**Abstract**  The eHealth technologies promote parental care practices for preterm infants. Nonetheless, we should underscore the abundant information and available apps and disparities in these resources’ quality, usability, and reliability. This article examines eHealth technologies directed at parents to care for preterm infants. An integrative review was conducted across the principal health databases (Capes, EBSCO, BVS, PubMed, Scholar, and SciELO), selecting works published from 2011 to 2022 in Portuguese and English, focusing on the use of eHealth technologies for the care of preterm infants. We identified 13 articles related to information and communication technologies in strategies for educating and promoting the health of preterm infants and their parents and the importance of evaluating and validating eHealth technologies in maternal and child health promotion. Properly validated eHealth technologies can be crucial in supporting parents in promoting health and providing care for preterm infants after hospital discharge, which, in turn, can drive the evolution of healthcare systems and improve clinical practices.

**Key words** Maternal-Child Health Services, Premature Newborn, eHealth Strategies, Public Health, Parenting
Introduction

Preterm newborn (PTNB) development requires much care to promote their health and better quality of life. In this context, the essential speech therapy aspects to be observed involve orofacial functions, language, and hearing. The term “orofacial” refers to the set of stomatognathic functions of breathing, sucking, chewing, swallowing, and speech – articulation and voice. While the term “language” considers the distinctly human form of receptive (ability to understand) and expressive (ability to produce) communication that gathers social groups. “Hearing” appears in this process as a function for apprehending environmental sounds and a facilitator of language development and speech acquisition.

Premature birth occurs before 37 weeks of gestational age and can be subcategorized into extremely premature (<28 weeks), very premature (28 to <32 weeks), and moderate to late premature (32 to <37 weeks). Over the years, technological advances aimed at maternal and child health and neonatal care have enabled the survival of many preterm infants. However, preterm infants have an increased risk of neurological development sequelae, including cognitive and socio-communicative impairments.

The neurocognitive and behavioral development of premature newborns can suffer losses resulting from neonatal characteristics and morbidities, mainly due to the need to remain in stressful environments, such as the Neonatal Intensive Care Unit (NICU), and adverse social factors that can influence their neurodevelopment. Recent studies state that eating disorders and language acquisition and development changes are observed more frequently in preterm babies than full-term. Such changes result in motor delays, global cognitive impairment, visual perception issues, executive functioning impairments, and learning difficulties.

Preterm babies are prepared for discharge from the NICU and dehospitalization when they are physiologically stable, and their family members or caregivers have the necessary skills to provide essential care in their daily lives. Thus, successful follow-up programs for preterm babies begin during hospitalization and follow-up outpatient clinics. They aim to guarantee the care of the baby after dehospitalization, facilitating early diagnosis of possible health and development problems, early or prophylactic intervention, support for families, and the realization of studies on prematurity to ensure advances in treatments.

Programs that encourage the bond between parents and babies through parental neonatal care practices positively influence the neuropsychomotor development of preterm babies. The family members of these babies have proven lower effective interactions with them than their full-term peers, which can be justified by the following aspects: the PTNB’s inability to focus and facial expressiveness during interactions; stressful and emotionally exhausting experiences for parents; separation from parents resulting from the extended stay of PTNBs in the NICU; and parental susceptibility to Vulnerable Child Syndrome, in which preterm babies who were at risk of death at one point in their lives continue to be perceived as more vulnerable than their full-term peers, generating more significant anxiety in parents.

The work of the multidisciplinary team is essential in organizing the follow-up. It can be coordinated by a neonatologist or pediatrician, with other professionals (neuropediatrician, ophthalmologist, otorhinolaryngologist, social worker, orthodontist, nurse, psychologist, nutritionist, physiotherapist, occupational therapist, and speech therapist). Each stakeholder is a facilitator of rapprochement and interaction between the baby and their family members through health education strategies that promote bonding and the ability of family members to detect and respond to the preterm baby’s behavioral signs daily, avoiding the deterioration of possible neurodevelopmental disorders. Thus, the opportunity arises for developing new technologies that enable advances and perspectives in access to information that strengthen parents’ knowledge and care for preterm babies.

Advances in technology have increased the population’s life expectancy and quality, which includes maternal and child health. In this setting, the World Health Organization (WHO) considers that eHealth technologies are tools applied to health that enable the implementation of therapeutic processes, learning, and health promotion, covering the following subcategories: mobile Health or mHealth; Health Information Systems or HIS; Distance healthcare (Telemedicine) and distance learning (Electronic Learning or eLearning).

With the use of the internet, the use of digital technology expands, enabling new ways of transmitting information to many people simultaneously. The e-Learning technologies, through distance learning (DL) tools, aim to expand people’s knowledge on specific topics. They are
effective in the contemporary world due to the individual’s learning practicality and autonomy. When these resources promote health, they bring knowledge to tackle issues, reduce illnesses, and foster positive behavioral changes.

In recent years, it has become common for parents of preterm babies to search for information related to the health and care of their children on the internet, often before even consulting a healthcare professional. This process includes using search engines or social networks. Furthermore, these parents remain connected even after discharge from the NICU, searching for responsive platforms, distance learning courses, and mobile applications directly from their cell phones to obtain more information about the health and well-being of their babies.

While a wide variety of information and apps are available for parents of babies and children born prematurely, it is expected to see variable quality, usability, and credibility, with generally low scores in user reviews. Furthermore, few peer-reviewed or empirical studies relate to this content, which highlights the need for more attention to developing reliable, high-quality resources for parents of premature babies who remain in the NICU.

Based on the facts presented, we ask: What topics are covered by the eHealth technologies available to alleviate the difficulties parents of preterm babies face in caring for their children after discharge from the NICU? What types of eHealth technologies geared to parents of preterm babies are mentioned in the studies? What are the contributions of eHealth technologies to equip these parents to care for their children?

The present study aimed to conduct an integrative review of eHealth technologies aimed at parents for the care of babies born prematurely.

Methods

Our integrative review revealed the scarcity of publications that directly address the design and validation of eHealth technologies aimed at parents of preterm babies, limiting the scientific evidence that supports their usability. However, this bibliographic gap also highlights the relevance of the topic under investigation and shows its relevance.

This integrative review was performed from August to December 2022 on the following healthcare portals and databases: Capes, EBSCO, BVS, PubMed, Scholar, and SciELO. The timeframe for the search included publications from 2011 to 2022 to include updated studies on the topic in Portuguese and English, aligned with the following guiding questions: What does the literature point out about the use of eHealth technologies to promote health education focused on the care of babies born prematurely? What does the literature point out about health promotion strategies and resources aimed at parents and families of babies born prematurely?

The integrative review is a careful research method that aims to provide and summarize the primary knowledge related to a given research problem so that it can be critically analyzed and incorporated into care practice. This information is provided in a systematic, orderly, and comprehensive manner, constituting the body of knowledge. Thus, the researcher can prepare an integrative review with different purposes, which may define concepts, review theories, or perform methodological analysis of studies on a given topic.

The integrative review in the health field can help obtain a complete and relevant picture of complex concepts, theories, or care-related problems. The sample’s varying composition and the integrative review’s many purposes contribute to its scope and relevance. Ganong proposes six steps to construct an integrative review: defining the theme and selecting the hypothesis or guiding question; establishing study/search inclusion and exclusion criteria; defining and categorizing information to be extracted from studies; evaluating included studies; interpreting results; and presenting the review/summary of knowledge. To this end, Medical Subject Headings (MeSH) descriptors or the following keywords were used, in English and Portuguese: “saúde materno-infantil” (maternal and child health); “recém-nascido, prematuro” (infant, premature); “promoção da saúde” (health promotion); “educação a distância” (education, distance); “estratégias de eSaúde” (eHealth strategies).

Two researchers identified and selected the studies, combining the abovementioned terms with Boolean operators “OR”/“AND.” These were subject to quality assessment, with independent evaluations between two researchers, as per the Joanna Briggs International approach. All articles included in the final sample met the quality criteria.

Initially, 1,571 studies were identified in the selection. Duplicate studies, those with titles that did not match the descriptors, studies without...
elements relevant to the scope of the study, and those that did not use eHealth technologies were excluded. At the end of this process, the search identified 54 scientific productions, including articles and a dissertation, as shown in Table 1.

The integrative review evidenced a lack of publications that addressed the use of eHealth technologies for the health education of parents of babies born prematurely, primarily related to oral and language development. The fifty-four publications initially selected were reviewed, and we excluded those that did not address the topic of interest, leaving only 13 publications (Chart 1).

After the selection, we performed in-depth reading of the material, followed by content analysis in thematic modality25, resulting in two themes presented in the results of this article. The partial results of this review were shown under a simple summary at the 11th Ibero-American Congress on Qualitative Research (CIAIQ 2022)26 and published in New Trends in Qualitative Research (NTQR)27.

Results and discussion

The themes emerging from the literature review are information and communication technologies (ICT) in education and health promotion strategies for preterm babies and their parents and the importance of evaluating and validating eHealth technologies in promoting maternal and child health.

We found that, among the resources and strategies used to promote the health of parents and families of babies born prematurely, most do not involve eHealth technologies and include parental intervention programs, multi-professional guidance, telephone-based screening, booklets, and leaflets. However, the 13 selected studies address using eHealth technologies in this context, such as Telemedicine, websites, mHealth, gamification, and eLearning.

Based on the first guiding question, the studies presented in Chart 1 present eHealth technologies to promote health education aimed at caring for premature babies. Only two adopted a mixed approach (quantitative and qualitative), emphasizing the complementarity of results obtained through statistical analyses and participants' perceptions. Breastfeeding, an orofacial function, was the most recurring theme among the studies.

Information and Communication Technologies (ICT) in health education and promotion strategies for premature babies and their parents

With the advancement of technology and the popularization of the internet and mobile devices, the dissemination and use of eHealth tools have become a viable option to provide maternal and child support and exchange information and knowledge with different target audiences, favoring the continuity of care for the baby after hospital discharge, follow-up by the multidisciplinary team and monitoring of child development30,36,37.

The eHealth technologies aimed at maternal and child health effectively promote health promotion and education, transforming health systems. Its clinical and scientific relevance is based on its possibilities of application at all care levels, overcoming the barriers imposed by physical distance and respecting the fragility and individuality of parents and family members15. However, before being adopted by the target audience, these tools must be evaluated regarding their applicability, advantages and limitations. In this sense, the internet has been increasingly used as a source of maternal and child health information, and social networks enable the exchange of experiences and parental support19.

Information and Communication Technologies (ICT) can guide parents and family members regarding the baby’s health pre- and postnatal periods. These technological tools effectively sensitize and encourage family participation in monitoring and stimulating the neuropsychomotor development of babies and children, contributing to maternal and child health and well-being. Furthermore, these health education resources can curb the risks of mortality and child development disorders38.

Table 1. Result of the literature review.

<table>
<thead>
<tr>
<th>Databases/ Electronic Portals</th>
<th>Type</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBSCO</td>
<td>Article</td>
<td>12</td>
</tr>
<tr>
<td>PubMed</td>
<td>Article</td>
<td>22</td>
</tr>
<tr>
<td>Scholar</td>
<td>Article</td>
<td>9</td>
</tr>
<tr>
<td>CAPES</td>
<td>Article</td>
<td>5</td>
</tr>
<tr>
<td>SciELO</td>
<td>Article</td>
<td>5</td>
</tr>
<tr>
<td>Scholar</td>
<td>Dissertation</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>54</td>
</tr>
</tbody>
</table>

Source: Authors (2023).
The maternal and child well-being provided by eHealth tools depends on the ability to implement programs that allow the exchange of knowledge and experiences between the target audience and developers. These actions should have a clear and differentiated language for parents and family members, meeting individual demands and contributing to baby care-related decision-making. Using technologies aimed at maternal and child audiences can potentially strengthen families and contribute to monitoring child development. When developing eHealth technologies, it is necessary to understand the concerns and challenges of the target audience to meet their specific educational needs.

An adequate approach to parents of preterm babies requires consideration of their fragility and individuality. Furthermore, health professionals working in the NICU must be trained in communicative skills to support parents in making decisions about the baby’s health. Lack of awareness about the importance of monitoring and stimulating children after hospital discharge can affect parents’ adherence to intervention programs. Therefore, it is essential to raise awareness among this population through health commu-

Chart 1. Selected studies that address eHealth technologies in feeding and communication care for babies born prematurely.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Year</th>
<th>Title</th>
<th>Objective</th>
<th>Study type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Ferecini</td>
<td>2011</td>
<td>Desenvolvimento e avaliação do objeto digital de aprendizagem sobre o aleitamento materno do prematuro.</td>
<td>Develop a website aimed at family members of PTNBs about BF and evaluate this digital learning object with nursing and IT professionals.</td>
<td>Quantitative</td>
</tr>
<tr>
<td>3 Cervantes Guijarro et al.</td>
<td>2014</td>
<td>Use of the new technologies and Telemedicine, in the healthy newborn follow up.</td>
<td>Show the effect of the eHealth tool in monitoring healthy babies in the first six months of life in a Primary Health Care service.</td>
<td>Quantitative</td>
</tr>
<tr>
<td>3 Jiménez-Serrano et al.</td>
<td>2015</td>
<td>A mobile health application to predict postpartum depression based on machine learning.</td>
<td>Develop a mHealth app to early detect the risk of postpartum depression and improve maternal care performance.</td>
<td>Mixed</td>
</tr>
<tr>
<td>4 Letourneau et al.</td>
<td>2015</td>
<td>Quasi-experimental evaluation of a telephone-based peer support intervention for maternal depression.</td>
<td>Assess the effect of telephone peer support on maternal depression and social support.</td>
<td>Quantitative</td>
</tr>
<tr>
<td>6 Posmontier et al.</td>
<td>2016</td>
<td>Telephone-administered interpersonal psychotherapy by nurse-midwives for postpartum depression.</td>
<td>Test the feasibility, effectiveness, and acceptability of interpersonal psychotherapy via telephone by certified nurse-midwives in the treatment of postpartum depression.</td>
<td>Mixed</td>
</tr>
<tr>
<td>7 White et al.</td>
<td>2016</td>
<td>Theory-based design and development of asocially connected, gamified mobile app for men about breastfeeding (milkman).</td>
<td>Develop the first evidence-based breastfeeding app aimed at men.</td>
<td>Mixed</td>
</tr>
</tbody>
</table>
The quality of communication between health professionals and the assisted population is directly linked to how knowledge and experiences are shared. Thus, communication strategies and health technologies can promote differentiated work, contributing to the growth, learning, and well-being of the parents-baby relationship43.

New systems can be offered to improve the activities of people and health services with technological progress and the emergence of mobile devices with greater processing power and advanced technical resources, as in the case of maternal and child health. However, there is a lack of published studies evaluating the use of mHealth technologies in postnatal interventions45.

Studies investigating eHealth technologies’ effects on maternal and child health cover different aspects, such as user profiles, criteria for developing actions, quality of the information provided, contributions of these tools to health services, and adherence of the target audience42. The results indicate positive effects of these technologies on maternal and child health and well-being, including managing gestational diabetes, mental health, self-care of pregnant women, and empowerment and participation of parents and family members in the care of the baby in low- and middle-income countries44. Moreover, Telemedicine interventions have been presented as high-quality care models with low risk and cost for health services44.

According to Wallwiener et al.45, the predominant profile of users who use eHealth tech-
nologies to search for maternal and child health information consists of young women of reproductive age who frequently use the internet, social networks, and smartphone applications. Using applications and websites on maternal and child health is highly applicable and accepted and promotes health education and the participation of young women. Furthermore, these tools provide benefits such as increasing knowledge about maternal and child health and reducing maternal anxiety and depression. In a systematic review of 15 studies with users of eHealth resources, Heuvel et al. highlight that most who seek information online are pregnant women, regardless of age, education, or socioeconomic profile. Furthermore, around 88% of this population uses smartphones, and 50% to 98% access maternal and child health information through websites and applications.

Telemedicine-based eHealth interventions represent a trend that aims to curb healthcare costs without compromising the quality of services, becoming an effective alternative for health plans by offering low-risk and low-cost care models. Studies on the impact of eHealth technologies on maternal and child health include the evaluation of parameters such as quality standards, target audience adherence, and increased provision of care. Using these technologies suggests positive effects regarding lifestyle, management of gestational diabetes, mental health, self-care of pregnant women, empowerment, and parental participation in baby care in middle and low-income countries.

Studies that evaluated the level of satisfaction of young, primiparous women with higher education who used maternal and child health applications suggested by health professionals describe high acceptance rates, convenience, education, and co-participation. The benefits of eHealth interventions in increasing mothers’ knowledge about their baby’s health are related to reducing maternal anxiety and visits to clinics due to insecurities and excessive concerns. The user satisfaction rate with the technologies analyzed ranges from 86% to 95% in studies that address mental health and 90% in research on mothers of babies monitored at home because these tools allow them to stay home caring for their children for a longer period.

Ferecini developed a website on breastfeeding for preterm babies for families and evaluated this technology with nurses and IT professionals. The technology was well accepted among nurses (96%) and IT professionals (92%), concluding that the instrument is valid for health education for parents of these babies, encouraging breastfeeding.

Kim investigated the concerns and needs of 18 parents (ten mothers and eight fathers of preterm babies) to develop an eLearning technology to strengthen the parent-baby bond and support parents in caring for their children after hospital discharge. Respondents highlighted the importance of personalized education and argued that an eLearning system could meet their educational needs.

The eHealth technologies are also used as care and health promotion strategies for premature parents and babies. An example of this is the effectiveness of these tools in managing the mental health of mothers with postpartum depression, which affects 3% to 15% of the cases. Also, telephone calls and applications for screening and detecting postpartum depression are viable and practical tools for tackling this issue. Mitchell et al. affirm that mothers with postpartum depression may be afraid to seek specialized help due to fear of losing their children. The eHealth technologies can help overcome this barrier, as they allow online psychotherapy, reducing depressive symptoms according to studies, especially when compared to groups on a waiting list. Furthermore, eHealth interventions have revealed significant improvements in social and peer support perception, related to fewer depressive symptoms.

The eHealth technologies have also proven to be a viable alternative for health insurers due to the good results obtained in health interventions with their use, besides contributing to cost reduction. For this reason, ICTs can be a suitable option to transform traditional health education and offer support in a free and widely accessible way.

The relevance of evaluating and validating eHealth technologies in promoting maternal and child health

Few studies address the perceptions of maternal and child health professionals regarding the use of eHealth technologies. A qualitative study conducted by Goetz et al. presented the results of interviews with twelve healthcare professionals in obstetrics departments who expressed concerns regarding the implementation barriers and potential legal risks of eHealth interventions. Some participants reported little familiarity and skill with adopting these technologies, which
limited their involvement and understanding of the possibilities they could offer perinatal care. These professionals generally considered Telemedicine an additional parallel service rather than integrating it into the prenatal care model.

Despite the increasing number of studies investigating interventions with eHealth technologies, there is a strong need to evaluate their impacts\(^\text{19}\). Identifying measurable and reliable indicators is the principal barrier to this assessment. Furthermore, methodological obstacles exist, such as establishing a clear causal relationship between the eHealth technology intervention and outcomes, which confounding factors may influence. Identifying these indicators is complex, as the time interval between the intervention and the result is often long, and the relevance of the indicators may be context-dependent. However, the availability of (direct and indirect) outcome indicators can facilitate consistent measurement and comparability of studies\(^\text{44}\).

Based on the above, there is a need to conduct more studies with a qualitative approach to using eHealth technologies in maternal and child health and greater interdisciplinarity in developing these technologies. We suggest applying the Interdisciplinary Method for the Development of Health Technologies (IMDHT) in designing more reliable eHealth technologies, following the stages of development, validation, and evaluation of research tools and strategies. This method aligns with the nature of the methodological study and qualitative approach, drawing the researcher nearer to the topic investigated for a better understanding of the facts. It enables the definition of the principal issue, the formulation of precise hypotheses, and the discovery of relevant results, which are not always evident\(^\text{41}\).

Adopting a qualitative approach, in turn, is a crucial tool for identifying the perceptions, feelings, and needs of parents of preterm babies. This information is essential for designing and validating more effective eHealth technologies, allowing a broader understanding of the setting and characteristics of the target audience and measuring the participants’ level of satisfaction. The current trend is gathering quantitative and qualitative approaches, following the IMDHT model, which seeks the complementarity of objective and subjective perspectives to obtain different perspectives, analyses, and interpretations of the objects of study\(^\text{41,55}\).

**Final considerations**

The themes covered in this study highlight the relevance of this integrative review and encourage more specific qualitative research on the use of eHealth technologies by parents of preterm babies to improve these children’s health conditions and global development. Although these technologies are recognized for strengthening health education and communication actions, enabling parents to care for their babies after hospital discharge, it is vital to hear the perspectives of both parents and health professionals about the meaning and contribution of these technologies so that they can be improved and widely used.

The studies show concern about developing consistent and systematic strategies to provide educational interventions for developing and caring for preterm babies. In this context, maternal and child health professionals use eHealth technologies to boost health education programs, obtaining significant results in the knowledge of parents and baby development. The eLearning resources are considered critical pedagogical resources for rapid and expanded content availability, providing education opportunities for people in remote locations with difficulties in in-person access. However, we recommend more qualitative studies to obtain greater consistency regarding parents’ experiences using eHealth technologies, including topics related to the development of feeding and language in preterm babies.

We identified that eHealth technologies are also used to promote and care for the health of preterm babies after hospital discharge, thus transforming health systems and increasing the practice resolutivity. From this perspective, we observe an increase in the survival rates of preterm babies in neonatal care using actions combining technologies, humanization, and quality control.

The strategies identified in the literature emphasize respect for individuality and guaranteed access to technologies that provide security and care for newborns and their families, facilitating the bond between parents and babies. Furthermore, health professionals can also benefit from eHealth technologies, as they increase the engagement of parents and family members in baby care, reducing the impacts of prematurity on the development and quality of life before and after hospital discharge.
Despite advances in eHealth technologies and their contributions to improving the quality of life of preterm babies, many challenges and innovations are still necessary, such as the need to evaluate and validate these resources by developing studies that evaluate their usability, validity, effectiveness, and efficiency.

Collaborations

MAS Queiroz contributed to the conception and design of the study, bibliographic research, data analysis and interpretation, and the work's drafting and formatting. CCP Brasil contributed to the conception and design of the study, the work’s critical review and approval of the version to be published. CBM Cabral and ACL Porto contributed to data analysis and interpretation and the work's drafting and formatting. PME Barbosa and RC Sousa contributed to data analysis and interpretation. RFG Alegria and V Peixoto contributed to the work's critical review and approval of the version to be published.
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