Interactive features such as trackers (Houle et al., 2017; Pérez, 2014), reminders (Chaudhry, 2016; Khader et al., 2019), notifications (Dhumal et al., 2016; Galinsky et al., 2017), connecting with clinicians via video calling or texting (Danbjørg et al., 2014; Kapinos et al., 2019), gamification (Burgess et al., 2018; White et al., 2016a), using geolocation to find nearby places for breastfeeding (Balaam et al., 2015; Wang et al., 2018), and forums/social networking (Kernot et al., 2014; Zhao et al., 2017a) were mentioned in the literature to create appealing evidence-based apps for parents. A few researchers found that parents preferred commercial apps over government/ academic apps due to the interactive features (Hearn et al., 2014; Lupton, 2016; Virani et al., 2019). One possible reason might be that many evidence-based apps are difficult to find as they go through a stringent process of research and modifications before they are available to the public, compared to commercial and/or poor-quality apps that are in abundance and require less turnaround time. For example, Virani et al. (2019), found that while a literature search revealed a few evidence-based apps for fathers, these apps were not available on the Google app store. Unavailability of evidence-based apps to the public in app stores and longer turnaround times for quality research-based apps has led to the poor quality and/or commercial apps being used among parents to fulfill their informational and emotional support needs.

***Content credibility.*** Credible content is an important feature of informational support apps that help parents improve their parenting knowledge and skills. Scott et al. (2014) presented a parenting app review and found only two functional and secure evidence-based apps, however, both apps did not fully meet the usability criteria. A few researchers also reported many parents may overlook the content credibility and use commercial and/or poor-quality apps if they find it useable and customizable to their needs (Asiodu et al., 2015; Virani et al., 2019; Zhao et al., 2017a).

***Privacy and security.*** App security mechanisms allow users to enjoy apps safely. However, many parenting apps, especially ones that provide customized information, collect and store personalized data daily. Users usually have no means and/or are unaware of the methods of deleting collected data and many apps do not use encrypted data sending features, making data prone to hacking (Chaudhry, 2016; Dhupal et al., 2016). Scott et al. (2014) examined ten free maternal and child apps and found only three apps employed a security mechanism to ensure users' security. While evidence-based apps take extra caution in ensuring users' security (Houle et al., 2017; Kuo et al., 2012), researchers have found that parents continued to use commercial and/or poor quality apps if they helped fulfill social support needs despite potential privacy and security issues (Hearn et al., 2014; Lupton & Pedersen, 2016; Taki et al., 2015).

In short, review findings suggest that parents prefer appealing, usable, functional, and personalized apps with interactive features and for that experience, many parents do not hesitate to compromise on content credibility and security features.

## **Discussion**

Through this literature review, the authors aim to explore characteristics of literature on parents' app use in the first year of parenthood, types of apps are available to parents that provide information and emotional support in the first year, and the factors that encourage and discourage parents' app use. The findings indicated the majority of apps provided social support for infant care and only a handful of apps discussed self-care and couple relationships. Gilmer et al. (2016), found similar results when conducted a review of the literature on parenting education interventions. They indicated the majority of interventions focused on parenting an infant. However, the importance of self-care and couple relationships cannot be denied in maintaining overall parental wellbeing. Hearn et al. (2014) performed a gap analysis for parenting content and reported mothers felt the available parenting content was "child-focused" and they would prefer to have "parent-focused" content (p. 3). Entsieh and Hallstrom (2016), presented a literature review on the needs of first-time parents in early parenthood, also indicated managing the spousal relationship was one of the important needs identified by parents. More apps should be developed to cater to parents' self-care and couple relationships thus supporting every aspect of their needs and assisting in their transition to parenthood.

Findings revealed that most researchers employed mothers as participants and a few involved fathers in research. The involvement of fathers in infant care has proven to be beneficial in the well-being of mothers and infants, as well as accounts of their perceptions are also as important as mothers (Shorey et al., 2017). A few researchers have also discussed the challenges of recruiting fathers such as work-related responsibilities and uncomfortableness with parenting programs which are mostly geared

towards mothers (Balu et al., 2018; Kane, 2015; Virani et al., 2020). However, Lee and Walsh (2015) suggested researchers should try different recruitment strategies and recruit even a small of fathers in research to make them feel heard and to develop parenting resources that are more accessible and appealing to them.

### **Implication for Practice**

Contemporary parents often have busy schedules and generally select social support sources that require less time and are easily accessible. Today, knowledge is constantly changing and time is precious, thus parents do not find traditional approaches (pamphlets, in-person classes, consultation over the phone) to accessing parenting information appealing or feasible (Asiodu et al., 2015; Hearn et al., 2014). Danbjørg et al. (2014) found parents preferred a postnatal app where they could send a picture, video, or text compared to consulting nurses over the phone. Considering shifting trends in accessing parenting social support, healthcare professionals and researchers should recommend quality apps to parents (Davis et al., 2017; Lupton & Pedersen, 2016; Marsh et al., 2018). Deave et al. (2019) reported parents were more likely to use an app if it was introduced or recommended by a health professional. Most parenting app reviews, however, presented quality issues with apps but did not guide healthcare professionals or parents towards quality apps. Virani et al. (2019) stressed the importance of providing a list of quality apps that may ease the search process for parents and increase recommendations of apps by healthcare professionals.

It is alarming to note that parents compromise on content credibility and security features due to the immediacy of the fulfillment of their needs and certain app features that make the app more usable or visually appealing. Parents tend to discard high-quality

apps with evidence-based information due to poor visual appeal and lack of usable features (Virani et al., 2020). While evidence-based apps pay more attention to content credibility and security, they may lack appealing features that deter parents from utilizing these apps. Therefore, it is important to co-create apps with parents and incorporate their suggestions in app development. Vanosdol et al. (2019), modified the NeMo app by incorporating users' feedback and indicated modification increased mothers' ability to accurately spot neonatal danger signs by at least 200%. Researchers should engage parents in the app development process to create appealing and usable evidence-based apps. The use of user inclusive approaches to design, such as PD, can be employed to engage users in the app development process.

### **Limitations**

Narrative reviews are generally less systematic due to the flexibility of including different types of research and non-research articles; however, this flexibility allows researchers to incorporate a wide variety of literature and provide a comprehensive overview of the topic. Further, the authors did not perform a quality assessment of the included articles due to the heterogeneity of the theoretical perspectives and reported methods and results.

### **Conclusion**

In this narrative review of the literature, the authors have discussed the types of apps available to parents providing informational and emotional support; evolving circumstances that had given rise to parents' apps use; and app features that encouraged and discouraged parents' use of quality apps. Contemporary parents' increased use of apps demands healthcare professionals to move from standardized approaches to

providing parenting social support and adopt digital mediums to increase parents' access to evidence-based resources. Parenting app reviewers should focus on providing a list of quality apps that healthcare professionals can recommend to parents and researchers should employ methods to co-create apps with parents to increase the uptake of evidence-based apps among parents.

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**Chapter 3: Parenting Apps Review: In Search of Good Quality Apps.**

Virani, A., Duffett-Leger, L., & Letourneau, N. (2019). Parenting apps review: In search of good quality apps. *mHealth* 5(44) 1-15. doi: 10.21037/mhealth.2019.08.10

Virani, A., Duffett-Leger, L., Letourneau, N., & Stroulia, E. (October 2019). *Review and Evaluation of Mobile Applications (Apps) for Parents*. Paper presented at the American Academy of Pediatrics (AAP) National Conference & Exhibition: 2019 Council on Clinical Information Technology (COCIT). New Orleans, Louisiana, United States.

## Abstract

### Background

Parenting can be challenging, and in this digital age, first-time parents actively access mobile applications or “apps” to adjust to their new roles. Apps are now technologically-savvy parents’ go-to tool for accessing information, tracking their babies’ development, editing and sharing photos, and much more. While apps have the potential to make parenting easier, the abundance of low-quality apps makes the process of finding a reliable one arduous for parents. Therefore, the objective of this app review paper was to provide a list of quality parenting apps that parents can use.

### Methods

The Google Play Store was searched on June 1st, 2018 for available parenting apps using 18 search terms: mum, mom, mommy, mama, mother, father, dad, daddy, papa, newborn, baby, infant, kid, child, children, family, parent, and parenting. The eligible apps (n=16) were evaluated on engagement, functionality, aesthetics, and information domains using Mobile App Rating Scale (MARS).

### Results

The authors identified 4,300 free apps on the initial search, of which n=16 apps were included in the review. All 16 apps were freely available to the public on Google Play Store. Most apps (n=13) were also available on the iOS platform. All eligible apps had a privacy policy, and half of the apps contained advertisements. Most apps (n=12) were updated within the last year and received 4.5 or above ratings from users.

Babybrains app, developed by a neuroscientist, had the lowest number of downloads (one thousand) whereas, BabyCenter, a commercial app, had the highest number of downloads

(ten million). A majority of apps (n=11) received MARS scores between 4.2 and 4.4/5, with four apps received the highest MARS score of 4.5/5, and one app received the lowest MARS rating of 4/5.

### **Conclusions**

Apps play an increasingly important role in supporting new parents in their first year of parenthood due to convenience and ease of accessibility. Healthcare professionals are in an ideal position to support technologically savvy parents in locating good quality apps; therefore, they should support the evaluation of existing parenting apps to ensure that the parents are presented with the up to date and best options.

**Keywords:** Mobile applications (apps); parenting apps; Mobile App Rating Scale (MARS)

## **Introduction**

Parenthood is a period of dramatic physical, social, and psychological adjustments that are full of joy and worry for many parents. First-time parents may be particularly challenged, as they may feel unprepared to care for their infants. They may rely upon the Internet and mobile applications or “apps” for support in handling day to day parenting situations (Asiodu et al., 2015; Jang, Dworkin, & Hessel, 2015; Shorey et al., 2017). Healthcare professionals and app developers have introduced numerous apps to support parenting. However, parents continue to report difficulty locating apps that meet their needs due to the proliferation of irrelevant and low-quality apps (Davis et al., 2017; Hearn et al., 2014; Lupton & Pedersen, 2016; Taki et al., 2015). Therefore, the purpose of this review paper was to offer a list of good quality parenting apps, available on the Google Play Store, that parents can use and healthcare professionals can suggest.

Contemporary parents are active users of apps to find information and support on common parenting issues such as improving infant sleep, tracking their babies’ growth and development, and sharing memorable moments (Chin, 2018; Lupton, 2016; Pehora et al., 2015). First-time parents appreciate the convenience of apps as they offer immediate assistance, day or night when more traditional parenting supports and services are typically inaccessible. Further, apps that work offline make it easier for parents to use their features in the absence of Internet access (Asiodu et al., 2015; Hearn et al., 2014; Mindell et al., 2016). In fact, Zhao et al. (2017a) reported that the 24/7 access offered by apps helped mothers adjust and transition to their new role as parents.

Since the advent of personal tablets and smartphones, there are a growing number of apps available on any given topic. The Google Play and Apple app store contain 2.1

and 2 million apps respectively (Statista, 2019). Searching for “parenting apps” in Google resulted in over 160 million hits ([https://www.google.ca/?gws\\_rd=ssl#q=parenting+apps](https://www.google.ca/?gws_rd=ssl#q=parenting+apps))

The widespread use of apps makes it an ideal platform to support parents in their parenting (Zhao et al., 2017a). However, the proliferation of low-quality apps creates barriers for parents in effectively utilizing apps. Lupton and Pedersen (2016) reported that 12% of mothers found parenting apps unhelpful due to inaccuracies, irrelevance, and anxiety-provoking content. Unappealing design, lack of interactive features, poor functioning, and lack of credible and useful content were found to compromise app quality and deter parents from using an app. Bhandari, Neben, Chang, and Chua (2017) found that app design affected parents’ first impressions about quality, thereby significantly encouraging or discouraging their download. Additionally, certain app features were more desirable to parents. Zhao et al. (2017a) reported 13 out of 21 parents rated interactive features such as reminders, calendars, keyword searches, and social networking as key reasons for using an app.

An app is a self-contained software program that comes in various sizes and features. The app is designed for a particular purpose and is downloadable from app stores to mobile devices, such as tablets and smartphones. There are a variety of attributes that users may consider when selecting an app. Reading about basic app features provided on the app description page can help parents make decisions about what to select and downloads. Each app description page is populated by the app developer and provides basic information about the app and showcases apps’ features. Basic features include size, system requirement, cost, last update, disclaimer, number of downloads,

user rating, and user comments. Table 1.1 presents definitions and interpretations of basic app features.

Table 1.1

*App features and its Interpretation*

App Features	Definition	Interpretation
Size	The space occupied by an app on a device (Morse et al., 2018; Noei, Syer, Zou, Hassan, & Keivanloo, 2017; Zhao et al., 2017b)	Lower the better (Morse et al., 2018; Noei et al., 2017; Zhao et al., 2017b)
System Requirement	The minimum software required to install and run the app (Noei et al., 2017)	Lower the better as users can install the app on older devices (Noei et al., 2017)
Cost	The dollar amount that users pay to access full app features (Harbach, Hettig, Weber, & Smith, 2014; Noei et al., 2017; Zhao et al., 2017b)	Debateable - Some authors suggest there is no difference in free and paid apps whereas some suggest otherwise (Harbach et al., 2014; Noei et al., 2017; Zhao et al., 2017b)
Last Updated	The date when the app was last updated (Brouard et al., 2016; Noei et al., 2017)	Better if it is recent. Periodic updates are essential as it ensures that the app is maintained well and functioning properly (Brouard et al., 2016; Noei et al., 2017)
Disclaimer	A rider that states the information on the app is a resource only and not intended to replace medical advice (Charbonneau, 2015)	Better if it is present as it ensures that people use the information with caution (Charbonneau, 2015)
Number of Downloads	The number of people installed the app (Morse et al., 2018; Zhang, Dong, Chen, Chai, & Liu, 2018)	Higher the better as it demonstrates an apps' popularity. However, it can be deceiving as it only goes up with the number of installs but does not reflect the number of people who

uninstalled the app (Morse et al., 2018; Zhang et al., 2018)

User Rating	The average rating score of the app on a scale ranging from 1 (very dissatisfied) to 5 (very satisfied) (Genc-Nayebi & Abran, 2017; Palomba et al., 2018)	Higher the better as it shows users' satisfaction with the app. However, a low number of reviewers can skew the rating (Genc-Nayebi & Abran, 2017; Palomba et al., 2018)
User Reviews	The comments entered by the users (Genc-Nayebi & Abran, 2017; Palomba et al., 2018)	Depending on a review. Reviews can provide an overall picture of apps' functionality, features, and issues that other users have experienced (Genc-Nayebi & Abran, 2017; Palomba et al., 2018)

Understanding the aforementioned features can assist parents in identifying an appropriate app for their parenting needs. However, this is not the only consideration in searching for a good quality app. According to the research, apps that are aesthetically pleasant, easy to use, functional, engage users, and provide credible information are generally considered to be high quality (Golden & Krauskopf, 2016; Stoyanov et al., 2015). Parents face numerous challenges in search of good quality parenting apps such as insufficient information or app features, navigation issues, and undue advertisements that hinders an app use and cause frustrations.

### **Aims**

Many researchers have identified issues with existing parenting apps (Bruno, 2015; Davis et al., 2017; Taki et al., 2015; Zhao et al., 2017a ) and reported that parents and healthcare professionals face difficulties finding good quality apps (Aitken, 2015; Danbjørg, Wagner, Kristensen, & Clemensen, 2015; Hearn et al., 2014; Lupton &

Pedersen, 2016); however, there is a lack of studies suggesting quality apps that parents can use. Therefore, this paper intended to facilitate decision making among parents by offering a review of quality apps that parents can use, and healthcare professionals can suggest.

## **Methods**

The Google Play Store was searched for freely available apps using prespecified eligibility criteria. First, an initial screening of all apps (n=4,300) was performed using the information available on the app store. Following this, 175 apps that met the criteria were downloaded on a device and were further screened for eligibility. Finally, a quality evaluation of sixteen apps was conducted using Mobile App Rating Scale (MARS), a reliable tool specifically designed for app evaluation. Before the app review, the authors viewed the MARS training video available on YouTube (<https://www.youtube.com/watch?v=25vBwJQIOcE>) as recommended by the MARS developers. The data for review was extracted from Google Play description pages (<https://play.google.com/store>) and the apps themselves.

**Search strategy.** The authors searched apps from the Google Play Store on June 1st, 2018 using the following eighteen terms: mum, mom, mommy, mama, mother, father, dad, daddy, papa, newborn, baby, infant, kid, child, children, family, parent, and parenting. The search was conducted on a public computer and none of the search restrictions were applied except free.

**Eligibility criteria.** The authors included apps based on the following inclusion and exclusion criteria. Apps were included that were: (I) written in English; (II) available to the general public; and (III) a self-contained product that did not necessitate addons or

an external device to operate. Apps were excluded that were: (I) duplicates; (II) exclusively for pregnancy; (III) targeting children or parents of children above the age of one; (IV) targeting infants' rather than parents (given screen time guidelines from Canadian Pediatric Society); (V) targeting healthcare professionals; (VI) focusing on diseases or conditions such as autism (study population was limited to healthy parents and healthy infants); (VII) focusing on parental dating and shopping (due to the potential risk of privacy and security such as theft and fraud); (VIII) non-relevant apps (apps focusing on food, nature, games, religion and parental greetings cards/quotes); (IX) deleted from the app store; and (X) targeting specific countries (e.g., child support apps). Apps (n=175) that met the inclusion/exclusion criteria were downloaded onto a Samsung Galaxy 7 tablet for further screening. Apps were further excluded if they had: inadequate information/features (n=48), navigation issues (n=39), insufficient free features (n=25), lack of credible information/sources (n=24), excessive advertisements (n=19), and demanded unnecessary personal information (n=4).

**App evaluation tool: MARS.** A multidisciplinary team of healthcare professionals and app designers/developers constructed the MARS tool to effectively evaluate the quality of apps. The internal consistency is  $\alpha = 0.90$ , and the interrater reliability intraclass correlation coefficient is 0.79 (Stoyanov et al., 2015). MARS is available free online (<https://mhealth.jmir.org/article/downloadSuppFile/3422/14733>). MARS is comprised of four subscales that measure: (I) engagement—fun, interesting, customizable, interactive, and well-targeted to audience; (II) functionality—performance, ease of use, navigation, and gestural design; (III) aesthetics— layout, graphics, and overall visual appeal of the app; and (IV) information—quality, quantity and credibility

of information, the accuracy of the app description page, and app goals. Each category is evaluated using a 5-point Likert scale (1 =inadequate, 2 =poor, 3 =acceptable, 4 =good, and 5 =excellent) or not applicable to provide a mean score for each subscale. The total mean value of all four subscales is considered the final measurement of the app quality (Stoyanov et al., 2015).

## **Results**

Of the 4,300 apps identified in the initial search, only 0.4% of the apps (n=16) met the quality criteria. All apps were free and available to the general public. The majority of the eligible apps were also available on the iOS platform, while only three apps were exclusively for the Android users. Most of the apps included in this review were featured in health and fitness (n=5) and parenting (n=5) categories. All of the apps (n=16) contained a privacy policy either on the app itself or on the official Website; a majority (n=12) were updated within the last year, and a half (n=8) were free of advertisements or “ads”. The lowest customer star rating was 3.9/5, and the highest was 4.8/5. A majority of the apps (n=12) were rated above 4.5 by users. The number of downloads ranged from one thousand to ten million. The lowest number of downloads was for the app Babybrains developed by a neuroscientist, and the highest number of downloads was for a commercial app, BabyCenter.

The overall highest MARS score was 4.5/5 for four apps, and the lowest was 4/5 for one app. The remaining 11 apps received ratings between 4.2 and 4.4 out of 5. The MARS subscale engagement mean was 4.3, with apps rated from 3.2 to 4.8/5. Most apps were rated high on functionality and ease of use (functionality mean score =4.6; ranging from 4.2 to 5), followed by visual appeal (aesthetic mean score =4.2; ranging from 3.8 to

4.6) and information (mean score =4.2; ranging from 3.6 to 4.7). Table 1.2 depicts the final scores for each subscale.

Table 1.2

*MARS Subscales and the Total Score*

App Name	MARS Subscale Engagemen t	MARS Subscale Functionality	MARS Subscale Aesthetics	MARS Subscale Information	MARS Total Score
Child Growth Tracker	4.3	5	4.3	4.2	4.5
Baby + – Your Baby Tracker	4.8	4.7	4.3	3.6	4.4
MyMedela Breastfeeding Companion	4.3	4.2	4.3	4	4.2
Baby and Child First Aid	4.3	5	4.3	4.5	4.5
BabyCenter	4.6	4.6	4.1	4.2	4.4
WebMD Baby	4.3	4.5	4.3	4.3	4.4
Info for Nursing Mum	4.3	4.2	4.3	4.7	4.4
Babybrains	3.2	4.2	4.3	4.4	4
Don't Cry My Baby (Lullaby)	4.7	4.8	4.6	3.6	4.5
White Noise Baby Sleep Sounds	4.7	4.8	3.8	4	4.4
Baby Sleep - White Noise	3.8	5	4.1	4.3	4.3
Familyalbum - Easy Photo & Video Sharing	4.2	5	4.3	4.3	4.5
First Smile - Baby Photo & Scrapbook App	4.7	4.2	4.3	4.3	4.4

ASL Dictionary for Baby Lite	4	4.8	4.3	4.3	4.4
Baby Weaning and Recipes	4.6	4.2	4.5	4	4.3
Parenting Tips for Children & Family By Lori Petro	4.1	4.7	4	4.4	4.3

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### **Brief Overview of Eligible Apps**

The apps covered varied aspects of parenting thus, for the ease of reporting the apps were divided into five categories according to their primary purposes such as tracking apps; information apps; sleeping-aid apps; photo-sharing apps; and, miscellaneous apps. The tracking apps allowed parents to track babies' basic activities, such as feeding, voiding, and bowel movements. Information apps provided parenting information such as infant feeding, age-appropriate activities, first aid, and more. Sleeping-aid apps presented white noises and lullabies to soothe infants and induce sleep. Photo sharing apps permitted parents to share baby moments privately with loved ones. The miscellaneous app category comprised of apps that did not fit any of the categories mentioned above, such as meditation. The authors presented the comparison tables in each category, except the miscellaneous apps, for parents to select apps based on the features that matter most to them and healthcare professionals to recommend app based on parents' needs.

**Tracking apps.** Tracking apps help parents understand their infants' basic activity patterns, identify concerns, and report accurate data to healthcare professionals upon their regular and emergency visits. These apps make parenting easier by allowing sleep-deprived parents to retrieve data with a click of a button instead of using their tired

mind recalling when their little one was fed last. Researchers had documented several features that make a tracking app appealing to parents (Chin, 2018; Demirci & Bogen, 2017; Lupton, 2016; Wang et al., 2018) including (I) ability to customize the app based on parents' needs and style such as the ability to add/delete activity, option to choose from automated or manual data entry, and data editing; (II) notifications/reminders for upcoming feeding and diaper change; (III) visual representation of the data through charts and graphs; (IV) synchronize or "sync" function to collaborate infant care and see real-time updates entered by other caregivers; (V) data export and sharing options and; (VI) built-in app support through chat rooms and forums.

The review included three tracking apps: Child Growth Tracker, Baby + – Your Baby Tracker, and MyMedela Breastfeeding Companion. The highest rated app in this category was the Child Growth Tracker app (4.5/5) due to the highest scores on functionally subscale 5/5 and on information subscale 4.2/5 compared to other apps in this category. The Child Growth Tracker app is simple and easy to use app that provides multiple evidenced-based scales to monitor a child's growth.

Table 1.3 illustrates the comparison between the apps to help parents select one based on their needs and style preferences. For example, out of all three apps, Baby + – Your Baby Tracker has the most tracking options, as well as additional features such as white noise, lullabies, baby book, and information. This app might be more suitable for parents who prefer a multifunctional app and would like to track more than just basic activities. On the contrary, the Child Growth Tracker is solely designed for recording infants' growth such as height, weight, head circumference, and body mass index (BMI). Over time, when the frequency of infants' basic activities reduces some parents only like

to monitor their growth by years. The MyMedela Breastfeeding Companion app was designed specifically for breastfeeding mothers to promote Medela LLC. products; however, users do not have to buy any Medela products to use the app. The app provides basic activity tracking and some information. Parents should be advised to use caution given that the information provided might be influenced by commercial gains.

Table 1.3

*Tracking Apps Comparison Table*

App Features	Child Growth Tracker	Baby + – Your Baby Tracker	MyMedela Breastfeeding Companion
Available on iOS	✘	✓	✓
Requires Login	✓ Optional	✓ It allows users to experience the app first and join later.	✓
Has A Syn Function	✘	✓ Via the same email	✘
Tracks Feeding (Breast/Bottle)/ Voiding/Bowel Movements	✓	✓	✓
Tracks Solids	✘	✓	✘
Tracks Sleep	✘	✓	✓
Tracks Growth	✓	✓	✓
Records Vaccinations	✘	✓	✘
Records Doctor's Visits/Medications	✘	✓	✘
Data Entry	Only manual	Only manual	Manual and

			automated Mothers can buy Medela breast pump for real-time data entry.
Data Editing	✓	✓	✓
Exports Data	✓	✓	✓
Reminders/ Notifications	✗	Users can also export baby photo book ✓ Only for medications	✓
Shows Trends	✓	✓	✓
Supports Multiple Babies	✓	✓	✓
Provides Information	✗	✓	✓
Forums/Chat Rooms	✗	✗	✗
Works Offline	✓	✓ Except for videos	✓ Only tracker
Ads	✓	✗	✗
Additional Features	It is also available in English, Spanish, French, and Portuguese languages. Parents can use it for children up to 20 years of age.	It also has baby teeth, milestone, and maternal weight tracker. It has lullabies, white noises, and a baby book.	It has an option to personalize information. It has add to favorites feature, checklists, and self-assessment tools.
Issues Identified	It provides many details such as Z score which might feel overwhelming.	The source of information is Health & Parenting Ltd., supported by Phillips and may be influenced by their commercial gains.	The source of information is Medela, which may be influenced by their commercial gains. 24/7 lactation consultant is a paid service.

Last updated	Oct 2018	Sept 2018	Nov 2018
Number of downloads	50 thousand	100 thousand	100 thousand
Size	7.1M	89M	61M
Pro/paid version	✓	✗	✗
In-app purchases	✗	✗	✗
			However, there is a shop icon if users would like to make a purchase.
Google Play Store Rating	4.7	4.5	3.9
MARS Rating	4.5	4.4	4.3

**Information apps.** First-time parents often feel unprepared for the care of their newborn, have doubts about what to expect regarding child development and questions about infant care. Many parents have used the Internet and apps to find quick and succinct answers to their immediate concerns (Asiodu et al., 2015; Jang et al., 2015; Shorey et al., 2017). Researchers have identified some characteristics that parents look for in an information app (Davis et al., 2017; Lupton & Pedersen, 2016; Taki et al., 2015; Zhao et al., 2017a) such as (I) credible; (II) appropriate amount of information; (III) relevant; (IV) various modes of information delivery; (V) keyword search; and (VI) discussion forums.

The review included five information apps: Baby and Child First Aid, BabyCenter, WebMD Baby, Info for Nursing Mum, and Babybrains. The top-rated app in this category was the Baby and Child First Aid app (4.5/5). The app scores highest (5/5) on functionality subscale, is easy to navigate and provides first aid information from a

reputable source, Red Cross. The Info for Nursing Mum app is specifically targeted to breastfeeding mothers and can be useful for first-time parents in the first couple of months. In comparison, the Baby and Child First Aid app covers emergency information for children and parents that is useful for years to come. The BabyCenter and WebMD Baby apps offer information on various parenting concerns and include additional functions such as a baby book, whereas Babybrains app is specific to activities that enhance infants' brain development. While Baby and Child First Aid and Info for Nursing Mum apps do not allow users to personalize the app based on the infant's age, the other apps permit parents to customize their homepage based on their baby's age.

Table 1.4 shows a comparison between information apps.

Table 1.4

*Information Apps Comparison Table*

App Features	Baby and Child First Aid App	BabyCenter App	WebMD Baby App	Info for Nursing Mum App	Babybrains App
Available on iOS	✓	✓	✓	✓	✓
Developer	British Red Cross	BabyCenter Health On Net (HON) certified	WebMD, LLC. HON certified	Family Health Service, Department of Health, Hong Kong	Silvia Dalvit Menabe, Neuroscientist, and founder of Babybrains UK
Country of Origin	UK	Originated in the USA but can be customized to many other countries.	USA	Hong Kong	UK

Requires Login	x	✓	✓	x	✓
Type of Information	First aid and emergency	Wide-ranging parenting information	Health information	Mainly breastfeeding	Brain development activities
Zoomable Text	x	x	x	✓	x
Videos	✓	✓	✓	✓	x
Quizzes/ Checklists	✓	✓	✓	x	x
Customizable to Provide Age-Specific Information	x	✓	✓	x	✓
Search Option	x	✓	✓	x	x
Mentions External Resources	x	✓	✓	x	x
Forums/ Chat Rooms	x	✓	x	x	x
Works Offline	✓	✓ Only for some content, mostly requires the Internet connection.	✓	x	✓
Ads	✓	✓	✓	x	x
Additional Features	It has a tracker for medications, allergies, emergency, and doctors'	It has a baby book and bookmark option.	It has a basic activity tracker and a baby book.	It is also available in Mandarin and Cantonese languages.	It is also available in the Italian language.

Issues Identified	contacts for multiple children. Some parents might find the text difficult to read due to the font size and color	It covers a broad range of parenting issues which might feel overwhelming.	It takes some time to load the content. Some parents might find the text difficult to read due to the font size.	It takes some time to load the videos.	Users have to go back and forth from the app to the Website to find activity material as there is no link provided.
Official Website	<a href="https://www.redcross.org.uk/">https://www.redcross.org.uk/</a>	<a href="https://www.babycenter.ca/">https://www.babycenter.ca/</a>	<a href="https://www.webmd.com/">https://www.webmd.com/</a>	<a href="https://www.fhs.gov.hk/english/">https://www.fhs.gov.hk/english/</a>	<a href="http://www.baby-brains.com/">http://www.baby-brains.com/</a>
Last Updated	Mar 2016	Oct 2018	May 2018	May 2017	Mar 2017
Number of Downloads	100 thousand	10 million	500 thousand	10 thousand	1 thousand
Size	53M	52M	20M	13M	11M
Pro/Paid Version	×	×	×	×	×
In-App Purchases	×	×	×	×	×
Google Play Store Rating	4.6	4.7	4.1	4.5	4.6
MARS Rating	4.5	4.4	4.4	4.4	4

**Sleeping-aid apps.** Sleep is a significant concern for new parents, and there is an abundance of literature available on the types and efficacy of soothing noises and lullabies to promote infant sleep (Brooks, 2016; O’Loughlin, 2018; Taheri, Jahromi, Abbasi, & Hojat, 2017). The apps presented in this paper intend to support parents in selecting the best available apps for white noises and lullabies if they choose these

strategies. The authors identified key features of sleeping-aid apps that parents might find useful, including (I) personalization options such as the timer, fade-out, ability to combine different sounds, record or add own sound/lullaby; (II); running in the background so parents can use their mobile device while lullabies/white noises are playing; and, (III) work offline so parents can use it in the absence of the Internet.

The authors included three sleeping-aid apps: Don't Cry My Baby (Lullaby), Baby Sleep - White Noise, and White Noise Baby Sleep Sounds. The most highly rated of the three was the Don't Cry My Baby (Lullaby), scoring 4.5/5. While this app has more lullabies and less white noises compared to the other two, it has additional features such as animals/instruments/cars sounds and a rattle that parents can use as a distraction; however, healthcare professionals should caution parents about screen time guidelines if parents decide to use this feature. Table 1.5 provides a comparison between sleeping-aid apps.

Table 1.5

*Sleeping-Aid Apps Comparison Table*

App Features	Don't Cry My Baby App	White Noise Baby Sleep Sounds App	Baby Sleep -White Noise App
Available on iOS	✓	×	×
Lullabies	19	4	4
White Noises	15	20	23
Timer	✓	✓	✓
Infinite Play	×	✓	✓
Fadeout Option	×	✓	×

However, the timer is up to 24 hours.

Option to Mix Lullabies/Sounds	✓ Up to 3	✓ Unlimited	✓ Users can only mix shh and hmm sound to other noises and lullabies.
Option to Record/Add Own Sound	✓	×	×
Option to Shuffle Lullabies/Sounds	✓	×	×
Sounds/Lullabies are Labelled	✓	×	×
Sounds are Categorized	×	×	✓
Works in the Background	✓	✓	✓
Works Offline	✓	✓	✓
Ads	✓	✓	✓
Additional Features	It has animals/instruments/car sounds and rattle that parents can use to distract the infant for brief moments. Lullabies' text is available.	It has a color customization option.	It has an option to choose from 24 languages.
Issues Identified	The link to YouTube videos is in the Korean language by default and is difficult to switch.	It looks a little busy.	It has limited options to personalize the app.
Last Updated	June 2018	Sept 2018	Oct 2018
Number of Downloads	1 million	1 million	1 million
Size	38M	21M	14M
Pro/Paid Version	×	×	×

In-App Purchases	×	×	✓
Google Play Store Rating	4.6	4.8	4.8
MARS Rating	4.5	4.4	4.3

**Photo-sharing apps.** Parenting is generally associated with an increased level of stress among parents. Sharing happy parenting moments with family and friends allow parents to prolong and intensify the positive emotions and appreciate the joy associated with parenting thus facilitating adjustments to their new role. A study of 435 parents of young children indicated individual and relational benefits of sharing positive parenting events with loved ones (Burkhart, Borelli, Rasmussen, & Sbarra, 2015). Many researchers have reported parents use social media to feel connected with their social network and to showcase and validate their parenting practices through likes and comments (Oeldorf-Hirsch & Sundar, 2016) however, sharing identifiable information along with photos may pose privacy and security risks ((Benevento, 2018; Brosch, 2016). Therefore, some app developers have developed private photo-sharing apps as an alternative to posting photos on public platforms. These apps allow parents to share photos with people they know and can trust with their infants' photos. There are two private photo-sharing apps included in this review: First Smile – Baby Photo & Scrapbook App and FamilyAlbum - Easy Photo & Video Sharing. Both apps have similar features except FamilyAlbum - Easy Photo & Video Sharing app allows parents to order photo books online, whereas the First Smile - Baby Photo & Scrapbook App offers a photo editing option. Family Album - Easy Photo & Video Sharing app was rated highest

(4.5/5) in this category because of the highest score on functionality subscale (5/5). Table 1.6 provides a comparison between the two photo-sharing apps.

Table 1.6

*Photo Sharing Apps Comparison Table*

App Features	FamilyAlbum - Easy Photo & Video Sharing	First Smile - Baby Photo & Scrapbook App
Available on iOS	✓	✓
Photo Editor	✗	✓
Supports Multiple Babies	✓	✓
Option to Post And Receive Comments	✓	✓
Easy to Invite People	✓	✓
Requires Other People to Download the App to Share Photos	✗	✗
Unlimited Free Storage	✓	✓
Creates Albums	✓	✓
Option to Import Photos From Google Photos	✗	✓
Ads	✗	✗
Additional Features	It is also available in the Japanese language.	It has Chromecast support. It has a vaccination recorder and reminder.
Issues Identified	Users cannot choose different invitees for different babies.	It does not have an option to turn the album into a video.

Last Updated	Nov 2018	Oct 2018
Number of Downloads	1 million	50 thousand
Size	Varies with device	20M
Pro/Paid Version	✘	✘
In-App Purchases	✓ Users can order photo books, DVDs, and more	✘
Google Play Store Rating	4.7	4.6
MARS Rating	4.5	4.4

**Miscellaneous apps.** Miscellaneous apps category contained apps that did not fit in the categories mentioned above. These apps were ASL Dictionary for Baby Lite, Baby Weaning and Recipes, and Parenting Tips for Children & Family by Lori Petro. These apps were exclusive to one particular activity such as baby sign language, baby weaning, and meditation; therefore, it was difficult to create a comparison table. The highest rated app in the miscellaneous app category was ASL Dictionary for Baby Lite (4.4/5) due to the highest score on functionality subscale (4.8/5) compared to other apps in this category. The authors identified key features of these apps, and a brief overview of each app is provided in Table 1.7 to assist parents and healthcare professionals in selecting desired apps.

Table 1.7

*Basic Features of the Apps in the Miscellaneous App Category*

App Features	ASL Dictionary for Baby Lite	Parenting Tips for Children & Family by Lori Petro	Baby Weaning and Recipes
Available on iOS	✓ It has a different name for iOS “Baby Sign Language Dictionary-Lite.”	✓	✓
Purpose	Learn and teach American Sign Language (ASL).	Mentally support parents in coping with parenting challenges.	Support parents in weaning their infants.
Brief Overview	The free version has 40 short videos with practical examples of incorporating these signs in daily routine.	In this app, Lori Petro, a certified parent educator, presents the parenting podcasts, to deal with everyday parenting stressors. The app also features meditations, relaxing sounds, and motivational content.	It has a week by week meal plan and 193 recipes which can be filtered by age, ingredient, type of meal, and cooking time.
Additional Features	It has self-assessment quizzes and add to favorites option.	It has a timer, widgets playlist, and daily inspiration notifications options.  The audios run in the background.	It has add to favorites feature.  Users can directly add ingredients from recipes to the shopping list.
Search Option	✓ The font color for the searched term is	×	×

	hard to read.		
Works Offline	✓	✓ It works offline only for the podcasts that are added to the playlist.	✓
Requires Login	✗	✗	✓ It allows users to experience the app for a few minutes and then prompt to sign up. Sign up is easy, but the welcome package is limited to the UK population.
Ads	✗	✗	✗
Issues Identified	There is no picture of the signs.	Text in podcasts is tiny and difficult to read.	Both the developer (Madeformums) and the sponsors (SMA nutrition)' Websites are not accredited.
Last Updated	Feb 2013	Mar 2018	Nov 2018
Number of Downloads	100 thousand	5 thousand	10 thousand
Size	35M	14M	49M
Pro/Paid Version	✓ The paid version offers 340 signs.	✗	✗
In-App Purchases	✗	✓ It offers the subscription to access additional podcasts.	✗
Google Play Store Rating	4.1	4.8	4

MARS Rating	4.4	4.3	4.3
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## Discussion

In this review of free parenting apps available on the Google Play Store, the authors found only 16 (0.4%) relevant quality apps out of 4,300 apps which reflects the extent of the problem contemporary parents face in a quest of finding a good quality app. The constant increase of app use amongst parents (Asiodu, et al., 2015; Jang et al., 2015; Shorey et al., 2017), the proliferation of low-quality apps (Davis et al., 2017; Hearn et al., 2014; Lupton & Pedersen, 2016; Taki et al., 2015), and the reluctance of healthcare professionals to suggest an app (Golden & Krauskopf, 2016; Stoyanov et al., 2015) present a timely opportunity to offer an app review that provides a list of good quality apps that parents can use. This app review offers a brief overview of quality apps that are evaluated using MARS (Stoyanov et al., 2015), a rigorously developed tool by a multidisciplinary team to appraise the quality of an app. The review also highlights the need for more evidence-based apps as none of the apps included in this review have trailed or tested for efficacy. This finding is similar to other studies (Baker, Sanders, & Morawska, 2014; Lupton & Pedersen, 2016; Tinschert, Jakob, Barata, Kramer, & Kowatsch, 2017).

Fathers play an important role in the development of an infant's physical, social, and mental well-being. Similar to mothers, fathers also go through uncertainty and anxiety related to infant care and require support after the birth of their child. However, it was intriguing to note that despite having four specific search terms for fathers (dad, daddy, papa, and father) none of the apps qualified for the MARS review that addresses

fathers' needs. The literature revealed a few apps such as mDad (Lee & Walsh, 2015), Milkman (White et al. 2016a), and DadTime (Balu et al., 2018) designed by healthcare professionals, especially for fathers. However, it seems that these apps are still under review or might not be developed for Android users as none of the apps came up on the Google Play Store search.

Evidenced-based apps are more scientifically robust, but they often lack user engagement and intuitive user interfaces compared to commercial apps (Hingle & Patrick, 2016; Jake-Schoffman et al., 2017). Commercial apps may pose privacy and security risks by leaking or selling personal data to third parties and provide content that may have influenced by commercial gains (Lupton & Pedersen, 2016). However, commercial apps seem to be more popular among parents (Hearn et al., 2014; Hingle & Patrick, 2016). For example, in this study, BabyCenter, a commercially developed app had the highest number of downloads (10 million) compared to an evidenced-based app that does not only have a low number of downloads (1,000) but also scored lowest on the MARS engagement subscale amongst all apps. Tinschert et al. (2017) presented a review of asthma apps and shared similar findings that academic apps scored lowest on the MARS engagement subscale.

### **Implications for practice**

Considering current trends of increased smartphone use, healthcare professionals have a responsibility to support digital literacy among parents. Healthcare professionals can encourage parents to look for the privacy policy of apps to ensure that personal information is not shared with the third party; to check for the source of information or Health On the Net (HON) seal, to verify the quality of health information; and to appraise

apps using app evaluation tools, such as the user version of the MARS (uMARS) (Stoyanov et al., 2016). These strategies will assist parents in identifying risks and benefits associated with the use of a particular app, thus facilitating informed decision-making regarding app use.

Several researchers have presented parenting app reviews but have limited their findings to discuss the quality issues with existing apps (Bruno, 2015; Davis et al., 2017; Taki et al., 2015; Zhao et al., 2017a) thus leaving parents and healthcare professionals to discover the quality apps on their own. Future apps reviews should not merely focus on concerns regarding available apps but should also offer apps that are of good quality. Providing a list of quality apps that parents can use will reduce the frustrations associated with app search and will increase the utilization of good quality apps. This app review is the first phase of a project that aims at developing a Website that will serve as a hub for quality parenting apps. The Website will be updated frequently and will also allow parents to suggest quality apps.

Creating strategic partnerships between academic and commercial entities for future app development may result in apps that are scientifically robust and appealing to users. Research methodologies, such as PD that advocates developing technology with the users, should be used in developing user-centered parenting apps. These approaches will increase parents' uptake of academic apps and reduces the dangers associated with the use of low-quality apps. Future research should also focus on developing and disseminating apps for fathers as the involvement of fathers is a crucial component of family-centered care.

## **Limitations**

Certain limitations need to be taken into account when considering the results and contributions of this review. The authors only included free apps available in the English language, and as a result, there is a possibility that some quality apps may have been missed. The primary author reviewed the apps independently using MARS. Although the MARS has good interrater reliability (Tinschert et al., 2017; Stoyanov et al., 2015) there is a possibility that authors' subjectivity might have impacted the scores; therefore, users are required to use caution in interpreting the findings of the review. The rapid rate at which apps develop, update, and disseminate imposes challenges to present an up-to-date review of the apps. It is likely that some of the apps' characteristics might not be the same as the authors presented in this review.

## **Conclusions**

Apps are increasingly becoming an essential part of technologically savvy parents' lives. However, the rapid growth of apps presents a challenge for parents and healthcare professionals to locate good quality apps. The authors offered a list of free 16 quality parenting apps available on Google Play Store and provided a brief overview of each app for parents, thereby facilitating selection of apps based on their style and need. The Google Play Store lacks quality apps for fathers, thus providing an opportunity for researchers to recognize the role of fathers and develop apps geared towards supporting fathers in adjusting to their new role. Academic apps should not only focus on evidenced-based content but also include parents' preferences and perspectives in designing future apps. Involving end-users in designing and developing apps will lead to better user-centered apps available for the general population and will increase the ownership and

utilization of these apps. Healthcare professionals should be equipped with the strategies to guide parents safe use of technology and to support technologically savvy parents in their quest to finding good quality apps.

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**Chapter 4: Parents' Perspectives of Parenting App Use. A Focus Group  
Study**

Virani, A. Duffett-Leger, L. & Letourneau, N. (2020). Parents' perspective of parenting app use. *Journal of Informatics Nursing*, 5(1). 8-18.

This article was featured as Continuing Nursing Education 1.2 credit hours.

Virani, A., Duffett-Leger, L., Letourneau, N., & Stroulia, E. (June 2019). Parents' Mobile Applications Searching Behaviors: A Focus Group Study. Paper presented at the *Canadian Nursing Informatics Association Conference*, University of New Brunswick, Fredericton, Canada.

### **Abstract**

Contemporary parents often use mobile applications to support their parenting. Several researchers have reported issues with current parenting apps. This study aims to explore parents' use of parenting apps to inform the development of an online resource that supports their search for apps. Four focus groups with Canadian parents were conducted. Four themes emerged and the study suggests a one-size-fits-all approach will be ineffective in designing a parenting resource. Healthcare professionals and researchers should aim at developing versatile mobile resources that support parents with diverse preferences.

**Keywords:** Mobile applications (apps), parenting apps, parent focus groups

## **Introduction**

Parenting an infant for the first time requires learning an overwhelming amount of new information and skills. Parents use of the internet to support their parenting have drastically increased due to global mobilization of people, increase in nuclear dual working parent families, early discharges from the hospital after childbirth, and instant availability of online parenting material (Danbjørg et al., 2015; Rathbone & Prescott, 2019; Statistics Canada, 2017).

Many parents use mobile applications (apps) to gain parenting information, track and record the growth and development of their infants, and play lullabies and white noises to soothe their infants. Apps providing 'how to' videos help parents gain practical knowledge regarding infant care issues such as bathing an infant or assembling and using baby products (Lupton & Pedersen, 2016). Parents often turn to online forums and blogs by other parents and experts to seek practical information, ask questions and find answers dealing with everyday parenting situations, and to get support (Baker et al., 2017; Jang et al., 2015). Parents also use apps to find localized information to help them connect with other parents in their communities, identify local resources, and search for local healthcare facilities and daycare services (Duggan et al., 2015; Johnson, 2015).

## **Aim**

There are hundreds of parenting apps on any given topic (Banerjee et al., 2019; Davis et al., 2017; Zhao et al., 2017a). Several app reviews on the topic revealed an abundance of poor-quality and irrelevant apps available for parents that makes the process of finding a desirable app difficult (Jake-Schoffman et al., 2017; Richardson et al., 2019; Shorey et al., 2017). The focus group discussions were part of an overall

project that aims at designing a parenting app directory with parents to support their search for apps.

## **Methods**

This qualitative descriptive study employed focus group discussion methods to explore parents' use of apps. Ethical approval to conduct the study was obtained from the Conjoint Health Research Ethics Board and all participants underwent a process of informed consent.

**Recruitment and eligibility.** Parents were recruited from public libraries, community health centers, and public health services perinatal classes, through posters, study cards, and in-person. A Facebook page was also created to recruit participants. Eligible participants were first-time parents of infants (0-12 months) who could communicate in English and have used parenting apps within the last 6 months. The study was limited to healthy parents and healthy infants; parents or infants with serious physical or mental health conditions were excluded. For this study, serious physical or mental health condition was defined as a health condition that carries a risk of mortality or impedes a parents/infants' daily functioning or quality of life (Kelley & Bollens-Lund, 2018).

## **Data Collection**

Four focus group discussions were conducted with a total of 18 parents. Each parent participated only once in focus group discussions; each discussion lasted approximately 2 hours. The discussions were conducted by the first author in public library meeting rooms. Focus group discussions were selected as it provides a natural environment in which ideas emerge through conversations. Participants influence and are

influenced by each other's perception of an issue. Group interactions generate data and facilitate the identification of users' technological needs, use, and preferences (Krueger & Casey, 2014).

Interviews employed a semi-structured questionnaire. The questionnaire included seven questions in the following categories: pleasant and frustrating app searching experiences, the types of app parents prefer to use, the average and maximum numbers of app search in one category, and free versus paid apps. Participants were also given 2 minutes to write down three app features they liked the most and share it with the group which generated a rich discussion of desired and undesired attributes of parenting apps which affects their app use. At the end of the focus groups, participants were provided a few parenting apps to choose from and instructed to use one or two apps for 10-15 minutes and shared their feedback with the group. The activity allowed parents to share their perspectives on existing parenting apps. See Appendix D for the focus group discussion questionnaire. Groups were run until data saturation was obtained.

### **Data Analysis**

The focus group discussions were audio-recorded and transcribed verbatim. NVivo 12, qualitative data management software, was used to organize the data for analysis. Thematic analysis, a qualitative descriptive approach, was used to analyze the data. Thematic analysis method assists researchers in identifying common threads that run across the data. In an inductive thematic analysis, the data is not analyzed using pre-existing theories or coding frameworks rather the themes emerge from the data itself. (Boyatzis, 1998). The thematic analysis method is an iterative and reflective process that involves a constant moving back and forth among data sets. The constant movement

allows researchers to ensure the themes are originated from the participants' data and represent participants' viewpoints (Braun & Clarke, 2006).

## Results

The study sample included 18 Canadian parents. Mothers' (n=15) age ranged from 29-39 years, with a mean age of 33 years (SD =3.41). Fathers' (n = 3) age ranged from 35-42 years, with a mean age of 39 (SD = 3.78). The majority of parents (89%) had university-level education (n = 16) and 72% had an annual income above \$100,000 (n = 13). Table 2.1 illustrates the participants' demographic characteristics. All parents used the internet daily for parenting purposes, and a majority (67%) spent 30 minutes to an hour every day searching for parenting material (n = 12). Sevens parents had one to three apps on their devices, whereas six parents had four to six parenting apps on their devices at the time of focus group discussions.

Table 2.1

### *Participants' Demographic Characteristics*

Characteristics	Number (n=18)	Percentage
Gender		
Male	3	17 %
Female	15	83%
Age		
Less than 30 Years	2	11%
31- 40 Years	14	78%
Above 40 Years	2	11%
Employment Status		
Maternity Leave	14	78%
Unemployed	1	5.5%
Self Employed	2	11%
Working Full Time	1	5.5%

Marital Status		
Married	17	94.5%
Never Married	1	5.5%
Level of Education		
Professional Degree	2	11%
University	14	78%
College	2	11%
Income*		
Above 100,000	12	71%
75,000 to 100,00	5	29%
Birthplace*		
Canada	12	71%
Germany	1	5.8%
Romania	1	5.8%
Pakistan	1	5.8%
China	1	5.8%
Mexico	1	5.8%

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*Note.* \*missing value

**Theme 1: process of searching for apps.** Most participants in this study commenced the process of searching for apps with the decision to conceive a child and continued after the baby was born. The use of fertility apps and pregnancy apps were common. For example, one mother shared her transition from pregnancy to parenting apps by stating: “I think it started before he was born so, I had What to Expect app following pregnancy and then one of my coworkers had suggested The Wonder Weeks app while I was pregnant, and that’s the one that I probably used most faithfully after he was born”. Parents tried several apps to find one app that met their needs and fit their lifestyles. On average, most parents tried out “three to four” apps in one category (e.g., tracking apps) before finding the app they liked. One mother shared, “I probably delete three [apps] for every one I keep”. A number of parents revealed five apps were the

maximum they would try in an attempt to find one that met their needs. One mother said, “I wouldn’t go over five of parenting apps for one category... I wouldn’t. Otherwise, I go crazy”. Very few parents went up to six or more apps for certain categories. One mother who critically analyzed each app that she used, mentioned, “I found one, good one out of five or six so yeah ... I had ... 15-20 apps and three that I like”. Parents used different strategies to find apps. During analysis, three patterns emerged:

- 1) Downloaded all apps and then decided what to keep.
- 2) Recommended apps.
- 3) Analyzed app attributes to make a decision.

In this group of parents, the most common method of locating apps was downloading all the free apps that came up on their search and screening them for usefulness. Parents kept the one that worked for them and deleted the rest. For example, one father shared, “I love the daddy apps and download them all, but some of them are just useless. So, I go through and see which ones are useful.”

Some parents felt the only way to find quality apps was via recommendations from family, friends, coworkers, and healthcare professionals. One participant reported, “I would download what was recommended by people. I haven’t explored too much myself, and then I most likely kept it.” Recommendations from friends, co-workers, and other parents were considered helpful. Parents felt if it worked for other people it might work for them, too. In one of the focus groups, when one mother shared her favorite app and explained the app features that she liked the most, another mother responded, “If you’re hearing another mom recommended an app and explained why I am more likely to download it and look at it. I know somebody had good luck, had success with it.

Otherwise, I usually don't." Perinatal classes were another good source for parents to find recommended apps. One parent described her experience, stating, "I heard about The Wonder Weeks in our Birth and Babies [perinatal] class. I normally don't like to pay for apps, but I heard that a lot of people found it helpful so I thought I'd give it a try."

Some parents were critical about available app selections. Parents mentioned following specific features to help them make decisions about download and retention such as visual appeal, last updated, number of downloads, ratings and user reviews, cost, registration forms/login, advertisements, and functionality. Table 2.2 provides more details about each attribute, its explanation, and parents' comments.

Table 2.2

*App Attributes that Affected App Downloads and Retention*

App Attributes	Explanation	Participants' Comments
Visual Appeal	Visual appeal was an important factor for some parents. If the name of the app or app icon did not seem appealing, they quickly moved on to the next app.	<p>"Even the name [of the app] was an issue. Like how you can tell someone easily what it is, that's not a good sign."</p> <p>"Usually the parenting apps have a babyface. I'm used to seeing a babyface. With this logo, I wouldn't guess it's a parenting app. It looks more like an Airbnb logo."</p> <p>"Especially if the logo appeals to me, I will try it. If it looks cheap, I wouldn't download and try."</p>
Number of Downloads	Parents used the number of downloads to evaluate an app's popularity: the higher the number such as "more than thousands or millions" the popular the apps were. Some parents downloaded the app out	"For me it's the number of people like if 10 million people downloaded it, I want to download it too, to see."

of curiosity to find out the reason for its popularity, and some downloaded the app thinking if many parents are using it, they might also find it helpful.

#### Last Updated

Parents used the last updated date to figure out how old and functional the app was. If the app was not updated within “12 to 18 months,” parents were less likely to rely on the information and questioned its functionality.

“Updating is very important. It causes the problem within the app if it's not updated. Some app [developers] stop updating, and then it just stops [working]. The information could be old as well, maybe like five years ago.”

#### Ratings and User Reviews

App ratings and user reviews were the most common information used by parents in this study to analyze the app. It communicated the perceived quality of the app, encouraged or discouraged the download, and cautioned parents about the app’s limitations. It was clear throughout the analysis that parents were aware of the debatable reliability of the ratings and reviews. They mentioned their frustrations about the ratings and reviews that did not provide any valuable information about the app.

“I read the top 10 positive reviews or either top 10 negative reviews to figure out why. A lot of the negative reviews are, people just put random nonsense stuff in there, so I don't read those ones. All I do is read through the reviews about the app. Apps may have lots of pleasant reviews but then in the last six months while they may have stopped updating stuff, so reading more recent than more negative is more helpful. There is a wide variety of reviews that gives you an idea of where the app is now.”

Some parents used only app ratings to decide as it was a quick way of analyzing the app quality compared to reading reviews. Several participants in this study followed a rule of thumb that an app less than three stars was not worth downloading.

“Probably three [stars] and above. If it's anything less than that you know, that's it...like the functionality or big issue or something.”

Parents generally looked for

“It's based on the rating and the

	<p>higher ratings. However, participants in this study were well aware of the fact that the ratings were affected by the number of reviewers. A small number of ratings affect the average score and can positively or negatively skew the overall ratings. In general, if the number of reviewers was less than 50, parents moved on to the next option thinking it was not enough to make a decision.</p>	<p>number of people. It's not like one or the other... you use those two factors to make the decision whether you wanted to download.”          “If there is one five-star [rating], it's not helpful, and if there is one rating that is average, I still don't want it.”</p>
<p>Cost</p>	<p>Cost consideration was an important factor in all types of app searches. Most parents in this group were “all about free” apps and “just chose not to pay for features or apps.” Some parents mentioned that they “haven't paid for an app before.” Most parents preferred free apps, however, if they really “liked” the app or found it “useful” or if it was “highly recommended” or if they could not find a better alternative, they happily paid for the app and considered it a “good investment.” An example of such a paid app mentioned by most participants was The Wonder Week app.</p>	<p>“I usually don't [pay for an app] ... I will look for something free or find something else.”          “I like it [the Wonder Weeks app] a lot better. I got the free version and then upgraded it.”</p>
<p>Registration Forms/ Login</p>	<p>Parents found it acceptable to fill out quick and short registration forms, log in with their existing Google or Facebook accounts, and skipping registration for now and sign up later. Registration forms that were long and required lots of unnecessary information negatively affected</p>	<p>“You don't have to register the email or anything. You can join your friends by logging in using Facebook. So, I like that you can skip the registration.”          Participant 1: “They ask for a ton of information before I even know if I wanna be on the app or not.”          Participant 2: “Yeah, that makes me delete all the files.”</p>

	<p>parents' experiences with the app and many parents deleted the app halfway through the registration form.</p>	<p>Participant 1: "I wanna see what the app is.... see if I actually want it, and then I will give you more info but, there is one like you have to fill the whole [registration form]."</p>
		<p>Participant 2: "Yeah, and you delete it halfway."</p>
		<p>Participant 1: "And you are like... no this isn't."</p>
<p>Advertisements or "Ads"</p>	<p>Ads are common in free apps as it generates revenue for the app developers. Parents were well aware of that fact and were willing to deal with the ads in free apps.</p>	<p>"If they [app developers] still let it be free for me I'm fine with watching ads so that it's free."</p>
	<p>Parents preferred targeted ads over random ads and apps with the least number of ads.</p>	<p>"The [ads] were random...I guess not related to the audience. It seems obvious, but like you're watching. [and there is an] ex body spray [ad]. I don't need that right now, versus like a pimple cream and you're like oh yeah. It sounds obvious, but something that is more targeted and not annoying."</p>
	<p>Ads that hindered app usage, hard to close or skip, flashy or bright in color, came with loud noises, covered most of the screen, and forced users to make a purchase were considered "annoying".</p>	<p>Participant 1: "It's the ad banner that's flashing that bothers me. If it's just an ad banner that's just in one color, fine, but the flashy is annoying, and yeah, the sound."  Participant 2: "Oh yeah and that disturbs your sleep [pointing at her baby], and you go like thank you" [sarcastic tone].  Participant 3: "Yeah, the one that pops up with the sound."  Participant 4: "And all the pop-ups that you have to find the teeniest tiniest little x."  Participant 5: "Oh yeah, the one that pops up, so you download something."</p>

Functionality	<p>Parents in this study deleted the apps within a couple of minutes of download if they had a hard time finding features or information. Parents preferred simple and clean interface instead of busy layouts.</p> <p>Parents in this study tend to delete apps right away if the app was slow (takes time loading or opening up) or if it had glitches.</p>	<p>“This [app] looks a little busy, a little bit crazy.”</p> <p>“It didn't just have a simple, easy kind of home page look.”</p> <p>“I went into the menu, but I couldn't figure out where to go, so it's hard to use within the 2 minutes of I downloaded it.”</p> <p>“Some apps keep locking you out, or you can't open them, or you can't close them, or it just doesn't function properly.”</p>
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**Theme 2: gender variations and app use.** Both mothers and fathers in this study searched parenting apps to support their parenting; however, it was clear throughout the analysis the app use was common amongst mothers more than fathers. One father stated, “A lot of dads I think, in my opinion, don't use apps. ...My wife uses it; she is always on it.” Most mothers also commented on lack of app use among fathers, as one mother stated, “My husband is not into [parenting] apps”. The primary author experienced similar statements while recruiting participants for the study. Many fathers declined to participate because they had never used a parenting app.

Several factors were mentioned by both mothers and fathers explaining the reasons for the lack of parenting app use amongst fathers including scarcity of quality apps for dads, the lack of gender-neutral language in parenting apps, and social integration of fathers' role. Parents shared their frustrations regarding the unavailability of quality parenting apps designed for fathers. One father commented, “There are not many daddy apps to choose from.” Another parent stated, “There isn't a lot for dads out there, like these apps and all, they are all targeted for the women.” Findings from a

parenting app review, conducted by the authors as the first phase of this project, support this contention (Virani et al., 2019). Despite a comprehensive search, not one quality app was found for fathers.

The exclusion of fathers was apparent in the language used in the apps. Participants felt that most apps did not use inclusive language and were mainly geared towards mothers. One father shared this concern by commenting, “We know as sex [father] you are not addressed.” When presented with a positive example of an app during an app review, a mother stated, “One thing I did like about this app is that it is for mom and dad whereas, I just don’t like the language where its only mom and baby.” Overall, fathers in this study felt the lack of parenting apps targeting fathers was because their role as a father was not socially valued. They suggested it would be helpful if an app could provide a platform to share their feelings and their role in an infant’s life, and offer social support as one father said,

“What if something was out there, in an app that makes it more acceptable for us to talk about ... An app that’s geared towards fathers, I think will be well received. ...I don’t think new information; new content needs to be generated, it needs to be curated better, framed better and toned needs to be framed or changed so that we can appeal to men who have these aspirations being in the hospital without overloading us.”

Mothers and fathers also differed in their parenting app use including parenting roles, types of apps preferred, and attention to details. While the role of mothers and fathers are evolving in modern societies as more fathers are taking paternal leave than ever before, traditional gender and parenting roles persist. Most participants in this study

depicted traditional role expectations. All the mothers in this study were on maternity leave while the fathers continued to work. As the primary caretaker, mothers spent more time with their infants and assumed the main information-seeking role within the family, exploring different options to support infants' physical, mental, and social wellbeing. Mothers in this study were 'way more motivated to find what works' than fathers when it came to adopting a parenting app. As one mother stated, "[Fathers] don't use many apps because a lot of them require continuity like I do all the stuff while he's at work." One participant commented on parenting roles as a deciding factor for app use,

"My husband doesn't download parenting apps. I think it's just because of our roles because I'm usually taking care of the baby so I'm the one downloading stuff ... I think that determined itself that whether or not you would be using parenting apps."

Mothers mainly focused on information, communication, and social networking apps to learn about their infants' needs and to get support. Mothers spent more time than fathers browsing and exploring different tabs and icons to reveal the apps' full potential. They favored multifunctional apps that could track, provide information, and play lullabies. In contrast, fathers preferred simple, straightforward apps that helped them accomplish their tasks well and using apps as a tool to manage childcare such as tracking infant data. For example, one father mentioned his favorite app stating, "Basically, once the kid goes to sleep, you just start the timer, it just kind of keeps track, it's not giving you tips, it's just keeping track of your kid."

Mothers paid more attention to app details, clicked and compared different options, and needed more time to make decisions to download. In contrast, fathers tended

to be quicker in making decisions by just reading the headlines and information provided on the main page. Similar patterns were observed during focus groups when parents were asked to evaluate a parenting app and present a review to the group. Fathers were quick to make the decisions about the app, whereas mothers took longer to evaluate an app and presented more detailed and critical reviews compared to fathers. One father described the difference between him and his wife app searching as,

“When we found these apps, we both went and looked for apps. I checked them out and five minutes in, this one works ... but she had six of them open, and she was flipping between them, what does this one is saying, and what does this one say, and I’m going like, good enough for me, no more.”

**Theme 3: commonly used apps.** Parents mentioned using several types of apps, though tracking and information apps were the most common amongst this group of parents. Study participants felt that sleep deprivation associated with caring for a completely dependent infant made it difficult for them to recall details of parenting activities, such as the number of diapers change and feedings in the last 24 hours. When asked about the types of apps they used as first-time parents, the first response from most parents was, “The baby tracker when they’re first born, you are using it for feeding and tracking changes. That’s the biggest thing.”

Parents in this group frequently mentioned three main benefits of using tracking apps. Tracking apps provided the visual representation of infants’ basic activities patterns in a graph/chart formats, facilitated the collaboration of infant care among caregivers through ‘sync’ (synchronize) function, and supported fathers’ involvement in care. Table 2.3 illustrates the benefits of tracking apps and quotations from parents.

Table 2.3

*Benefits of Tracking Apps*

Benefits of Tracking Apps	Explanation	Participants' Comments
Visual Representation of Data	Tracking app made it easier for parents to keep a track of their infants' feeding and sleeping patterns and report it to healthcare professionals on their regular visits or in case of any concerns.	"When we called 811 [a phone service that provides health-related information to Albertans], they like to know when was the last time the kid pooped? How many times has the kid pooped? Because my wife keeps track of this stuff, it was easy for her to shoot that off.... I was reluctant to use this thing; I was like our moms survived without all these app businesses, but there is definitely some positive to it."
Collaboration in Childcare	Sync feature in tracking apps allowed parents and caregivers to share infant care data without contacting the other person or remembering details.	"This is the other thing about it [the tracking app] is this if she puts something in there, I'm seeing it, if I put something in there, she is seeing it. My wife is going to go back to work and I work from home, so if I have to feed her four times a day or five times a day, I'm not going to remember what time I did or what the timeframe is."
Supported the Involvement of Fathers	Fathers were more inclined to use tracking apps than any other parenting apps because the tracking apps were generally simple and permitted fathers to be part of the infant care process by simply inputting the data.	"I like this [tracking] app because it's simple, its geared towards something a guy can like. There are not too many frills, it's just straight, input the information. I mean that's not hard. You click that icon, and that's it. Even though I don't like using it, ...I'm okay with using it."

While most parents expressed admiration for the tracking apps, some parents found tracking every single thing a lot of work. For example, one mother stated,

“I find it’s hard to use apps for tracking and stuff. I used the baby tracker as well, but it was a lot of commitment. I found once we had him unless there was a problem, I didn’t track anything. So, if there is something wrong, then I might pay attention to it a little bit more but there is no reason really when things are going well, to create that extra work of entering everything in an app on top of everything else.”

Information apps were the second most common type of app that parents used.

Parents in this study preferred information apps that provided:

- Different ways of presenting the information.
- Appropriate quantity of information.
- Age-specific information.
- Credible information.

Table 2.4 presents a detailed explanation of these characteristics and supporting quotations from participants.

Table 2.4

*Desired Characteristics of an Information App*

Desired Characteristics of Information Apps	Explanation	Participants’ Comments
Different Ways of Presenting Information	Parents appreciated the different content delivery styles such as mnemonic, pictures, videos, Frequently Asked Questions (FAQs), and self-assessment quizzes, that helped them understand and remember things better rather than just	<p>“I am a visual person, so having pictures help me.”</p> <p>“It has a test so you can take a test to learn the stuff beforehand too.”</p> <p>“I like that it’s got a whole list of different questions that people tend to ask or want to</p>

	plain text.	know about breastfeeding.”
	Parents appreciated the ReadAloud option that read articles for them with a touch of a button as they could listen to the article while performing their parenting tasks.	“If you open them [articles], there is an option to audio, so you don't even have to read it. You can press play, and it will read the article for you.”
Appropriate Quantity of Information	Parents preferred apps in which the quantity of information felt right to them. Little information was viewed as incomplete, and too many details were considered overwhelming. Most parents in this study preferred a synopsis of information and links to further reading.	“I like that app because it sends you an email each week. I find that it’s usually short and it just talks about their milestones where they're at. It also says that you may also be dealing with this and it gives you some links to some articles, so it's perfect. I don’t like too much information; then I get overwhelmed.” “I think it would be helpful to outline like which age this app is applicable for. Like right now, my first question is when can I start, and I don't know the answer, so I have to do research in addition to download the app that makes it less functional.”
Age-Specific Information	Many parents in this study favored apps that provided age-specific information over generic or standard information. The major concern with generic information apps was the inability to find relevant information quickly.	“It's very generic, too comprehensive but it wouldn't have specific content like if you have a crisis, you can't find the information right away what you need. I would worry it'll take a long time to find the information I need when there is a situation.”
	Parents in this study frequently searched apps that provided age-specific activities to enhance their infants’ physical, social, and mental development.	“It's an app that tells you according to the age, what activities you can do with your baby to stimulate cognitive development. I liked it because that’s what I was looking for in

Credible Information	<p>The credibility of the information presented in the app was important to parents. Parents preferred in-text citation or an overall introduction of the authors of the app content.</p>	<p>Kinedu [app], activities to do with the little kids that will be helpful to them.”</p>
	<p>Parents chose a scientific facts-based app over opinion-based content. Parents judged the content by the style of writing as if it was scientific and written by an expert in the field or it was just some parents’ opinion.</p>	<p>“When I opened the articles, they are cited so that I liked... There is a shortcut, and it will open the link where they got the information from.”</p> <p>“I primarily use developmental apps, so I want to make sure that I am doing stuff appropriate for age, not someone’s opinion.”</p>
	<p>Parents considered apps credible if they were from reputable sources such as universities or health ministries.</p>	<p>“The M&amp;B [app] was by the Ministry. You know those things then you will be more likely to listen to it.”</p> <p>“WebMD has a really good reputation. I want a more official source, more based on data and scientific facts verses like all the stuff out there on Google.”</p>

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**Theme 4: alternatives to parenting apps.** Most parents in this study enjoyed using apps, but some parents frequently deleted apps due to a lack of space on their phones. Parents looked for alternatives such as Websites, podcasts, YouTube, and sound machines to replace information and sleeping-aid apps on their phones. Parents in this study also queried the need for parenting specific apps for photo sharing and social support. Table 2.5 depicts alternatives to parenting apps and participants’ comments.

Table 2.5

*Alternatives to Parenting Apps*

Apps	Alternatives	Participants' Comments
Information Apps	Websites	"If all I want to do is get information, why have an app? A lot of apps are just glorified Webpages anyways."
	Podcasts	"I subscribe to a lot of podcasts. I can listen to it without having to scroll on the phone when my hands are busy. So, I found podcasts tend to be more helpful than apps. After giving birth, my hands are always busy."
Sleeping-Aid Apps	Sound machines	"I have one white noise app on my phone, but I used my phone too much, so I bought a machine."
	YouTube	"I YouTube music when we are doing her sleep rituals."
Photo Sharing Apps	Social media apps (Facebook and Instagram)	"My wife put together a Facebook page for our kids so the family could get at pictures." "I just use Instagram to share [photos] with my family."
	Communications apps (WhatsApp and Viber)	"Anytime I use, and share photos its right through WhatsApp. All my family is on a group. They always want to see my daughter, so we post it on there." "We use Viber for sharing photos so we all can see it."
	Google photos app	"I like Google pics. You can share your pictures pretty easily, and they have it where you can send people links to your album so that only certain people can see that album and also it has a program where it automatically creates collages and videos."
Support Apps	Communication apps (WhatsApp)	"We were in the Birth and Babies class, we were 12 couples, and all 12 of them keep in touch because they are on WhatsApp. We have

everybody's group where the guys and the girls are on it, and then they have the moms' only group. They are constantly on it, so the kid gets sick, somebody is posting on that, they found some tips or tricks, they post that."

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Downloading apps for the parenting material that could be freely accessed through YouTube was considered wastage of phone space. While reviewing a sleeping-aid app, one mother said, "Meditations and white noise and lullabies or whatever you could find on YouTube so I wouldn't download an app for that." Parents in this study used sleeping-aid apps only when they were away from home and did not have access to their sound machines. One mother shared her thoughts in response to a sleeping-aid app review, "The only time I would use [the sleeping-aid app] maybe is if he was napping at my mom's house or something." The only sleeping-aid apps considered acceptable that did not limit the use of their phones by running in the background or could be used offline without using the Internet. As one mother stated,

"I think some of the features that you have mentioned that being able to use it offline and being able to use it in the background. I have another white noise app, but you can't use it in the background, so you have to leave your phone but, yeah, for those functionalities I would use it."

Some parents continued to use non-parenting apps they used before having a child, such as social media and communications apps, for social support and to share photos of their children. Most parents mentioned using Facebook, Instagram, WhatsApp, Viber, and Google Photo to share photos with their loved ones. As one mother said, "I don't think for my purposes; I would have an additional app for pictures. I think with

Facebook or like just texting pictures on WhatsApp I have enough I don't need something extra.”

Parenting apps that allowed private sharing of photos were uncommon among this group of parents as only one parent mentioned using such an app. While most parents expressed little concern about the security issues of posting pictures on social media, others shared they do use privacy settings when posting baby photos on social media. Some parents only posted a few pictures on social media and often used apps that allowed users to develop private groups for photo sharing.

Parents in this study expressed the need for support and accessed support through communication and social media apps. These apps provided a platform where parents could exchange ideas and opinions about an issue. Most parents in this study initially used online forums and social media apps for support but stopped when it became too stressful. One mother shared her frustrations, stating, “They have these online forums where you can post questions or comment, which can be really bad sometimes. At some point, I just had to stop.” Similarly, one father phrased his thoughts about getting support from social media, “If you have insecurities, [social media] is going to feed that ... it just kind of feeds off of what's already in your head, whatever is self-reinforcing.” As a result, parents preferred seeking support from friends, family, and other parents they met through classes or community programs rather than a random person online. They frequently reported using WhatsApp to get support and to discuss parenting-related matters. One mother shared,

“Many moms are going to the Facebook mom posts and forums. What I find is they're very anxious moms, and I started becoming anxious just reading them. In

WhatsApp, I feel there are few friends, that are moms, are a little bit more in my style, so those are the ones that I communicate with personally. Those communications I value a lot more than using time in reading everybody's anxiousness.”

## **Discussion**

This study explored parents' use of parenting apps, their preferred app features, and types of parenting and non-parenting apps they use to support their parenting. Parents are similar in many ways such as preferring online resources due to the convenience and time constraints, commonly using tracking and information apps to get support in the first few months of parenting and using social media to showcase their parenting practices. Despite having similarities, however, many parents differed in their preferences. For instance, while some parents used tracking apps to record every single activity of their infant daily, others found it unnecessary and only recorded activities when they had concerns. Most parents in this study overlooked the security issues of publicly posting baby photos on social media; however, some used privacy settings before posting and preferred private groups to share.

Research on biological sex differences and online consumer behavior indicates men and women differ in their online preferences. The gender role expectations, such as mothers as primary caregivers and fathers as breadwinners, further differentiate the way mothers and fathers respond to online resources (Gur & Gur, 2017; Margalit, 2015; Pew Research Center, 2015). Similarly, in this study, sex and gender roles indicated unique preferences, such as fathers were focused on one task. They quickly made the app

download decisions and did not spend much time exploring an app's potential. In contrast, mothers explored the apps in detail and preferred multifunctional apps.

Study findings suggest every parent is unique and selects resources based on what works for them. When it comes to parental preferences for online resources, it was clear a one size fits all approach was ineffective. To support contemporary parents in their parenting, it is important for healthcare professionals and researchers to integrate design features preferred by parents in future app development, to use gender-neutral language in designing parenting content, to improve access to evidence-based resources, and to support the safe use of social media.

**Integrating app features preferred by parents.** Contemporary parents are active users of online resources. They use their smartphones to manage their lives, from ordering groceries online to handling finances via banking apps. Smartphones have become a crucial part of contemporary parents' lives. A study of 90 Canadian parents indicated 97% of the parents accessed the internet daily and 81% of parents ranked their smartphone as an important source of parenting information compared to books (56%) and brochures (33%) (Orr et al., 2017). The significance of smartphones in parents' lives was also evident in this study. App features that limited phone usage was considered incommodious. Parents in this study mentioned three app features that can increase an app's functionality and its uptake amongst parents: small size, works offline, and runs in the background.

Most parents use their smartphones more than any other digital device to access online resources. However, given the mobile nature of phones, they often have more limited space. Parents in this study also complained about a lack of space on the phone as

their phones were always filled with baby's photos/videos. Therefore, they preferred apps with small sizes and frequently deleted apps that occupied a large amount of space on their phone.

Although the internet is accessible in most places, there are some occasions when people cannot access the internet, such as during flights or when they have restrictions on using data. Apps that worked offline allowed parents to access the material anytime with or without an internet connection. Developing apps that are available offline can increase their worth over other resources that require an internet connection.

Parents in this study preferred an app that worked in the background as it permitted the effective use of their phones. Apps that limited their phone usage were considered less functional for instance, parents frequently mentioned deleting sleeping-aid apps that did not have an option to play lullabies and white noises in the background. Infant care responsibilities posed time constraints and apps that ran in the background allowed parents to perform tasks on their phones while playing lullabies or listening to an audio on a parenting topic. Future parenting app developers and researchers should consider this feature while designing apps for parents.

**Use of gender-neutral language.** Both mothers and fathers in this study shared their frustrations about the lack of quality apps for fathers and also voiced their concerns regarding the use of language in apps that primarily addressed mothers. Healthcare professionals should consider using neutral language, such as parent or family instead of 'mother and baby' while designing app content. The gender-neutral language will allow fathers to feel welcomed and encourage the use of evidence-based resources. More

research is needed in exploring fathers' app preferences and designing a resource with them that facilitates their transition to parenthood.

**Improving access to evidence-based resources.** Parents in this study differed in their preferences and selected the resources that worked best for them. Many parents reported using multiple avenues such as apps, Websites, podcasts, and YouTube videos to access the same parenting material. For instance, most parents in this study frequently reported using BabyCenter as it was available as an app, Website, and it also sent personalized email periodically thus increasing its access among users. Many commercial parenting resources, such as BabyCenter, ensure their resources are available on multiple avenues to increase their reach to parents with different preferences. Increased access to a parenting resource on multiple avenues seems to be one of the reasons parents favor commercial parenting resources over evidence-based resources (JakeSchoffman et al., 2017; Richardson et al., 2019; Shorey et al., 2017).

The availability of evidence-based resources over multiple avenues such as apps, Websites, podcasts, and YouTube channels, will increase its utilization and deter parents from using low-quality online resources. However, evidence-based resources usually take longer to develop (7-12 months) and incur huge costs. For example, it costs approximately \$270,000 (U.S.) to develop an app that does not include updates and maintenance costs (Jake-Schoffman et al., 2017). The time and cost are major limitations for creating publicly accessible evidence-based resources on multiple avenues compared to a commercial resource. In the future, academic partnering with commercial companies may serve as a solution to time and cost limitations; however, there may be a conflict of interest due to commercial product promotions.

**Safe use of social media.** Most parents in this study preferred social media (Facebook and Instagram) to share their baby photos and to get support on parenting-related matters. This finding supports previous research that many parents post their baby photos on social media to feel connected with their social network and to showcase and validate their parenting practices through likes and comments (BrissonBoivin, 2018; Oeldorf-Hirsch & Sundar, 2016). However, sharing identifiable information along with photos may pose privacy and security risks (Benevento, 2018). For example, according to Brosch (2016), sharing photos creates digital footprints of a child's life that may affect their future admissions to universities and job opportunities. Most parents in this study were least concerned about the privacy and safety of their children. It was obvious the immediacy of their needs and convenience outweighed their concerns about the long-term implications of sharing their infants' photos. Healthcare professionals should discuss strategies such as the use of privacy settings, being mindful of the information posted on social media, refraining from posting identifiable information, and turning off location while posting real-time photos and information to promote the safe use of social media among parents.

Some concerned parents in this study reported using WhatsApp to share their baby photos and to get support for parenting concerns instead of using social media. WhatsApp is a free communication app that works across different smartphone platforms (Apple, Android, etc.) to facilitate instant text/voice messages, pictures, videos, and voice/video calls via an internet connection. WhatsApp's group chat feature allows users to create groups with specific people for specific purposes such as a family group for sharing baby's photos. It also has end-to-end encryption features to protect user privacy

(Boulos, Giustini, & Wheeler, 2016; Nouwens, Griggio, & Mackay, 2017). Healthcare professionals can encourage the use of WhatsApp group chat feature for private sharing of baby photos and for accessing parenting support from people they know instead of sharing with random people on public platforms.

### **Study Limitations**

The study was limited to healthy Canadian parents who were able to converse in English. While every effort was made to select a diverse group of parents, the participants were primarily highly educated Canadian earning above \$100,000. The low number ( $n = 3$ ) of fathers in the study presents another limitation that warrants readers' caution in interpreting study findings. Despite limitations, the study generates insight into contemporary parents' app use and their preferences that can be used by healthcare professionals, nurse researchers, and app developers in designing future online parenting resources.

### **Future Considerations**

A parenting app study that will include large numbers of low income, low education, and non-English speaking parents would help further inform the body of evidence on the development of online parenting resources. Including parents of sick infants will expand the literature on the role of apps in supporting parents whose infants are experiencing complex health conditions. Employing mixed-method studies to explore a similar issue may provide different perspectives that can aid researchers in developing better parenting resources in the future.

**Conclusion**

Contemporary parents often rely on online resources to access parenting material. This study has generated insight that first-time parents are mostly similar in their parenting app use, yet they vary in their preferences. Mothers and fathers select the resource that works for them. Fathers prefer simple task-oriented apps and they make quick decisions to download, while mothers spend extra time and effort exploring the full potential of an app by clicking on multiple options. Considering gender differences in designing a resource will increase its uptake amongst both mothers and fathers. Future app development should also consider incorporating parents' apps features preferences such as small size and offline use in designing apps to increase the use of evidence-based online resources among parents. Developing tailored resources will increase the likelihood that they will be well-received by parents.

**Acknowledgments**

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**Chapter 5: Developing an Online Resource to Support Parents' Search for Mobile Applications**

Virani, A. Duffett-Leger, L. & Letourneau, N. Developing an online resource to support parents' search for mobile apps. *Journal of Mobile Technology in Medicine* (under review-submitted March 2020).

Virani, A., Duffett-Leger, L. & Letourneau, N. (March 2020). Developing an Online Resource to Support Parent's Mobile Applications (App) Search. To be presented at *the Sixteenth International Conference on Technology, Knowledge, and Society, United States*. (Postponed due to Covid19).

## **Abstract**

### **Background**

Contemporary parents use mobile applications or “apps” to resolve their day-day parenting concerns. However, research suggests an abundance of low-quality apps makes the app searching process arduous for parents, therefore, there is a need to develop a resource that supports parents’ search for apps.

### **Purpose**

The study aimed at engaging parents in developing a parenting app directory and designing a user interface for Webpages to feature the directory.

### **Methods**

Four focus group discussions were conducted with 18 first-time Canadian parents (15 mothers and 3 fathers) to develop the parenting app directory. Participatory design was used to co-create Webpage prototypes (landing or main Webpage and the app description page) with 3 first-time Canadian parents (2 fathers and 1 mother).

### **Results**

Twelve apps were included in the parenting app directory that met the eligibility criteria. Parents supported the idea of creating an app directory and recommended sharing the link in perinatal classes. During design sessions, parents stressed the importance of an organized user interface, providing less but best choices to ease the search process for apps, reduce the number of clicks to save time, and mobile optimization of the Website to accommodate different screen sizes.

**Conclusion**

Contemporary parents' use of apps is growing significantly; therefore, clinicians should support parents' search for quality apps and guide them accordingly. Parents can provide insight into design principles that can be used in developing appealing parenting app resources. Parents should be involved in designing future resources as they can significantly contribute to ensuring a resource is useful.

**Keywords:** Mobile applications, Parenting Apps, Participatory Design, Co-creating Webpage Prototypes, User Interface

## **Background**

Infants grow significantly in the first year of their lives requiring parents to keep up with their constantly changing needs (Jang et al., 2015). The literature on parents' use of online resources suggests mobile applications or "apps" are commonly used by parents to resolve their everyday parenting concerns (Asiodu et al., 2015; Brisson-Boivin, 2018; Shorey et al., 2017). Parents use apps for things like retrieving information on parenting topics, getting support from friends, family, and other parents, and tracking their babies' growth on a daily basis (Chin, 2018; Lupton, 2016; Pehora et al., 2015).

The proliferation of low-quality and irrelevant apps creates barriers for parents in effectively accessing parenting material. Taki and colleagues (2015) performed a systematic analysis of infant feeding apps and reported 91% were of poor quality due to issues with user interface design (e.g., navigation) and content (e.g., readability). Many evidenced-based apps are invisible to users because they are lumped in with poor quality apps. By 2018, 84,000 publishers had released 325,000 apps on the marketplace which indicates the increased number of choices available to users thus worsening the search for evidenced-based apps which are comparatively very few and require more time and resources to develop (Jake-Schoffman et al., 2017; Pham, 2019). Some researchers have reported content credibility and security concerns as barriers to app utilization (Asiodu et al., 2015; Biediger-Friedman et al., 2018; Zhao et al., 2017a). Many parents, however, overlook the credibility of the content and security of the personal data concerns due to the benefits gained from using certain app features such as customization of data (Lupton & Pedersen, 2016; Sunyaev, Dehling, Taylor, & Mand, 2015; Wicks & Chiauzzi, 2015).

The importance of an organized and functional user interface cannot be denied in the effective utilization of apps. Users generally evaluate apps on utility, functionality, and security standards and if these requirements are not met, they move on to the next app. Apps with poor first impressions, poor design, lack of interactive features, glitches, unnecessary personal information requests, and malware alerts lose users quickly, receive low star ratings, and poor user reviews, negatively affecting their search ranking in the app store (Sanhz, 2016). Evidenced-based apps are scientifically robust; however, many lack parents-preferred user interface elements and therefore, receive less attention and low star ratings on the app store. For example, Virani et al. (2019) reported an evidenced-based app had the lowest number of downloads, overall lowest MARS (Mobile App Rating Scale) score, and the lowest score on the MARS engagement subscale compared to other 15 apps that were included in the review. Hingle and Patrick (2016) also found that evidenced-based apps frequently lacked visual appeal, interactive features, and intuitive user interfaces.

Users learn to locate apps through trial and error methods. Today's parents have limited time to scroll through hundreds of pages or apps, rather, they typically select from the initial few search options. Poor searching skills (e.g., inappropriate search terms, unfamiliarity with advanced search functions) often lead to irrelevant results that fail to meet parents' needs and quality expectations. Many parents feel trapped in cycles of app searching, installing, trialing, uninstalling, and starting over (Chidgey, 2015; Tinschert et al., 2017; Virani, Duffett-Leger & Letourneau, 2020). Thus, there is a need for a solution that provides parents easy and efficient access to quality apps in a way that is preferred by parents.

## **Purpose of the Study**

While evidenced-based apps have been developed to better meet the needs of parents, these apps are difficult for parents to locate due to their low visibility among the plethora of parenting apps. Further, evidence suggests that co-designing with the target population leads to more relevant and useable technologies compared to products developed on their behalf (Halskov & Hansen, 2015; Wolstenholme, Ross, Cobb, & Bowen, 2017). Therefore, the purpose of this study was twofold: (1) to engage parents in developing a parenting app directory that contains the list and brief information about quality parenting apps to support their search for apps; and (2) to involve parents in designing a user interface of Webpages featuring a parenting app directory.

The rapid rate at which apps develop, update, and disseminate requires constant maintenance of the existing apps, and the addition of new apps to the directory. It is difficult for the student investigator (primary author) to keep up with this challenge and sustain the intervention; therefore, the researchers partnered with an existing parenting Website that provides resources to parents/caregivers of children from birth to 8 years. The Website hereafter refers to as host Website. The participants were asked to design only two Webpages; a landing page and an app description page using the basic layout, color, and design of the host Website. Participants were also engaged in developing links supporting feedback on existing apps and the addition of new apps in the future. These links will be integrated into the host Website's "Quick Links" section. The final prototypes will be part of the hosting Website in the future.

## Study Design and Methods

Derived from participatory action research, PD approaches to software design involve users throughout the design process from identifying needs to developing and testing the design product. The democracy and empowerment of users of technology are the core principles of PD (Bratteteig & Wagner, 2015; Halskov & Hansen, 2015; Wolstenholme et al., 2017). Appropriate democratic participation empowers users by involving them in technology-related decisions that affect their lives in some way. Final design decisions are based on consensual agreements between researchers and users. PD creates a sense of ownership among users and empowers them as key stakeholders (Andersen, Danholt, Halskov, Hansen, & Lauritsen, 2015; Wolstenholme et al., 2017). To involve participants throughout the process the project was divided into three phases: app review, focus group discussions, and Webpages prototyping. To address this aim, the study had the following objectives:

1. To gain an insight into available parenting apps and their quality by performing an app review on the Google Play Store.
2. To explore parents' perceptions of available parenting apps and involve them in the development of a parenting app directory through focus group discussions.
3. To engage parents in designing Webpages prototypes to feature the parenting app directory.

**App review.** The authors conducted an app review to gain insight into current trends of parenting apps and their quality. The authors found 4,300 apps on their initial search using 18 search terms: mum, mom, mommy, mama, mother, father, dad, daddy, papa, newborn, baby, infant, kid, child, children, family, parent, and parenting. Most apps

were of poor quality due to inadequate information/features, lack of credible information/sources, navigation issues, and excessive advertisements. Detailed findings of the app review have previously been published (Virani et al., 2019). Some of the apps from the review were used in the next phase to explore participants' perceptions of available parenting apps.

**Focus group discussions.** The parenting app directory was developed in focus group discussions with 18 first-time Canadian parents of infants (birth-12 months) who owned a smartphone and have used at least one parenting apps in the past six months. Parents were recruited via placing posters and distributing study cards in community health centers, public libraries, and in perinatal classes. A Facebook page was also created to recruit parents. The focus groups were conducted in public library meeting rooms in Calgary, Canada. Each focus group lasted approximately 2 hours and explored parents' search for apps, their preferences, their desired features in apps. While the detailed findings of focus group discussions are shared somewhere else (Virani et al., 2020), findings that are pertinent to the development of the parenting app directory are described in this paper.

The apps for the directory were selected via two strategies: First, during focus group discussions, parents mentioned a few apps that they liked to use. The authors evaluated those apps on MARS (Mobile App Rating Scale), developed by a multidisciplinary team to appraise app quality (Stoyanov et al., 2015). Apps that scored 3 and above were added to the directory. Second, during focus group discussions in one of the activities, the moderator provided app cards (cards with the name and icon of the app, and its purpose) and asked parents to review one or two apps based on their interest.

After reviewing apps for 10-15 minutes, each participant individually shared their feedback to the group and further discussed each app with other participants including likes/dislikes, pros/cons, and reason for inclusion or exclusion of the particular app in the directory. The discussion ended with the mutually agreed decision that whether the app should be part of the directory or not. Apps that received participants' agreement for inclusion were further evaluated on the MARS scale by researchers and only included in the directory if they received 3/5 or above score on the MARS.

**Design sessions.** The primary author and 3 parents (2 fathers and 1 mother) co-created the user interfaces for 2 Webpages in a series of 3 sessions. The prototype designing sessions were conducted online using SMART kapp™ technology. The SMART kapp™ technology consists of a SMART kapp™ digital whiteboard and a SMART kapp™ app, that allows real-time sharing and editing of the drafts created by moderator on the whiteboard. For details about this technology please visit <https://www.smarttech.com/>. Prior to the designing session, the moderator sent a link to download The SMART kapp™ app, a link for the designing space (see Figure 1), and examples of a few app directories. On the day of the designing session, participants were connected using the SMART kapp™ technology. The moderator incorporated participants' feedback on the SMART kapp™ digital whiteboard which participants could see on their SMART kapp™ app in real-time. The design sessions were video recorded and analyzed after each session by the researchers to incorporate parents' suggestions. After finalizing the whiteboard prototyping drafts, the moderator developed the interactive prototype in Wix, a free Website builder, and sent the link via email to

participants for review. The prototypes were further modified based on participants' feedback.

## Results

The results section is divided into 2 parts: parenting app directory and user interface designing.

**Parenting app directory.** The focus group discussions revealed 34 apps and parents reviewed 20 apps during focus group discussions. After removing duplicates (n=14), 12 apps were selected for the app directory by using the following criteria. Apps were considered ineligible if they were paid (n=4); mostly used in pregnancy (n=4); needed a device to operate (n=2); targeting sick kids (n=1); non-parenting apps (n=5); voted out by participants (n=10) and; scored less than 3 on MARS (n=7). Apps were divided into categories as suggested by participants to ease the searching process. The list of eligible apps, their categories, MARS scores, and purposes are presented in Table 3.1.

Table 3.1

*List of Parenting Apps Included in the Directory*

Apps	Category	MARS Score	Purpose
BabyTime	Tracker	4.5	It tracks infants' activities and also provides lullabies and white noises.
Baby + – Your Baby Tracker	Tracker	4.4	It tracks infants' activities and also offers lullabies, white noises, and a baby book.
CANImmunize	Tracker	3.8	It records, tracks, and provides information on

immunizations.

Baby and Child First Aid	Information	4.5	It provides information on emergency and first-aid and also records medications, allergies, emergency, and doctors' contacts.
Info for Nursing Mum	Information	4.4	It mostly provides information on breastfeeding.
BabyCenter	Information	4.4	It provides information on a wide range of parenting topics and also offers a baby book and parenting forums.
WebMD Baby	Information	4.4	It provides information on health-related matters and also offers a baby book and a basic tracker.
Babybrains	Information	4.0	It provides information on brain development activities.
Don't Cry My Baby (lullaby)	Sleeping-aid	4.5	It provides white noises and lullabies.
Baby Sleep -White Noise App	Sleeping-aid	4.3	It provides white noises and lullabies.
ASL Dictionary for Baby Lite	Miscellaneous	4.4	It supports teaching and learning of sign language.
Baby Weaning and Recipes	Miscellaneous	4.3	It provides recipes and information on baby weaning.

To explore the viability of creating a parenting app directory to support parents' search for apps, at the end of the focus group discussions, participants were asked to share their feedback. All participants agreed that the parenting app directory will support parents in finding quality apps. One mother (age 39 years) said:

“I really like the idea because I usually Google top apps for whatever and I get the list of 10 things and go through it... It's basically just centralizing it... and I think one thing for me is that it will give you the things to search for, so it might actually help to look up things.”

While reviewing apps during the focus group discussions many parents were excited and surprised to learn about the different types of apps to assist them with their day-to-day parenting concerns, such as sign language app. They felt the Website would be a good resource for parents to learn about new apps. One mother (age 29 years) shared her feeling while reviewing a breastfeeding information app, “I wish I had that [info for nursing mum app] when I first started doing breastfeeding. Most of the information is for the first months when you need it the most.” One father (age 35 years) shared his thoughts about a tracking app, “That [tracking app] looks useful, and if we did know about that we would have probably used it.” Another mother (age 29 years) commented while presenting an app review to the group on a sign language app, “I had never thought [about a sign language app] and I'm happy that I did try one.”

Parents suggested that the parenting app directory link should be promoted in prenatal classes to make parents aware of these online resources in advance. As one mother (age 29 years) said, “If the Website link is given in the... parenting prep classes, then they [to be parents] will have time to look through those before the baby is born.”

**User interface designing.** During focus group discussions and design sessions, parents provided several suggestions to design a usable user interface for the Webpages. See Table 3.2 for the suggestions and supporting quotations from participants.

Participants co-created two Webpages prototypes: a landing page for the list of apps included in the directory and the app description page for each app.

Table 3.2

*Parents' Suggestions for Designing A Usable User Interface and Supporting Quotations*

<b>Suggestions</b>	<b>Participant's Words</b>
Apps should be presented in categories to ease the search process.	“I think the categories would work well... that would be the best” (mother, age 32 years).
There should be a maximum of three best apps in one category; too many apps with similar features in one category were deemed overwhelming.	“I would recommend you to include two to three apps that have the best ratings” (mother, age 36 years).  “They gonna be lost if you put 50 or 60 apps on that main page” (mother, age 37 years).
Use of an organized interface; busy and chaotic Webpages were considered “annoying” and took longer to find desired parenting material.	“I just find if there is too much on there and I have to search through a bunch of things to find what I'm looking for then I just get frustrated” (mother, age 33 years).
Mobile optimization of the Website as parents used smartphones more than any other device due to its smaller size.	“If the website is mobile optimized then three [apps] in a row is fine. If not, then it will be very difficult and a long row to see on a small screen... You know 80% of your traffic comes from mobile so make sure it is mobile optimized” (father, age 35 years).
Avoid repetition of the content on the Webpages; fewer words and use of images were recommended to convey the message.	“You can check app-specific comments on the app store. No need to duplicate that here” (father, age 33 years).  “I just don't want you to duplicate what's on the app store” (father, age 35 years).
Reduce the number of clicks; more clicks waste time and deter parents from using the resource effectively.	One father commented on other fathers' disagreement on adding another click: “I agree, there will too many clicks and it will

be confusing” (father, age 35 years).  
“If I am on the computer, I don’t mind the clicks but if I am on the phone, I definitely want less clicks” (mother, age 32 years).

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***Landing Webpage porotype.*** The landing page will feature the app directory on the host Website and will provide a list of apps. See Figure 2 for the landing Webpage prototype. Parents suggested categorizing apps and placing three apps in one row to permit a quick glance of the available apps in a specific category. The directory has 2 active links. The first link takes users to an app comparison chart for each category. The comparison chart allows parents to compare app features in a category and select an app based on their preferences. As one mother (age 32 years) said: “I really the comparison idea. It is definitely handy to see everything in comparison like that.” See Figure 3 for a comparison chart. The second link is labeled as “read more” which takes parents to the app description page and allows parents to learn more about the app. One mother (age 32 years) commented on the importance of having a short app description accompanied by a ‘read more’ link, said: “The number of apps I have seen I kinda guess what this app is, but I am not sure exactly what it is for? So, a shorter description with a link to read more will help”. See Figure 4 for the app description page.

As mentioned earlier that the resource will also involve parents in commenting on existing apps and the addition of new apps. The host Website contains a ‘Quick Links’ section on the right side of the Webpage permitting quick access to the relevant material. Two links, ‘comment board’ and ‘recommend an app’, will be added to the ‘Quick Links’ section to engage parents. The comment board allows parents to comment on the app’s

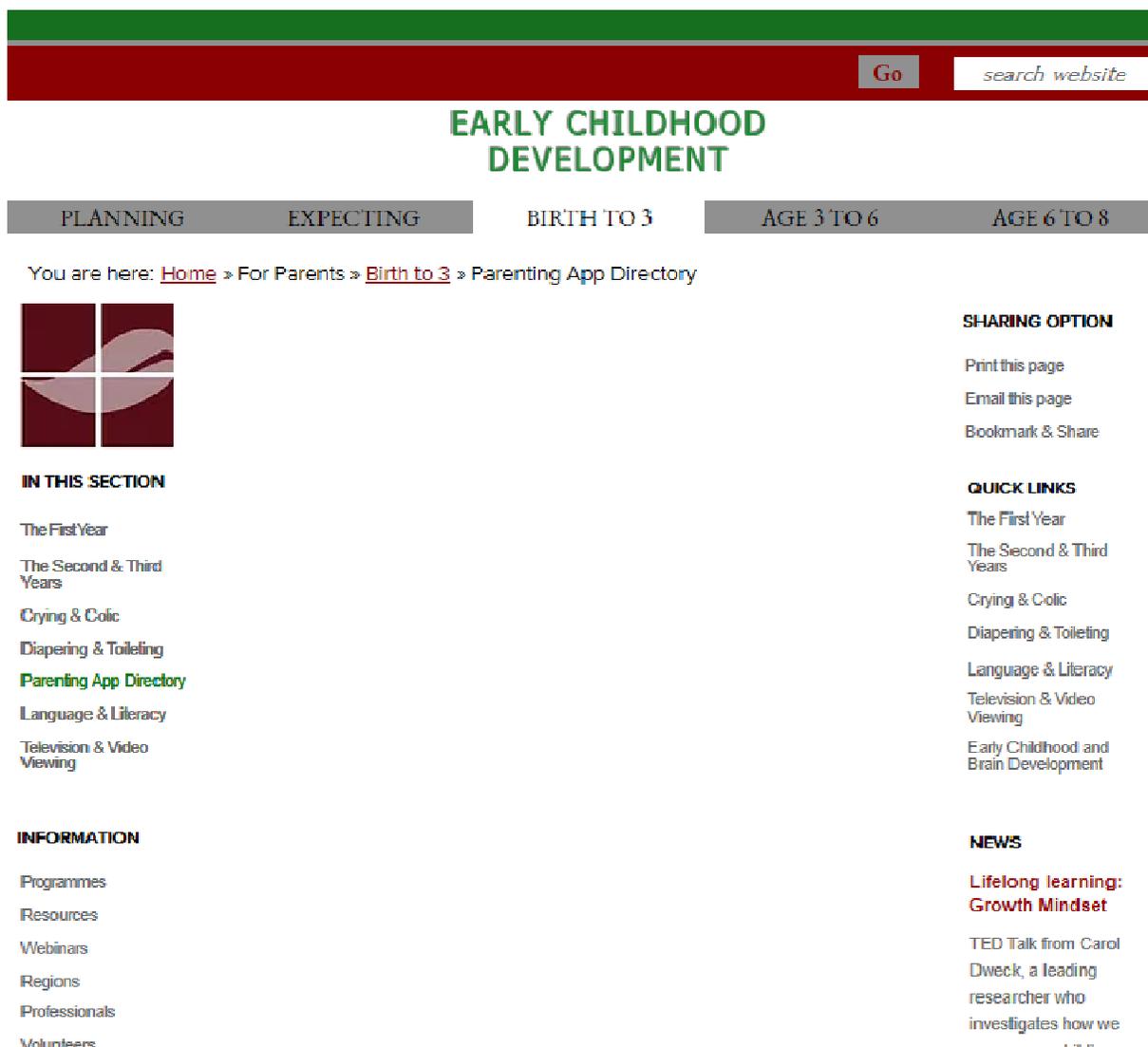
current status and view other parents' feedback on apps. The 'recommend an app' link permits parents to suggest apps that they would like to share with other parents. However, when parents suggest an app, they will receive a message "thank you for recommending an app. Our team will evaluate the app and it will be posted on the directory if it meets the quality standards". This additional step will ensure that only quality apps are added to the directory. As one father (age 33 years) stated: "People can submit all kinds of app... and every time someone sends an app, you have to make sure that it is relevant, reviewed and placed in the right category. It has information that is reputable."

Participants also suggested that it would be nice to have a link for interested parents who would like to know the process of app selection. To accommodate this request 'how we assess apps' will be added to the 'Quick Link' link section to let interested parents learn about the app selection process for the directory. (In this link we refer to the host organization).

*App description page.* The app description page will be specific to each app and will describe the app briefly to assist parents in selecting apps based on their preferences. See Figure 4 for the app description page. Participants suggested an organized interface with less repetition from the app store description page. Parents felt that the availability of the app in multiple languages was important information which is often not showcased and should be available next to the app icon on the app description page. As one father (age 35 years) stated: "English is her [my wife's] second language, or for people who have recently moved here, their English might not be as good. Everything in the app store is in English, and it would be nice to know if it is available in additional languages like French or German."

The app rating was another important piece of information that parents used to decide whether an app is worth trying before going through the details. One mother (age 32 years) said: “I would like to see, app rating without having to click on the app store.” Participants felt that a link from the app store description page to download would be sufficient for interested parents to get detailed information about the app from the app store. Participants recommended a pros and cons chart for each app that would permit parents to have a quick glance at apps’ potentials and facilitate their decision to download. One father (age 33 years) commented: “If you have 20 apps and you don’t want to download all of them to try and see which one is good. These pros and cons can help you decide whether to download it or not.” Participants also suggested adding the review details at the bottom including app ratings, date of review, and link to any research studies or expert review if available. For example, one father (age 33 years) said: “I like the review details in the end, it tells me that the app is updated and someone is responsible for the update.”

Figure 1

*Designing Space*


The image shows a screenshot of a website's navigation menu for 'EARLY CHILDHOOD DEVELOPMENT'. At the top, there is a search bar with a 'Go' button and the text 'search website'. Below the search bar, the main title 'EARLY CHILDHOOD DEVELOPMENT' is displayed in green. A horizontal navigation bar contains five categories: 'PLANNING', 'EXPECTING', 'BIRTH TO 3', 'AGE 3 TO 6', and 'AGE 6 TO 8'. The 'BIRTH TO 3' category is highlighted. Below the navigation bar, a breadcrumb trail reads: 'You are here: [Home](#) » For Parents » [Birth to 3](#) » Parenting App Directory'. To the left of the main content area is a large graphic of a stylized face in shades of red and white. The main content area is divided into three columns. The left column is titled 'IN THIS SECTION' and lists: 'The First Year', 'The Second & Third Years', 'Crying & Colic', 'Diapering & Toileting', 'Parenting App Directory' (highlighted in green), 'Language & Literacy', and 'Television & Video Viewing'. Below this is an 'INFORMATION' section with links for 'Programmes', 'Resources', 'Webinars', 'Regions', 'Professionals', and 'Volunteers'. The right column is titled 'SHARING OPTION' and includes 'Print this page', 'Email this page', and 'Bookmark & Share'. Below that is a 'QUICK LINKS' section with links for 'The First Year', 'The Second & Third Years', 'Crying & Colic', 'Diapering & Toileting', 'Language & Literacy', 'Television & Video Viewing', and 'Early Childhood and Brain Development'. At the bottom right is a 'NEWS' section with a link for 'Lifelong learning: Growth Mindset' and a snippet of text about a TED Talk from Carol Dweck.

**Go** search website

## EARLY CHILDHOOD DEVELOPMENT

PLANNING EXPECTING BIRTH TO 3 AGE 3 TO 6 AGE 6 TO 8

You are here: [Home](#) » For Parents » [Birth to 3](#) » Parenting App Directory

**IN THIS SECTION**

- The First Year
- The Second & Third Years
- Crying & Colic
- Diapering & Toileting
- Parenting App Directory**
- Language & Literacy
- Television & Video Viewing

**INFORMATION**

- Programmes
- Resources
- Webinars
- Regions
- Professionals
- Volunteers

**SHARING OPTION**

- Print this page
- Email this page
- Bookmark & Share

**QUICK LINKS**

- The First Year
- The Second & Third Years
- Crying & Colic
- Diapering & Toileting
- Language & Literacy
- Television & Video Viewing
- Early Childhood and Brain Development

**NEWS**

**Lifelong learning: Growth Mindset**

TED Talk from Carol Dweck, a leading researcher who investigates how we

Figure 2

Main or Landing Webpage

Go

## EARLY CHILDHOOD DEVELOPMENT

PLANNING
EXPECTING
BIRTH TO 3
AGE 3 TO 6
AGE 6 TO 8

You are here: [Home](#) » For Parents » [Birth to 3](#) » Parenting App Directory



### IN THIS SECTION

- The First Year
- The Second & Third Years
- Crying & Colic
- Diapering & Toileting
- Parenting App Directory
- Language & Literacy
- Television & Video Viewing

### INFORMATION

- Programmes
- Resources
- Webinars
- Regions
- Professionals
- Volunteers
- News
- Events
- Publications
- Survey

### PARENTING APP DIRECTORY

#### Tracking Apps

[Click here to see tracking app comparison chart](#)



**BabyTime (Parenting, Track & Analysis)**

Tracks your baby's pee/ poop/ feeding/ solids...[Read more](#)



**Baby + - your baby tracker**

Tracks your baby's pee/ poop/ feeding/ solids...[Read more](#)



**CANimmunize**

Tracks your baby's vaccinations and provide info...[Read more](#)

#### Information/Milestones Apps

[Click here to see information/milestones app comparison chart](#)



**Babybrains**

Provides age appropriate brain stimulating activities...[Read more](#)



**Baby and Child First Aid**

Provides first aid and emergency information through animations, videos...[Read more](#)



**WebMD Baby**

Provides information, tracks baby's growth, creates a baby book...[Read more](#)

### SHARING OPTION

- Print this page
- Email this page
- Bookmark & Share

### QUICK LINKS

- The First Year
- Comment Board
- Recommend an App
- How We Assess Apps
- Language & Literacy
- Television & Video Viewing
- Early Childhood and Brain Development

### NEWS

**Lifelong learning: Growth Mindset**

TED Talk from Carol Dweck, a leading researcher who investigates how we can grow a child's brain...

### EVENTS

Figure 3

*App Comparison Chart*

The screenshot shows a website header with a search bar and navigation tabs for 'PLANNING', 'EXPECTING', 'BIRTH TO 3', 'AGE 3 TO 6', and 'AGE 6 TO 8'. Below the navigation is a breadcrumb trail: 'You are here: [Home](#) > For Parents > [Birth to 3](#) > Parenting App Directory'. The main heading is 'Tracking Apps Comparison Chart'. The table below compares three apps based on various features.

App Features	BabyTime (Parenting, Track & Analysis)	Baby + - Your Baby Tracker	CANImmunize
Available on iOS	x	✓	✓
Has a syn function	x	✓	x
Tracks feeding, voiding & bowel movements	✓	✓	✓
Tracks solids	x	✓	x
Tracks sleep	x	✓	✓
Tracks growth	✓	✓	✓
Records vaccinations	x	✓	x
Records doctor's visits/medications	x	✓	x
Data editing	✓	✓	✓
Exports data	✓	✓	✓
Reminders/ notifications	x	✓	✓
Shows trends	✓	✓	✓
Supports multiple babies	✓	✓	✓

*Note.* The information presented here is not factual.

Figure 4

## App Description Page

[Go](#)

## EARLY CHILDHOOD DEVELOPMENT

PLANNING
EXPECTING
BIRTH TO 3
AGE 3 TO 6
AGE 6 TO 8

You are here: [Home](#) » For Parents » [Birth to 3](#) » Parenting App Directory



**IN THIS SECTION**

- [The First Year](#)
- [The Second & Third Years](#)
- [Crying & Colic](#)
- [Diapering & Toileting](#)
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### BabyTime (Parenting, Track & Analysis)



**Free**

**Languages:** Italian and Spanish




**Features**

- Tracks your baby's feeding (breast/bottle/solids), pee, poop, tummy time and growth
- Allows syncing to your partner's or caregiver 's device
- Exports data to email or printer

Pros	Cons
<ul style="list-style-type: none"> <li>✓ Allows multiple babies</li> <li>✓ Sends Reminders</li> <li>✓ Provides several customization options such as adding/deleting required icons, choosing date/time style, picking a colour for each child, selecting unit of measurements, allowing day/night interface and adding widgets</li> <li>✓ Works offline (no internet connection required to input data)</li> <li>✓ Good customer service as per users' reviews</li> </ul>	<ul style="list-style-type: none"> <li>✗ Small icons</li> <li>✗ Icons are not labelled</li> <li>✗ Advertisements at the bottom</li> <li>✗ Need pro version to remove advertisements, to sync with more than one person and to get more options for exporting data.</li> </ul>

**Review Details**

**Date:** Oct 12, 2018  
**Version:** 1.5  
**Ratings:** Google Play, 4.6; App Store, 4.3 and MARS, 4.2 [read about MARS](#)  
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## **Discussion**

This study engaged Canadian parents of infants in developing a parenting app directory and in designing Webpages that featured the directory to ease their search for apps. It is well established that online parenting material is abundant and it is difficult for parents to find quality resources (Davis et al., 2017; Taki et al., 2015; Virani et al., 2019). The developed app directory centralizes the apps on one Webpage thus creating a one-stop-shop for parents looking for quality parenting apps. Slomian and colleagues (2018) utilized a similar idea and centralized Websites in the French language for mothers of children under one year of age. They found that the Website was a useful solution in addressing mothers' information needs, especially during the postpartum period.

Changes in current trends of dual-parent working families have affected parents' time availability. Time constraints force parents to make quick decisions in selecting and using an online resource. Ryan, Haroon, and Melvin (2015) found 42% of the parents never accessed a Website developed to support them with ADHD, reporting lack of time as a major barrier. Similarly, in this study parents frequently mentioned time constraints in accessing and evaluating online material and recommended time-saving interface elements such as an organized homepage, categorization of the content, less text, synopsis accompanied with 'read more' link for interested users and mobile-optimized Website. Andrew (2019) indicated time-saving design is on the rise due to a gradual shortening attention span in humans. One of the most important features of the time-saving design is a homepage that is content-oriented, context-specific and highlights only the most relevant information thus minimizing users' time spent on other distracting features and guide users to subsequent Webpages based on their preferences.

First-time parents who are already overwhelmed with the responsibilities of an infant find it further overwhelming to select a quality resource from the infinite app choices available to them. Laja (2019) stated in this world of unlimited choices, designers need to eliminate options for users. A huge number of choices distract users and they end up choosing nothing. In this study parents also felt overwhelmed with the abundance of app choices in one category and recommended to include only three top apps in a category.

The PD provides the opportunity to engage users in designing a resource that works for them. Technology products that are designed in partnership with end-users meet their expectations and increase the uptake of the developed resource. Abbass-Dick et al. (2018) designed and evaluated an eHealth breastfeeding resource with Canadian Indigenous mothers using PD. They found that involving mothers in co-creating the resource resulted in a culturally relevant Website that met their needs and was appreciated by the participants. Similarly, in this study using a PD approach, parents participated in selecting the apps for the directory and suggested the user interface elements that are relevant to busy and overwhelmed parents and can simplify their search for apps.

### **Implication for Practice**

The growing trend of parents' use of apps and the proliferation of poor quality and irrelevant apps presented a timely opportunity to design an online resource for parents supporting their search for apps. Clinicians need to support technologically savvy parents in a way that they like to receive information rather than the way healthcare professionals used to deliver information.

Danbjørg et al. (2015) designed an app for postnatal parents and indicated parents were comfortable with app use and found it easy to use compared to other methods such as consulting nurses over the phone. However, nurses reported feeling incompetent while interacting with parents using the app due to unfamiliarity with digital modes of delivering information. Researchers and clinicians' participation in evaluating and suggesting apps can support parents' use of quality resources.

Co-creating resources with end-users not only provide insight into issues that users are facing but also provides ideas of dealing with the issue in a way that is appealing to users. Research methods such as PD can be used in exploring the target population's specific concerns and developing an online resource that suits their needs and meets their expectations. Researchers should consider involving parents throughout the process from identifying their needs to evaluating the end-product. Davis et al. (2017) also recommended that nurses should actively participate in involving parents and other multidisciplinary teams in developing evidence-based resources that are acceptable to parents.

Users may not be theoretically equipped with design knowledge but they can provide insight into design principles that may be used in developing an appealing resource for the target populations. For example, in this study parents indicated that infant care responsibilities account for a huge amount of their time and suggested using time-saving user interface design elements to ease the search process for parents. Researchers can use this as a guide in developing future online resources targeted to parents and incorporate design elements that are relevant to parents.

## **Limitations**

The study has a few limitations that need to be considered while interpreting findings. The high representative sample of mothers may not have very well captured fathers' perception in this study. However, involving fathers in research is a challenging task that has been mentioned by several researchers (Balu et al., 2018; Lee & Walsh, 2015; White, Giglia, Scott, & Burns, 2018). In the future, a parenting app study that would involve a greater number of fathers may provide a different insight into the matter. As the directory will be part of a host Website to sustain the intervention, participants were given a designing space with predefined basic layout that restricted their feedback on certain design elements such as color, images, and so on. Future studies that incorporate parents' preferences of the basic layout will add significantly to the body of parenting user interface design literature.

## **Conclusion**

Today's parents are driven by the need for time and access to resources that are convenient, efficient, and freely available. In this study, parents co-created user interface with researchers to feature the app directory to support their search for apps. Parents consistently advocated for time-saving design features, such as a less cluttered and easier to navigate user interface that provides less but best choices in a particular parenting app category, to incorporate the resource in their busy lives. Current trends depicting a constant increase in accessing apps to resolve parenting concerns, demand clinicians' and researchers' participation in supporting parents' search for quality online resources. Involving parents in research and gaining their perspectives on developing online resources will result in well-targeted technology products and will increase uptake

amongst parents. Technology that is developed with users has a more powerful impact than those developed on behalf of them. This study provided insight into parents' preferred user interface features that can be used in designing future online resources.

### **Acknowledgments**

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## Chapter 6: Conclusion

Parents are increasingly using apps to support their parenting; however, the abundance of poor-quality apps makes it difficult for parents to find a desirable app (Hingle & Patrick, 2016; Jake-Schoffman et al., 2017; Lupton, 2016; Zhao et al., 2017a). Therefore, the purpose of this study was to co-develop a parenting app directory to support parents' search for apps and co-create Webpages prototypes that will feature the directory. The prototypes will be integrated into an existing parenting Website (host Website) to sustain the project.

### Brief Overview of the Study Results

The project was divided into three phases based on the Spinuzzi's (2005) three stages of PD research: *Phase 1-App review* of existing parenting apps; *Phase 2- Focus group discussions* with new parents of infants; and *Phase 3- Design sessions* with parents. The details regarding each phase of the study are provided in Chapter 3 (App review), Chapter 4 (Focus group findings), and Chapter 5 (Design session findings) briefly summarized below.

**App review.** A parenting app review of 4,300 apps was conducted to explore available apps for parents and identify quality apps to be compiled in the parenting app directory. The review resulted in 16 quality apps, appraised using MARS (Stoyanov et al., 2015). Although the review was conducted on the Google Play store, 13 out of 16 eligible apps were also available on the iOS app store. The eligible app ratings on Google Play store ranged between 3.9 and 4.7/5, and MARS ratings varied between 4 and 4.5/5. The eligible apps were further reviewed with parents during focus group discussions to finalize the addition of these apps to the parenting app directory.

**Focus group discussions.** Eighteen Canadian parents (15 mothers and 3 fathers) participated in four focus group discussions. The inductive thematic analysis revealed four themes: (1) process of searching for apps; (2) gender variations and app use; (3) commonly used apps, and; (4) alternatives to parenting apps. A notable finding from focus group discussions was the perceived lack of quality apps for fathers and the use of gender-specific terms that deterred fathers from using a parenting resource. The focus group discussions resulted in the development of a parenting app directory and with the help of parents, researchers finalized 12 apps to be included in the directory. The detailed process of app selection was discussed in Chapter five.

**Design sessions.** In a series of three design sessions, three parents (two fathers and one mother) co-created two Webpages prototypes to feature the directory developed with parents during focus group discussions. Since infant care consumes a huge segment of their daily routine, parents suggested using the time-saving design that is simple, functional and directs users to the relevant content in a limited number of steps (Andrew, 2019). Parents recommended a user-friendly, well organized and less cluttered interface; usable navigation requiring minimal clicks to efficiently find desired apps; maximum of three best apps in one category to reduce the number of choices; a synopsis of the app followed by a ‘read more’ link, providing an opportunity to take action or research further if desired; less or no repetition of the content from the app store; and, mobile optimization of the Website to accommodate smaller screens.

## **Discussion**

**Challenges associated with PD.** Approaches such as Canada’s Strategy for Patient-Oriented Research (SPOR) and family-centered research emphasize the

involvement of health consumers as co-researchers (Canadian Institutes of Health Research, 2019; Rosenbaum, 2011). A scoping review on parental engagement indicated that 90% of studies found parental involvement led to the development of more usable and sustainable interventions. Parental participation also resulted in a sense of ownership among parents, increased credibility of the qualitative research, and reduced gap between knowledge gained from the literature and practical knowledge of parents (Shen et al., 2017).

PD methodology is a user inclusive methodology that enables researchers to envision product use from the users' perspective and pay attention to users' context rather than technical aspects of designing a product. Users' involvement provides an opportunity for researchers/designers to test and refine their imaginations and assumptions regarding product-to-be-developed against users' practical circumstances and use. Engaging parents in PD research, however, can be challenging. Several researchers reported time commitment issues, scheduling problems, unforeseen circumstances (child sickness), power struggles, communication-related concerns, and increased use of financial and human resources as barriers to parental involvement in research (Balaam, 2015; Shen et al., 2017). As a result, PD research requires a high level of flexibility, as well as excellent facilitation and problem-solving skills.

In this PD research, a few challenges necessitated modifications to study protocols and approaches to accommodate the needs of the target population. Study participants were first-time parents of infants and to engage them as co-researchers required an open and flexible approach as many first-time parents feel overwhelmed with the stressors that a new infant brings to their lives. Despite parents' best intentions and

efforts to support the research they may not be able to participate due to their childcare responsibilities. Here are a few examples of modifications and changes that were made to the research protocols to accommodate parents' needs.

- A low number of fathers signing up to participate in the research was one of the major issues encountered during recruitment. To overcome this challenge, the recruitment of fathers continued beyond the data saturation point. Special messages for fathers were posted on the Facebook recruitment page and modifications (such as recruitment extension to other cities) were made to the eligibility criteria. An option to participate online was also provided to fathers recognizing that barriers to their participation might include work commitments, the time required to travel to a physical location, and potential discomfort with the parenting sessions which are often geared towards mothers.
- More participants were recruited per focus group to deal with the last-minute cancellations due to family obligations.
- Parents were provided an option to join late and leave the focus group discussions early if they had other conflicting appointments.
- Parents were also permitted to bring their infants to the sessions due to the issues related to childcare. Although it created some disruptions during the sessions and made it more difficult to transcribe the data, it was important to accommodate parents' needs in order to encourage participation.
- A safe space was created for parents in focus group discussion rooms where they could breastfeed or change their infants' diapers during the sessions. The

moderator explicitly mentioned this to the participants at the beginning of the sessions so that parents felt free to cater to their infants' needs as required.

- Design sessions required participants to commit to attending three consecutive sessions. Given the challenges getting this time commitment from parents and considering their interest and comfort with technology, design sessions were made remote allowing parents to participate in the comfort of their own homes.

**Importance of social support and relevance of this research to the current pandemic.** This research focuses on improving social support for parents. Social support refers to the individuals' perception that assistance is available from various sources such as family, friends, healthcare professionals, and organizations. Providing social support to parents is an effective intervention, particularly among vulnerable parents such as adolescent mothers and those suffering from postpartum depression (Letourneau et al., 2015; Letourneau, Stewart, & Barnfather, 2004). Social support includes the following four domains: emotional (expressions of nurturance); informational (suggestions/ advice); instrumental (tangible products/ services) and appraisal (feedback/ praise) (Birch, 1998; Gottlieb & Stewart, 2000; Letourneau et al., 2015). Social support is especially important for parents during times of increased stress and major life transitions, such as the birth of a baby and parenting during the current pandemic.

The postpartum period is a stressful time for parents partly due to post-delivery hormonal fluctuations and sleep deprivation. Further, the COVID-19 pandemic has heightened parents' stress levels due to the fears related to the health concerns, social isolation measures, and limited availability of tangible services /support. In-person

postnatal classes that allow new parents to connect with other parents for social support are unavailable due to the risk of spread. These circumstances have given rise to social isolation and perceived lack of social support among new parents. If the situation persists it may lead to poor long-term effects on mother and baby's physical and emotional wellbeing. Davenport and colleagues (2019) conducted an online survey of 900 pregnant and postpartum women (72.8% were Canadian) 93% of whom were practicing physical distancing to avoid exposure to coronavirus (83% were self-isolating at home). These researchers found that 64% of women reported reduced physical activity due to protective measures, as well as a significant increase in self-reported levels of anxiety (72% during pandemic versus 29% pre-pandemic) and depression (40% during pandemic versus 15% pre-pandemic).

Perceived access to effective social support has the potential to positively affect the physical and psychological well-being of parents and infants. One of the key forms of social support is informational support, defined as the provision of advice, guidance, suggestions, or other useful information, in response to someone's needs (Gottlieb & Stewart, 2000; Letourneau et al., 2015). Given the current pandemic, the need for informational support for parents has increased due to their concerns regarding the care for their newborns during pandemic and self-isolation practices. There has been a dramatic global increase in app downloads and usage due to the lockdown and physical isolation (Perez, 2020). According to Koetsier (2020), the pandemic has increased the app downloads and usage "to the highest in the history". Apps have the potential to provide informational support to parents in the convenience of their own homes,

highlighting the relevance of this research that focuses on providing social support via digital means.

The parenting app directory that was developed in this study to support parents' search for apps is particularly timely during these times when the use of digital resources is increasing among parents due to self-isolation measures. Apps added to the directory such as Baby and Child First Aid, Info for Nursing Mum, WebMD Baby, and Babybrains provide information on breastfeeding, first aid, and infants' physical, mental and social development are easily accessible to parents without the need to leave their house. BabyCenter, another app that was added to the parenting app directory, provides informational support for parents about the coronavirus as well as social support through parent forums. Parents can share their fears and concerns regarding the current pandemic situation and access support from other parents in similar conditions. The internet is inundated with coronavirus content related to newborn care from unauthentic sources that may create anxiety and undue stress on parents. This dangerous situation underscores the need for healthcare professionals to be more in tune with better support parents' digital needs and self-isolation practices.

### **Significance of the Study**

While parents' use of apps to support their parenting is on the rise, to date, limited evidence-based parenting apps have been developed and made commercially available on app stores. As a result, many parents are willing to compromise on security and content credibility if they find an app usable and appealing (Hearn et al., 2014; Lupton & Pedersen, 2016; Taki et al., 2015; Zhao et al, 2017a). This alarming finding calls for action from researchers and clinicians to support parents' search for quality apps. The

parenting app directory provides a potential solution by enabling parents to easily and efficiently access quality apps, thereby minimizing the use of poor-quality apps that may have detrimental effects on parents and their infants.

While many researchers have presented the parenting app reviews critiquing the current state of apps, none of the reviews provide a list of quality apps that parents can use (Davis et al., 2017; Scott et al., 2014; Taki et al., 2015). The app review conducted for this study offers a list of quality apps clinicians can suggest to parents thus meaningfully adding to the literature on parenting apps. The focus group discussions not only provide the types of apps parents prefer but also highlight the app features that parents would like to see in future app development. For instance, parents want apps that work offline so the content is accessible in the absence of internet access as well as apps that run in the background, allowing parents to play lullabies while simultaneously performing tasks on their phone. These findings may support researchers in developing usable parenting apps in the future.

The use of a PD approach enabled researchers to co-create a resource for parents and researchers, thereby parents' perceived relevance and increasing the likelihood that they will utilize the quality parenting apps in the future. In this study, parents were engaged in every phase of the project and provided unique insights about parents' preferences resulting in the development of a viable product. This study adds significantly to the existing body of literature on involving parents as co-researchers and highlights the importance of parental engagement in developing appealing and usable parenting resources.

Fathers play an important role in a child's physical, mental, and social development. The study findings, however, indicated that the digital resources were mostly exclusively designed for mothers, and the use of terms such as 'mother and baby' made fathers feel invisible to the researchers and app developers. Most studies on parents' use of online resources have utilized mothers as participants (Balaam et al., 2015; Biediger-Friedman et al., 2018; Bond et al., 2019). This study is one of the few that provides accounts for fathers' perceptions regarding parenting apps in the first year of parenthood. Although the number of fathers' involvement was low (n=4) compared to mothers (n=15), this research sheds light on fathers' perceptions of available parenting apps illustrating gender differences in app use and design preferences thus providing some basis for future research on designing apps that are amenable to mothers and fathers. Future studies focusing on involving new fathers in such projects can add significantly to the body of existing literature.

### **Implications for Policy Education, Practice and Research**

**Implications for policy.** First-time parents often find their transition to parenthood impaired by shorter postnatal hospital stays (Barnes et al. 2008; Danbjørg et al., 2015; Sink, 2009). According to the Calgary Health Region, Women's and Infant Health Policy and Procedure (2005) a stay of 12 to 48 hours after a normal delivery is deemed adequate to preserve resources. Despite the development of community resources to support postpartum parents, there is a significant gap in the healthcare system in preparing and supporting contemporary parents' ongoing parenting needs. Matusicky and Russell (2009) found that the majority of prenatal classes are geared towards birth preparation and very little attention is given to parenting; postnatal programs focus on

medical issues such as umbilical cord care and jaundice rather than developing parenting skills to deal with evolving needs of infants; the majority of programs are short-term, one day a week for six weeks, not enough to learn about parenting; a very few programs cater to first-time parents relational needs as couples; and most programs are geared towards mothers, leaving fathers alone to struggle, whereas the majority of first-time parents decide to become parents as a couple. As a result, contemporary parents are increasingly turning to apps to find informational and social support.

Healthcare professionals including nurses lack the required knowledge, training, time, and institutional support to assist parents in fulfilling their informational and social needs via digital means (DeHoff et al., 2016; Strudwick, Hall, Nagle, & Trbovich, 2018). Policy changes with regards to supporting nurses are required to increase frontline staff informatics competencies and the ability to respond to contemporary parents' needs. For example:

- Nursing informatics should be considered a mandatory competency. Modules/courses providing nurses with a basic understanding regarding the use of informatics in practice should be part of the requirement to practice nursing. Mandatory annual renewal of informatics competencies will lead to increased confidence among nurses and assist them in providing quality care to their clients.
- Policies supporting nurses' training and allowing time to accommodate informatics related practices should be developed to reduce barriers related to knowledge and time constraint to practice such skills.
- Policies regarding engaging frontline nurses in appraising and developing digital resources can also minimize barriers related to unfamiliarity. Nurses' involvement

will create a sense of ownership with the developed resources and increase its utilization.

**Implications for education.** The Canadian Association of Schools of Nursing (CASN) and the Canadian Nurses Association (CNA) have taken several initiatives to improve digital health competencies among frontline nurses, nurse educators, and nursing faculties. These initiatives have included an e-nursing strategy, digital health nursing faculty peer network, nursing informatics teaching toolkit, CASN entry-to-practice nursing informatics competencies, and digital health webinars and modules. While these initiatives have improved the preparation of contemporary graduates, as many nursing schools have now incorporated nursing informatics into their curriculum, many nurses in the workforce are still unfamiliar or uncomfortable using digital technology. It is time for initiatives within the healthcare system to support frontline nurses and equip them with the knowledge and skills required to support contemporary parents' needs. Nurse managers and educators can support nurses by:

- Providing adequate knowledge and training to frontline nurses to facilitate parents' e-resources search and use. Several tools such as NPMED and MARS can be introduced to nurses to quickly appraise an app quality and support parents' app use. NPMEDAPP stands for Novel, Potential of benefit versus risk, Medically sound, Ease of use, Developer, Audience, Price, and Platform. MARS is another easy to use tool for appraising app quality and any healthcare professional interested in using the scale can access the MARS training video, freely available on YouTube.

- Supporting nurses in suggesting safe use of apps during parents' regular visits to community centers and introducing app evaluation tools to parents such as uMARS, developed for the general population to appraise the quality of apps.
- Creating awareness regarding available resources to improve digital health competencies such as a series of modules titled *e-health technologies* by Alberta Health Services, *nursing informatics 101* module by CARNA, and *entry-to-practice nursing informatics competencies* by CASN.

**Implications for practice.** Parents prefer using apps recommended by nurses and other healthcare professionals, however, a literature search reveals nurses have been reluctant to embrace digital modes of delivering care (Aitken, 2015; Canadian Association of Schools of Nursing, 2013; Deave et al., 2019; Ventola, 2014). Danbjørg et al. (2015) found that while parents were comfortable using an app designed for postnatal parents, nurses reported feeling incompetent interacting with parents using the app mainly due to their unfamiliarity with digital modes of delivering care, time constraints, and difficulty adjusting to new routines (e.g., answering parents' questions digitally via the app instead of over the phone). Many contemporary parents prefer apps over traditional methods of delivering information such as in-person classes and printed material. Healthcare professionals, however, continue to provide printed information in the form of pamphlets, handouts, and books that may not be feasible for contemporary parents who may be used to digital modes of information (Asiodu et al., 2015; Danbjørg et al., 2014; Lupton, 2016). The constant rise in the use of apps and digital resources demands nurses to:

- Seek assistance in increasing informatics related competencies by approaching nurse educators and colleagues, competent in informatics practice.
- Take initiatives in improving their e-health competencies by using modules developed by their employers and nursing associations such as AHS, CASAN, CARNA, and CNA.
- Read research articles, identify quality resources, and participate in continuing education activities to improve their informatics practice. The published manuscript, for example, provides a list of quality apps that nurses can use to recommend apps to parents. Attending conferences relevant to the practice can also permit nurses to keep up to date with current research.

**Implications for research.** Several evidenced-based apps have been developed for parents; however, in most cases, researchers did not involve parents in designing the apps or merely involved them in evaluating the apps post-development (Anggraini et al., 2015; Dhumal et al., 2016; Lopez et al., 2013). Parental involvement in co-creating resources is important in producing appealing and meaningful resources. This study presents the following implications for research:

- The use of user inclusive methodology such as PD should be used to engage parents in co-developing meaningful and usable e-resources.
- Research in parental use of digital resources should not merely include mothers as participants. Considering the current trends of the shift in parenting roles and responsibilities researchers should include the perspectives of fathers in parenting research.

- Current parenting app reviews focus on the quality concerns with existing apps, however, fail to meet the needs of healthcare professionals by providing a list of apps that they could suggest to parents. This research sets a new direction for future app reviews by highlighting the need to showcase quality evidenced-based apps to assist healthcare professionals in better supporting parents' digital needs.

## **Conclusion**

This project was born out of the desire to help first-time parents in finding quality apps. It was inspired by the student researcher's personal experience of being a first-time mother and the struggle for apps in the first few months of parenting. The app directory will help reduce the challenges for other new parents who may be struggling to find helpful apps and will support them in their parenting as they adjust to their demanding roles as parents. A PD approach was used to guide the project. This user inclusive methodology supported the notion that including parents in the co-design of an app directory helps ensure that the directory is meaningful and usable to parents. In this study, parents indicated that they preferred to use information and tracking apps and recommended incorporating time-saving design elements in future resources. These findings can be used as a guide by researchers to develop more appealing parenting apps in the future.

The findings of this study confirmed that parents face difficulties in finding desirable apps and a parenting app directory can serve as one of the potential solutions to this problem. As a result, parents tend to use poor quality apps, in the absence of quality apps, compromising on security, and content credibility in order to support their needs. Despite the availability of private photo sharing apps, parents continue to report using

social media to post their infants' photos and share identifiable information. These findings emphasize the need for nurses and other healthcare professionals to suggest quality apps and better support parents in making safe digital choices.

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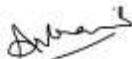
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Dr. Letourneau

Date:

## Appendix D

### Focus Group Discussion Questionnaire

**Q1. As a first-time parent, what types of apps do you look for?**

**Q2. Share your pleasant or frustrating app searching experiences?**

Probing questions

- How did you find the apps that you were looking for?
- Share positive experiences you have had with a particular app?
- Share disappointments you have had with a particular app?
- How did you find your favorite parenting app?
- Which app features attract you most?
- What did you struggle with?
- What did you find helpful?
- Who or what influences your decision to download a particular app?
- What were your big questions/ concerns?
- If you could wave a magic wand what would have helped?

**Q3. On average, how many apps do you go through before finding an app that you like? Give an example if you can**

**Q4. What do you think about free versus paid apps?**

**Q5. Write three things that matter most to you when downloading a parenting app and circle the option that is most important to you?**

**Q6. App review activity**

Moderator will provide app cards (cards with name, app icon, and its purpose) to the participants and will provide the following instructions:

Choose an app that interests you. Download the app on your device, use it for 5-10 minutes, and present the app review to the group. At the end of the review let's vote and decide whether this app should be part of the parenting app directory or not?

**Q7. Would it help to have a parenting app directory that brings together all available quality apps and allows you to select apps based on your preferences?**