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Review

USE OF SMARTPHONE APPLICATIONS TO PROMOTE BREASTFEEDING IN PRETERM INFANTS: A SCOPING REVIEW

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ABSTRACT

Aim: Systematize the available productions on the use of smartphone applications for promoting breastfeeding in preterm infants. **Method:** Scoping review conducted in September and October 2019 in the databases: CINAHL, MEDLINE, Scopus, and PubMed. There was no language or time limitation. In addition to the search for scientific production on this theme, a search was conducted on the download platforms of the two hegemonic smartphone operating systems – Google Play Store (Android) and Apple App Store (iOS). In March 2020, the same search strategy was replicated to verify whether new papers have been published from protocol results, as well as to identify new studies or protocols. **Results:** The search resulted in 764 documents, of which two articles and three protocols were included in the review. The number of studies found confirms the scarcity of scientific production on apps specifically aimed at the preterm infant population, although they point to a current growing trend to incorporate this resource for the breastfeeding promotion and support. The selected studies showed no statistically significant differences in breastfeeding rates when using such resources compared to in-person care. More studies are needed to evaluate different application proposals and in different settings to analyze the effectiveness of this technological resource as a complement to conventional care. **Conclusion:** The available productions on the use of apps to promote and manage breastfeeding in preterm infants are very scarce. The information available to assess the effect of this type of resource to promote breastfeeding in this population is considered insufficient.

Descriptors: Mobile Applications; Breast Feeding; Infant, Premature; Postpartum Period; Educational Technology; Health Promotion.

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INTRODUCTION

Breastfeeding is the most effective strategy to promote nutrition, child development, and maternal and child health[1], and its advantages for the baby, mother, family, and society are strongly proven and reported in the literature[2,3]. As it is an effective and economical strategy to reduce infant morbidity and mortality, several health policies have been developed to favor this practice[2,4,5]; however, global breastfeeding rates have been far from recommended[2]. Preterm birth is one of the contributing factors to early weaning[1,3].

Breastfeeding is also recognized as an important strategy to reduce the complications caused by preterm birth, an event that occurs approximately 15 million times worldwide each year[6]. Nevertheless, the circumstances involved with prematurity make the challenges faced by mothers willing to breastfeed even greater than at term birth[4,7,8]. At 24-26 weeks the digestive tract of the preterm infant is morphologically similar to the full-term infant, but functionally incomplete[7]. The coordination of the sucking, swallowing, and breathing mechanisms, essential for establishing breastfeeding, is generally not complete until 32 to 34 weeks gestation; gastric emptying is slow, intestinal motility is reduced, and preterm infants are more prone to developing necrotizing enterocolitis[7,9]. Mothers of preterm infants often report feelings of helplessness, anxiety, guilt, and failure when dealing with the challenges of breastfeeding[10].

Acting in this scenario, health professionals seek strategies that contribute to the establishment and maintenance of breastfeeding of preterm infants[3], which traditionally occurs in face-to-face interactions with the binomials. However, in the context of the Covid-19 pandemic, this reality has undergone important changes. The need for social distancing to contain the spread of the virus disrupts the functioning of family and community support networks that usually assist women during puerperal experiences and creates barriers to traditional breastfeeding support services. Some parents and health professionals may choose to cancel, postpone, or limit consultations and face-to-face interactions in which breastfeeding support is traditionally provided.

Considering the accessibility factor, the growing popularization of internet access,

and technological devices such as computers, tablets, and smartphones are highlighted, and the concept of mobile Health (mHealth) is disseminated as the use of mobile and wireless technologies to promote and improve health and wellness practices[11–13]. It is noticeable that parents increasingly seek out these tools for support and assistance in the breastfeeding process[3,13]. Thus, by playing their role as educators, nurses can use the technologies of the digital world as resources to enhance the scope of care for this clientele, seeking better results in the initiation and maintenance of breastfeeding[3].

Given the above, it is important to establish an overview of the production of educational strategies supported by mHealth aimed at this peculiar population. Thus, the present study seeks to systematize the available studies on the use of smartphone applications (apps) for promoting and managing breastfeeding in preterm infants.

METHOD

This is a scoping review, a method particularly indicated for emerging health topics that require an overview of published evidence, without the commitment to qualitatively evaluate the rigor of study designs or even select specific types of studies to answer the specific research quests(15). The guiding protocol was PRISMA-ScR, which published an extension of this checklist specifically for scoping reviews: 1) alignment of the research question with the objective; 2) search for relevant studies (inclusion and exclusion criteria and definition of terms); 3) selection of studies and data extraction; 4) analysis and recording of evidence; 5) synthesis and description of evidence; 6) analysis and conclusion of findings(15).

An adaptation of the PICO strategy was used to develop the guiding question (16). The research question delimited was: "What is the contribution of scientific production on the use of smartphone applications (apps) for promoting and managing breastfeeding in preterm infants?"

The search in the databases Cumulative Index to Nursing and Allied Health Literature (CINAHL), Medical Literature Analysis and Retrieval System (MEDLINE), Scopus and National Library of Medicine National Institutes of Health

(PubMed) occurred between September and October 2019. The descriptors selected in the Medical Subject Headings (MeSH) were mothers, postpartum women, educational technology, mobile applications, smartphone, breastfeeding, and health promotion (all in English). A search was also conducted in the download platforms of the two smartphone operating systems - Google Play Store (Android) and Apple App Store (iOS). It was also decided to verify whether there were records of studies in progress whose results had not yet been published. In March 2020, an update of the search on the ClinicalTrials.gov platform and the Brazilian Registry of Clinical Trials (ReBEC) was conducted for clinical trial protocols involving the use of a smartphone app as a technological resource for promoting breastfeeding with a focus on prematurity.

The inclusion criteria were studies that reported on the use of smartphone apps to promote breastfeeding and whose content addressed prematurity. There was no language or time limitation in order to explore all the scientific production on the subject in this clipping. As it is a new and potentially little explored theme, all types of studies were considered, including reviews.

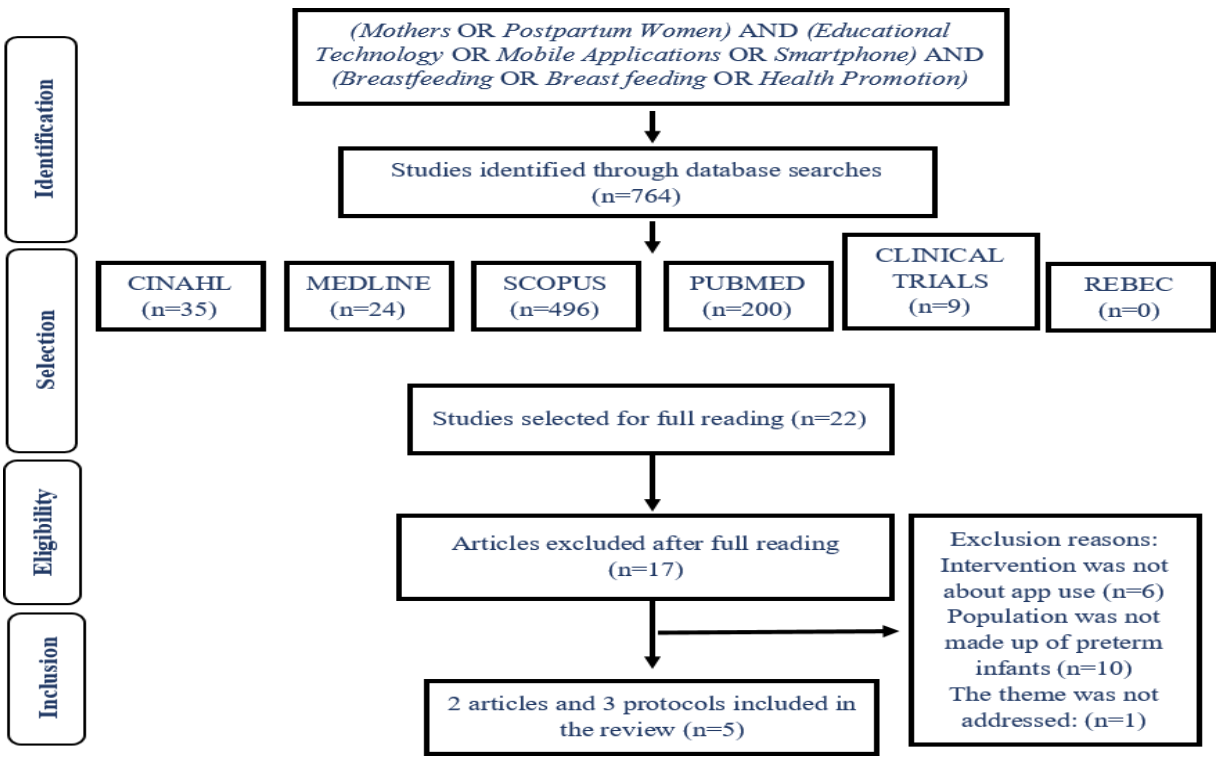

Figure 1: Diagram of the selection of studies included in the scoping review. Paraná, Brazil, 2020

The searches were carried out by two reviewers independently, and the discrepancies were submitted to a third reviewer for evaluation. Data were compiled, extracted, and summarized using Microsoft Excel. Information about the selected Randomized Clinical Trials (RCT) protocols was also described in the same summary chart (Chart 1).

RESULTS

The initial search yielded 764 studies, including RCT protocols. The flowchart of the selection process of the studies that make up this review is shown in Figure 1. Two articles met the previously established inclusion criteria, confirming the scarcity of scientific production on the subject. The first(17) is a cross-sectional descriptive study of the "survey" type, published in 2016, developed in the State of Pennsylvania, USA. The second(18) is an RCT developed in the same place, published in 2020. Studies with apps favoring breastfeeding promotion with strategies focused primarily on the population of healthy, full-term newborns stand out, since 10 materials were excluded for not including preterm infants.

As for the extension of the search to include protocols of ongoing studies, 9 RCT protocols were found in ClinicalTrials.gov. Of these, three mentioned mothers of preterm infants as the population. No study protocol on this topic was found in the Brazilian Registry of Clinical Trials (ReBEC), and no app on Google Play Store and Apple App Store download platforms met the defined inclusion criteria.

The main information extracted from the two articles and the three RCT protocols has been compiled and is presented in Chart 1.

DISCUSSION

Considering the peculiarity of the challenges that permeate the breastfeeding practice of mothers and preterm infants, new strategies that favor the success of this practice are necessary. Although the use of mHealth is increasing in other areas, this study revealed that little has been produced to date in the development of apps to

Chart 1: Characterization of the studies included in the scoping review. Paraná, Brazil, 2020

Authors/ country/ publication year	Study type/research design	Objectives	Population	Main results	Technology Type/app description
Demirci, Cohen, Parker, Holmes, Bogen (2016)[17] EUA	Survey type cross-sectional descriptive study	Identify post-partum women's preference for using technologies to receive information on pregnancy, baby care, and breastfeeding.	A total of 146 mothers of infants with gestational age (GA) between 34 and 37 weeks and 6 days at birth were interviewed.	Most used some technological support for emotional, informational, technical, and advisory support on breastfeeding.	The resources used by post-partum women were e-mail, websites, and smartphone apps.
Uscher-Pines L (2019)[18] EUA	Randomized clinical trial	Assess the impact of app-based lactation consultant support on breastfeeding rates in a population with difficult access to professionals.	203 mothers of infants with GI greater than 35 weeks who had started breastfeeding and wished to continue after hospital discharge.	Exclusive breastfeeding rates in the intervention group were higher than in the control group but were not statistically different.	The intervention group had access via smartphone app to video clips with breastfeeding consultants.
Hägi-Pedersen (2018)[19] Dinamarca	Randomized Clinical Trial Protocol	Testing early home care (PreHomeCare) via app and videoconference.	186 mothers of preterm infants with a GA greater than 34 weeks at birth.	Check breastfeeding rates one month after discharge and measure parent/baby trust and interaction, and parent knowledge of the preterm baby.	The app contains information on breastfeeding and skin-to-skin contact; option for video contact with a nurse and daily baby data logging.
Uscher-Pines (2019)[20] EUA	Randomized clinical trial	Verify the impact of using a virtual breastfeeding support.	203 mothers of NBs with GA greater than 35 weeks who started breastfeeding during hospitalization and wished to continue breastfeeding after discharge.	Check breastfeeding and exclusively breastfeeding rates and duration and mothers' perceptions and satisfaction with breastfeeding.	The app provided a platform for video calls by mothers with breastfeeding consultants.
Massa (2018)[21] EUA	Randomized clinical trial	Check whether meditation increases breast milk production in mothers who are expressing milk for infants in the NICU*.	Mothers who had babies with GA from 24 weeks to 32 weeks and 6 days.	Measure milk production, self-confidence, stress, anxiety, and depression levels with the use of the app for meditation by mothers.	There are no specific descriptions of the app, only the mention that mothers will use an app designed for meditation during milk extraction.

promote breastfeeding specifically for mothers of preterm infants. Extending the search beyond databases, also exploring the Google Play Store and Apple App Store download platforms, revealed a gap in this type of application, even in the commercial area.

A study published in 2018 sought to identify apps available on smartphone online stores with content related to breastfeeding; however, the content of the apps found also failed to include guidelines on breastfeeding for preterm infants[22]. The selection criteria were free apps available in Portuguese that addressed breastfeeding in their content, resulting in 12 selected apps. The content of the apps was analyzed and only one showed reference to the source of the content provided, pointing to the need for greater scientific rigor in the development of these materials[22].

Importantly, although preterm infants are commonly excluded from intervention studies aimed to improve breastfeeding-related outcomes, they are the population that most needs and benefits from human milk properties. The milk from mothers of preterm infants has greater nutritional value and anti-infectious properties, ideal for the most critical needs of these babies, preventing the development of intolerances, enterocolitis, bronchopulmonary dysplasia, and late sepsis. The benefits extended to these mothers, when supported with specific interventions to assist them, are also valuable[23,24].

There are vast possibilities for exploring mHealth to develop apps that assist mothers of preterm infants in the arduous challenge of breastfeeding. Such help could be timely at various times: during prenatal care, during the critical phase of establishing breastfeeding, at the also critical moment of hospital discharge, at the end of maternity leave and when mothers return to work, and even during the phase of introducing complementary feeding. Furthermore, regarding the purpose of the app, several approaches could be explored, such as: educational, instructional, motivational, supportive, etc.

In the survey[17], most of the women interviewed had higher education, characterizing a good socioeconomic level, and most (87%) had a smartphone with internet access and used technological support to obtain information during prenatal care and after birth. The most common

technology used in prenatal care involves apps (63%), followed by websites (54%) and email (28%). In the postpartum period, the preferred means for women to receive information on baby care and breastfeeding was e-mail (53%), followed by Internet links (41%) and apps (31%). It is worth noting that the reasons given for preferring one technology over others included the cost of obtaining and maintaining apps and text messaging plans.

This same study[17] pointed out that the search for information on breastfeeding during the prenatal period was not a priority among the study participants, since a minority (7.5%) mentioned the interest for this guidance still during pregnancy. During this period, the main searches were related to pregnancy progression and fetal development, signs of premature labor, general pregnancy information such as symptoms, calculating the probable date of delivery, counting contractions and fetal movements, and information about the birth.

Lack of interest in knowledge on breastfeeding during pregnancy was observed in another study[25], which pointed out that most pregnant women postponed breastfeeding counseling for later consultations or even after delivery. The authors point out that these women are often surprised by situations that can make breastfeeding difficult in the early days after the baby is born and, at this moment, they understand that discussions on breastfeeding during prenatal care would facilitate this process[25]. This fact deserves to be highlighted, because the population's misinformation in general can be considered a cause of early weaning[26,27]. A study investigating the practice of breastfeeding and the reasons for weaning correlated the lack of guidance on breastfeeding during pregnancy with high rates of early weaning and low prevalence of exclusive breastfeeding[28].

Prenatal care is considered an opportune moment for health professionals to develop educational actions aimed at managing and promoting breastfeeding, which can contribute to women's decision to start breastfeeding[27]. Thus, it is essential that information to encourage, support, and promote breastfeeding starts early, i.e., before birth. Moreover, considering the evidence that mothers of preterm infants breastfeed less than mothers of babies born

at term[29], it becomes even more necessary that these orientations to high-risk pregnant women occur before birth[8] and continue during the postpartum period. For these women, the orientation should emphasize the importance of breastfeeding, specifically for preterm infants, and the need for dedication and commitment to initiate and maintain breastfeeding in this unique condition.

In addition, it is essential to consider and understand the experiences of mothers of preterm infants in their unique breastfeeding establishment journeys in order to plan professional approaches based not only on technical support, but also on continuous support to mothers and family[4].

Although it is the responsibility of health professionals to provide information and support for the breastfeeding process, many are faced with a lack of time and material resources to do so[26]. A study carried out with pregnant women and health professionals showed that 45% of pregnant women said they had not received orientation on breastfeeding during consultations; however, their reports pointed to the search for this information in other sources of information, such as the Internet[26]. In this sense, support based on digital technologies proves to be a useful tool, especially because of its instantaneous availability and possibly concomitant with the emergence of difficulties.

As health professionals limit their time and resources to effectively promote breastfeeding, it is worth reflecting on the space that apps could occupy, whether it is only complementary to the usual care or a substitute for it. Aspects related to the face-to-face interaction of professionals with patients, the establishment of the therapeutic bond, and even the women's personal preferences should be considered. On the other hand, in the current context of the Covid-19 pandemic, app use stands out as a possibility to promote health actions without the need for face-to-face meetings, and in the case of breastfeeding support, without the undesirable exposure of pregnant women or mother-baby binomials to health service environments.

The RCT protocols included in this review describe studies with the common purpose of using smartphone apps to promote the breastfeeding of preterm infants; however, they differ as to the purpose of the app. The first protocol[19]

presented in Chart 1 points out the development of an app aimed at providing information inherent to the breastfeeding process, in addition to functioning as a means of videoconferencing with health professionals. In the second one[20], the aim was to evaluate a virtual breastfeeding support service provided by breastfeeding consultants, and the app served as a platform to enable videoconferences. The last RCT protocol[21] has meditation practice during breastfeeding as an intervention, and the app is the technology chosen to provide this intervention to the study participants. Even with different objectives regarding the purpose of the app use, this has been one of the technological possibilities of choice to help in the breastfeeding ins the prematurity context; however, the intervention of one of the protocols would not exactly be the use of the app, but the meditation strategy made possible through the app.

This review pointed out the scarcity of initiatives that focus on the uniqueness of breastfeeding in the context of prematurity, since only one RCT[21] intends to exclusively include mothers of preterm infants, while the others address both mothers of preterm and full-term infants[19,20]. Moreover, this was also the only initiative[21] that included the most vulnerable population that faces greater difficulties in establishing and maintaining breastfeeding, which are preterm infants under 32 weeks.

One of the included RCT protocols[19] proposes to verify an early home care program (PreHomeCare) that includes video consultations using an app and check whether it influences breastfeeding rates. During the completion of this review, it was found that one article from this protocol was completed and published[30]. Participants were randomized to either the intervention or control group. Both groups received PreHomeCare care, which involved early home care with a variety of baby care guidance, and two to three weekly in-person consultations with a nurse about child development and weight gain assessment. In the intervention group, in addition to this usual care, a smartphone was made available with an app containing all the information and techniques needed for breastfeeding management, skin-to-skin contact, an option for participatory guidance through video call with the nurse, and an option to record the baby's daily data, in addition to the consultations being held by videoconference.

There was no statistically significant difference in exclusively breastfeeding rates between the groups, and the authors suggested that the similarity in results found was due to technical problems with the app's video function, implying that participants in the intervention group only received consultations by phone, and not by video, as expected. Considering that technologies are susceptible to failure and, therefore, need constant improvement, the authors suggest this modality of assistance as complementary and not as a substitute in postpartum care.

The second RCT protocol[20] planned to verify the impact on breastfeeding rates by employing virtual support via a smartphone app for mothers living in a rural area with limited access to assistance from professional lactation consultants. The goal of the app was to provide a platform for video calls by mothers with the breastfeeding consultants. Unlike other healthcare professionals who provide breastfeeding support as a complementary form of care, breastfeeding consultants are trained professionals exclusively for this purpose, and to receive this title of specialist in breastfeeding, they must be certified by the International Board of Lactation Consultant Examiners (IBLCE)[31]. Their efforts focus exclusively on providing the necessary support and guidance to overcome difficulties and achieve success in establishing lactation and breastfeeding[31].

The second article[18] included in this review is a result of the aforementioned protocol[20] which investigated the use of virtual support with breastfeeding consultants via smartphone app. The study concluded that this type of care can be implemented in an impoverished population with difficult access to health care professionals, and that the exclusively breastfeeding rates in groups that used this support were higher than in groups that received only the usual care, even though the differences were not statistically significant[18]. Considering the reality in Brazil, the advance of Internet access by the population is growing. In 2016, the access rates to this resource permeated 68%, and of these, 93% had access to the network through their smartphone[32]. However, in 2018, the Internet was already used in 79.1% of Brazilian households, and in 99.2% of households that had Internet access, the mobile cell phone was used for this

purpose[33]. Parallel to this, it is important to consider that the availability of professional consultants in breastfeeding within the SUS is still scarce[34]. Thus, one can consider the use of this type of technology as a growing trend, even for less favored populations.

Education and socioeconomic status are variables commonly correlated with breastfeeding duration. It has been shown that mothers with lower levels of education have fewer prenatal visits or start prenatal care late and tend to stop breastfeeding early[35]. These results point to the need to provide support to low-income and poorly educated mothers, through the intensification of health policies aimed at this population, and having technological resources in mHealth as an alternative to complement the work of health professionals may be considered one of the solutions.

Regarding the content of the apps, the survey[17] showed that mothers wanted emotional, informational, technical, and advisory support on breastfeeding. The most desired types of support were encouragement and counseling, expectations related to breastfeeding difficulties encountered during the postpartum period, information on adequate production, and aspects related to breast milk extraction. Similarly, research has shown that women are mainly interested in breast preparation and assessment, positioning and correct latching, and how to increase milk production[27,35].

Another result of the survey[17] was that most women wanted emotional support and encouragement, and preferred it to be constant or daily. Even in the time allotted for birth, women often experience a certain amount of vulnerability and insecurity in the postpartum period, let alone in times of adverse conditions such as the current pandemic.

Social isolation and difficulty initiating breastfeeding are associated with an increased risk of depression and postpartum anxiety; these mood disorders can aggravate breastfeeding difficulties, lead to early breastfeeding cessation, and have serious implications for the well-being of both parents and infants [36]. A moderate to high stress level has been found among pregnant and postpartum women in this new global setting [37].

Encouragement and support are a way to welcome, enabling women to build a

sense of confidence and improve self-efficacy in their role as mothers and nurturers[14]. This support needs to be made possible even in the face of current recommendations or determinations of social isolation, which can be achieved, albeit with limitations, using mHealth resources such as smartphone apps.

Finally, the survey also showed a panorama of preferences and expectations of content for perinatal support and breastfeeding according to the desire of women, which can contribute to the planning and development of digital tools more likely to be adhered to[17].

CONCLUSION

This review has found that the production related to the use of smartphone apps for promoting and managing breastfeeding in preterm infants is scarce. The published studies point to an incipient panorama of research on the incorporation and effectiveness of this resource for the support, promotion, and maintenance of the breastfeeding process, either as a substitute for conventional care or as a complement.

It is worth noting the need for studies that assess different app proposals and in different contexts with and without the assistance of a professional through teleconferencing to guide the implementation of this tool. This evaluation is timely, especially in the current global context in which important barriers to accessing traditional breastfeeding support services have emerged.

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