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### e-Health for the control of children's growth and development after maternal death: a scoping review

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#### Abstract

**Introduction:** Maternal death is an event that impacts not only the family, but also the development of children in their first years of life.

**Objective:** to identify evidence that e-Health contributes to the control of children's growth and development after maternal death.

**Method:** A scoping review was conducted, following the guidelines and stages of the Joanna Briggs Institute. PRISMA-ScR was used to report the results.

**Results:** The initial search resulted in 3,284 studies in the databases, of which 1,186 were excluded due to duplication. After applying the exclusion and inclusion criteria and additional reading of titles and abstracts, 2,051 more studies were excluded, leaving 47 for full reading. Of these, 18 studies did not meet the eligibility criteria according to the study population criteria. Thus, 29 articles were selected for full reading and additional analysis.

**Conclusion:** Digital and telemediated interventions constitute a type of care applicable to the promotion of child development in different contexts. The lack of evidence on the use of e-Health in the monitoring of children up to one year of age who have lost their mothers indicates the need for research and specific proposals for this population. The demands involve the risk of interrupting breastfeeding, the possibility of delays in psychomotor development, and exposure to variations in the emotional state of substitute caregivers. The development of technologies aimed at this group can contribute to the organization and continuity of care.

**Descriptors:** Technology; Telemedicine; Maternal Mortality; Child; Nursing Care.

#### Introduction

Maternal death is an event that impacts not only the family, but also the development of children in their first years of life. According to the World Health Organization (WHO), approximately 303,000 women died during or after pregnancy and delivery in 2020, leaving a legacy of vulnerability for

their children<sup>(1)</sup>. Children who lose their mothers during delivery or in the first year of life face risks of delays in physical growth and neuropsychomotor development, in addition to emotional and social challenges<sup>(2)</sup>. In this context, continuous monitoring of these children becomes essential to mitigate the effects of maternal loss and ensure healthy development.



E-Health technologies emerge as a promising tool for monitoring children growth and development, especially in vulnerable settings. Mobile applications, platforms, and wearable devices have been used to monitor indicators such as weight, height, vaccination, and developmental milestones, offering support to both caregivers and health professionals<sup>(3)</sup>. However, the application of these technologies in the context of maternal orphans is still little explored, especially in low- and middle-income countries, where maternal mortality is more prevalent<sup>(4)</sup>.

Despite the potential of e-Health, gaps persist in the literature regarding its effectiveness, cultural acceptance, and integration into public health systems, such as the Unified Health System (SUS) in Brazil. In addition, few studies address how these technologies can be adapted to meet the specific needs of children who have lost their mothers, considering psychosocial and emotional aspects<sup>(5)</sup>. Given this scenario, it is urgent to map the existing evidence on the use of e-Health in monitoring the growth and development of children after maternal death, identifying good practices, requirements, and opportunities for future interventions.

This study aims to identify evidence that e-Health contributes to monitoring the growth and development of children after maternal death. The review seeks to answer the following question: "What evidence is there that e-Health contributes to the control of care regarding the growth and development of children, after maternal death?"

## Method

The Scoping Review protocol adopted the guidelines proposed by the Joanna Briggs Institute (JBI). The following stages were observed: (1) identification of the research question; (2) identification of relevant studies; (3) selection of studies; (4) data extraction; (5) interpretation, synthesis, and dissemination of results. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) checklist<sup>(6)</sup> was used to guide and report the essential items of this review. In addition, the protocol for this scoping review was registered in the Open Science Framework (OSF) (<https://osf.io/etzah/>).

The research question was defined using the strategy: Population, Context, Concept (PCC), where P: Children under one year old, with loss of mother, due to maternal death; C: e-Health monitoring; C: Environments where health care occurs. The following research question was used for this review: "What is the evidence that e-Health contributes to the control of care regarding the growth and development of children after maternal death?", which guided the search and selection in the PubMed/MEDLINE, LILACS/BDENF, CINAHL, BDENF, SCIELO, INDEX, Embase, Web of Science, Scopus, Cochrane and IEE databases in November 2024.

The search strategy combined descriptors and keywords related to the terms "e-Health; child development and nursing care", which were interconnected by the Boolean operators AND and OR. Search strategies adapted to each database were developed according to Box 1.

**Box1 - Strategy for searching studies. Florianópolis, SC, Brazil, 2023.**

| Platforms and Database | Search keys                                                                                                                                                                                                                                                                                                                                    |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Pubmed/MEDLINE         | ("Telemedicine"[Mesh] OR "Telemedicine" OR "Mobile Health" OR "mHealth" OR "Telehealth" OR "eHealth" OR "Mobile Applications"[Mesh] OR "Mobile Applications" OR "Mobile Application" OR "App" OR "Apps" OR "Smartphone"[Mesh] OR "Smartphone" OR "Smartphones") AND ("Child Development"[Mesh] OR "Child Development" OR "Infant Development") |
| Embase (Elsevier)      | ("Telemedicine" OR "Mobile Health" OR "mHealth" OR "Telehealth" OR "eHealth" OR "Mobile Applications" OR "Mobile Application" OR "App" OR "Apps" OR "Smartphone" OR "Smartphones") AND ("Child Development" OR "Infant Development")                                                                                                           |
| CINAHL (EBSCO)         | ("Telemedicine" OR "Mobile Health" OR "mHealth" OR "Telehealth" OR "eHealth" OR "Mobile Applications" OR "Mobile Application" OR "App" OR "Apps" OR "Smartphone" OR "Smartphones") AND ("Child Development" OR "Infant Development")                                                                                                           |
| Cochrane Library       | ("Telemedicine" OR "Mobile Health" OR "mHealth" OR "Telehealth" OR "eHealth" OR "Mobile Applications" OR "Mobile Application" OR "App" OR "Apps" OR "Smartphone" OR "Smartphones") AND ("Child Development" OR "Infant Development")                                                                                                           |
| Scopus (Elsevier)      | ("Telemedicine" OR "Mobile Health" OR "mHealth" OR "Telehealth" OR "eHealth" OR "Mobile Applications" OR "Mobile Application" OR "App" OR "Apps" OR "Smartphone" OR "Smartphones") AND ("Child Development" OR "Infant Development")                                                                                                           |
| Web of Science         | ("Telemedicine" OR "Mobile Health" OR "mHealth" OR "Telehealth" OR "eHealth" OR "Mobile Applications" OR "Mobile Application" OR "App" OR "Apps" OR "Smartphone" OR "Smartphones") AND ("Child Development" OR "Infant Development")                                                                                                           |

|              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LILACS/BDENF | ("Telemedicine" OR "Mobile Health" OR "mHealth" OR "Telehealth" OR "eHealth" OR "Mobile Applications" OR "Mobile Application" OR "App" OR "Apps" OR "Smartphone" OR "Smartphones" OR "Telemedicina" OR "Ciber Saúde" OR "Ciber-Saúde" OR "Cibersaúde" OR "Saúde Conectada" OR "Saúde Digital" OR "Saúde Eletrônica" OR "Saúde Móvel" OR "Tele-Serviços em Saúde" OR "Teleassistência" OR "Telecuidado" OR "Telessaúde" OR "e-Saúde" OR "eSaúde" OR "mSaúde" OR "uSaúde" OR "Aplicativos Móveis" OR "Ciber Salud" OR "Ciber-Salud" OR "Cibersalud" OR "Salud Conectada" OR "Salud Digital" OR "Salud Electrónica" OR "Salud Mueble" OR "Salud Móvil" OR "Teleasistencia" OR "Telesalud" OR "eSalud" OR "mSalud" OR "uSalud" OR "Aplicaciones Móviles") AND ("Child Development" OR "Infant Development" OR "Desenvolvimento Infantil" OR "Desenvolvimento Pré-Escolar" OR "Desenvolvimento da Criança" OR "Desenvolvimento das Crianças" OR "Desenvolvimento de Criança" OR "Desenvolvimento de Crianças" OR "Desenvolvimento de Lactentes" OR "Desenvolvimento de Pré-Escolares" OR "Desenvolvimento do Lactente" OR "Desenvolvimento do Pré-Escolar" OR "Desenvolvimento dos Lactentes" OR "Desenvolvimento dos Pré-Escolares" OR "Desarrollo Infantil" OR "desarrollo de lactantes" OR "desarrollo de los lactantes" OR "desarrollo de los niños" OR "desarrollo de los pré-escolares" OR "desarrollo de preescolares" OR "desarrollo del lactante" OR "desarrollo del niño en edad preescolar" OR "desarrollo del preescolar" OR "desarrollo infantil" OR "desarrollo preescolar") |
| SciELO       | ("Telemedicine" OR "Mobile Health" OR "mHealth" OR "Telehealth" OR "eHealth" OR "Mobile Applications" OR "Mobile Application" OR "App" OR "Apps" OR "Smartphone" OR "Smartphones" OR "Telemedicina" OR "Ciber Saúde" OR "Ciber-Saúde" OR "Cibersaúde" OR "Saúde Conectada" OR "Saúde Digital" OR "Saúde Eletrônica" OR "Saúde Móvel" OR "Tele-Serviços em Saúde" OR "Teleassistência" OR "Telecuidado" OR "Telessaúde" OR "e-Saúde" OR "eSaúde" OR "mSaúde" OR "uSaúde" OR "Aplicativos Móveis" OR "Ciber Salud" OR "Ciber-Salud" OR "Cibersalud" OR "Salud Conectada" OR "Salud Digital" OR "Salud Electrónica" OR "Salud Mueble" OR "Salud Móvil" OR "Teleasistencia" OR "Telesalud" OR "eSalud" OR "mSalud" OR "uSalud" OR "Aplicaciones Móviles") AND ("Child Development" OR "Infant Development" OR "Desenvolvimento Infantil" OR "Desenvolvimento Pré-Escolar" OR "Desenvolvimento da Criança" OR "Desenvolvimento das Crianças" OR "Desenvolvimento de Criança" OR "Desenvolvimento de Crianças" OR "Desenvolvimento de Lactentes" OR "Desenvolvimento de Pré-Escolares" OR "Desenvolvimento do Lactente" OR "Desenvolvimento do Pré-Escolar" OR "Desenvolvimento dos Lactentes" OR "Desenvolvimento dos Pré-Escolares" OR "Desarrollo Infantil" OR "desarrollo de lactantes" OR "desarrollo de los lactantes" OR "desarrollo de los niños" OR "desarrollo de los pré-escolares" OR "desarrollo de preescolares" OR "desarrollo del lactante" OR "desarrollo del niño en edad preescolar" OR "desarrollo del preescolar" OR "desarrollo infantil" OR "desarrollo preescolar") |
| IEEE         | ("Telemedicine" OR "Mobile Health" OR "mHealth" OR "Telehealth" OR "eHealth" OR "Mobile Applications" OR "Mobile Application" OR "App" OR "Apps" OR "Smartphone" OR "Smartphones") AND ("Child Development" OR "Infant Development")                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| INDEX        | ("Telemedicine" OR "Mobile Health" OR "mHealth" OR "Telehealth" OR "eHealth" OR "Mobile Applications" OR "Mobile Application" OR "App" OR "Apps" OR "Smartphone" OR "Smartphones") AND ("Child Development" OR "Infant Development")                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

**Source:** Prepared by the authors, 2023.

Inclusion and exclusion criteria were established for the selection of studies. Studies available in full, published in national and international journals, with different quantitative research designs, with the main theme of e-Health for monitoring children under one year of age who have lost their mother due to maternal death, published between 2000 and 2022, in English, Spanish or Portuguese, were included. Literature review articles had their references analyzed for the possibility of including new studies that were not extracted with the search strategy adopted, that is, reverse or cross-search.

In addition, books or book chapters, theses or dissertations, editorials and review articles, and studies that also included a

population other than children under one year of age who have lost their mother due to maternal death were excluded.

The full texts were then carefully read by two independent reviewers, who extracted the data using an instrument designed by the researchers with the following data: article title, year of publication, methodology, and country, listing all texts that were relevant to the research question of the review. Whenever necessary, the selected materials were revisited to obtain a better understanding of the data or to resolve disagreements between the reviewers. The selected studies were organized and classified by categories arising from the subthemes that emerged from the search, as well as the evidence they presented. The discussion of the results is presented in narrative form<sup>(7)</sup>.

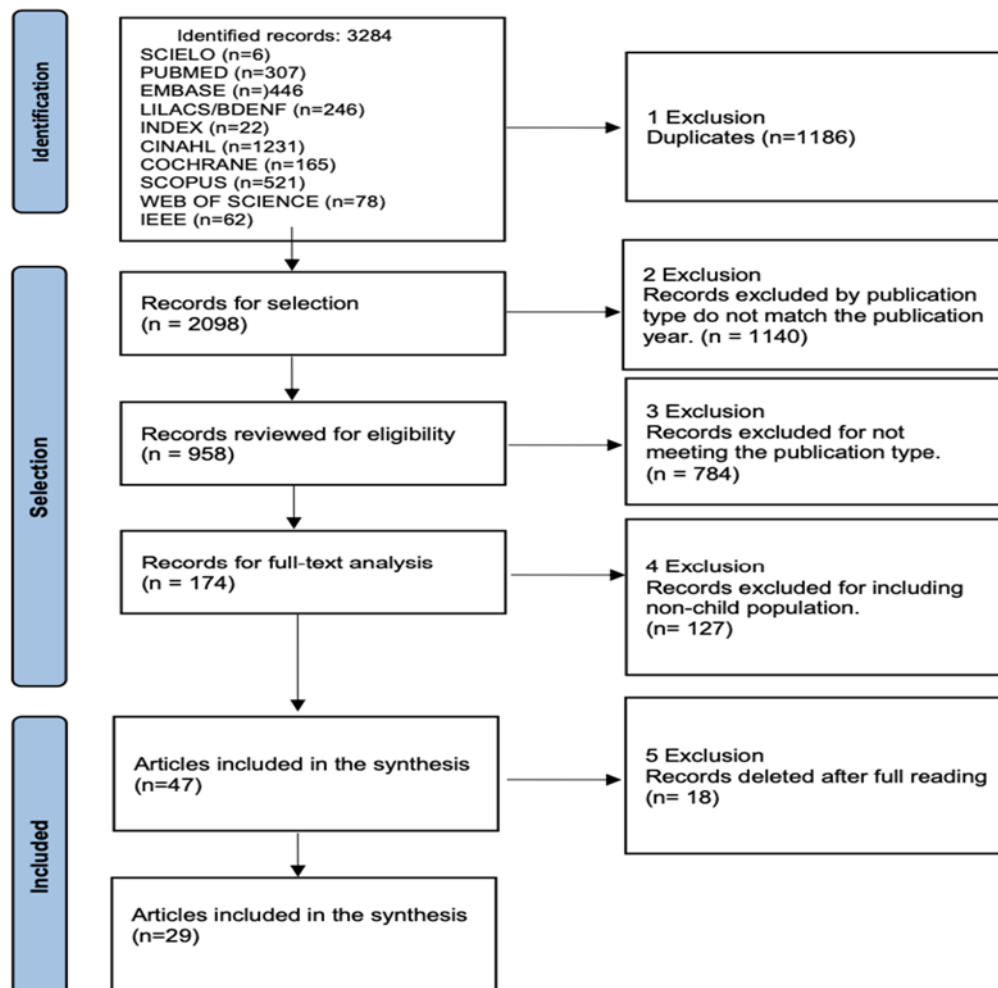
## Results

The initial search resulted in 3,284 studies in the databases, of which 1,186 were excluded due to duplication. After applying the exclusion and inclusion criteria and additional reading of titles and abstracts, 2,051 more studies were excluded, leaving 47 for full reading. Of these, 18 studies did not meet the

eligibility criteria according to the study population criteria. Thus, 29 articles were selected for full reading and additional analysis.

Initially, the PRISMA-ScR (PRISMA extension for Scoping Reviews) flowchart was used to present the selection of studies, as illustrated in Figure 1.

Figure 1. PRISMA study selection flowchart.



Source: The authors (2025).

Data extraction was guided by a Microsoft Excel table, predefined with the following data: author/year of publication, location, approach and type of research, objective of the

article, study population/sample size, instruments used and results. The data were presented in box and tables, accompanied by a narrative synthesis as shown in Box 2, presented in supplementary material.

**Box 2.** E-Health for monitoring and promoting child development, according to title, year of publication, method and country. Florianópolis, SC, Brazil. 2025.

| NUMBER | TITLE/YEAR                                                                                                                                                  | METHOD                            | COUNTRY         |
|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|-----------------|
| 1      | Applicability of the Guide for Monitoring Child Development as a Telehealth Delivered Intervention During the Pandemic. 2022.                               | Longitudinal mixed methods design | Türkiye         |
| 2      | Parenting app to support socio-emotional and cognitive development in early childhood: iterative co-design learnings from nine low-income and middle-income | Descriptive study                 | Asia and Africa |

|    |                                                                                                                                                                                                                                                                                                        |                                      |                 |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|-----------------|
|    | countries. 2023.                                                                                                                                                                                                                                                                                       |                                      |                 |
| 3  | Implications of Early Diagnosis and Intervention in the Management of Neurodevelopmental Delay (NDD) in Children: A Systematic Review and Meta-Analysis. 2023                                                                                                                                          | Systematic meta-analysis.            | Saudi Arabia    |
| 4  | Mobile applications as a strategy to support parents in the care of newborns: a scoping review.2023.                                                                                                                                                                                                   | Scoping review                       | Brazil          |
| 5  | Effects of a Mobile-Based Intervention for Parents of Children With Crying, Sleeping, and Feeding Problems: Randomized Controlled Trial. 2023.                                                                                                                                                         | Randomized controlled trial          | Germany         |
| 6  | Assessing parents' awareness about children's "first thousand days of life": a descriptive and analytical study. 2021.                                                                                                                                                                                 | Descriptive analytical study         | Iran            |
| 7  | Telehealth Treatment of Behavior Problems in Young Children With Developmental Delay: A Randomized Clinical Trial. 2023.                                                                                                                                                                               | Randomized controlled trial          | USA             |
| 8  | Improving infant outcomes through implementation of a family integrated care bundle including a parent supporting mobile application. 2020.                                                                                                                                                            | Cohort                               | England         |
| 9  | Family member and service provider experiences and perspectives of a digital surveillance and service navigation approach in multicultural context: a qualitative study in identifying the barriers and enablers to Watch Me Grow-Electronic (WMG-E) program with a culturally diverse community. 2024 | Randomized controlled clinical trial | Australia       |
| 10 | Parents' use of mobile computing devices, caregiving and the social and emotional development of children: a systematic review of the evidence. 2019.                                                                                                                                                  | Systematic review                    | Australia       |
| 11 | The relationship between users' technology approaches and experiences in a child development mobile application. 2020.                                                                                                                                                                                 | Transversal                          | Israel          |
| 12 | The feasibility of a crowd-based early developmental milestone tracking application. 2022.                                                                                                                                                                                                             | Transversal                          | Israel          |
| 13 | Early childhood tracking application: Correspondence between crowd-based developmental percentiles and clinical tools. 2023.                                                                                                                                                                           | Transversal                          | Israel          |
| 14 | Use of a Group Text Messaging Application to Teach Developmental Milestones on a Pediatric Clerkship. 2020.                                                                                                                                                                                            | Quasi-experimental                   | USA             |
| 15 | The TREEHOUSE Program: Promoting Early Childhood Development and Parent--Child Interaction via Telehealth in Pediatrics. 2022.                                                                                                                                                                         | Quasi-experimental                   | USA             |
| 16 | Designing an App for Parents and Caregivers to Promote Cognitive and Socio-emotional Development and Well-being Among Children Aged 0 to 5 Years in Diverse Cultural Settings: Scientific Framework. 2023.                                                                                             | Applied research                     | Australia       |
| 17 | Process and effect evaluation of the app-based parenting program Samen Happie! on infant zBMI: A randomized controlled trial. 2022.                                                                                                                                                                    | Randomized controlled trial          | The Netherlands |
| 18 | Caregivers' Perceptions of Telehealth for Child Developmental Screening in the Community. 2023.                                                                                                                                                                                                        | Mixed method                         | Ireland         |
| 19 | Telemonitoring of motor skills using the Alberta Infant                                                                                                                                                                                                                                                | Transversal                          | Brazil          |



|    |                                                                                                                                                                          |                                                                           |            |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|------------|
|    | Motor Scale for at-risk infants in the first year of life. 2024.                                                                                                         |                                                                           |            |
| 20 | Randomized controlled trial on effectiveness of mHealth (mobile/smartphone) based Preterm Home Care Program on developmental outcomes of preterms: Study protocol. 2019. | Prospective randomized controlled clinical trial protocol.                | India      |
| 21 | App-based support for parental self-efficacy in the first 1,000 days: a randomized control trial. 2022.                                                                  | Randomized controlled trial                                               | England    |
| 22 | Use of mobile application for intelligent screening of child growth and development with vaccination support. 2020.                                                      | Applied research                                                          | Nepal      |
| 23 | A technology-enabled adaptation of face-to-face caregiver-mediated JASPER intervention: Preliminary examination of video conferenced caregiver coaching. 2021.           | Single-case trial with simultaneous multiple-baseline experimental design | USA        |
| 24 | Evaluating the Effects of the Supportive Parenting App on Infant Developmental Outcomes: Longitudinal Study. 2023                                                        | Prospective longitudinal project                                          | Asia       |
| 25 | Development of a Supportive Parenting App to Improve Parent and Infant Outcomes in the Perinatal Period: Development Study. 2021.                                        | Technological development method guided by theoretical frameworks         | Asia       |
| 26 | Effectiveness of a Technology-Based Supportive Educational Parenting Program on Parental Outcomes (Part 1): Randomized Controlled Trial. 2019.                           | Randomized trial                                                          | Asia       |
| 27 | The BEM Program: An innovative online parenting program for socioeconomically disadvantaged caregiver-child dyads in Brazil. 2023.                                       | Model for Intervention Description and Replication                        | Costa Rica |
| 28 | Innovation of m-health-based PROSA-HI APPLICATION for early detection of child growth and development. 2023.                                                             | Sequential mixed approach                                                 | Indonesia  |
| 29 | Early detection of developmental delays in vulnerable children by community care workers using an mHealth tool. 2019.                                                    | Transversal                                                               | Africa     |

**Source:** Prepared by the authors, 2025.

The studies included in this review address technological interventions and innovative strategies for monitoring and promoting child development, with an emphasis on telemedicine, mobile applications, and multicultural approaches. The synthesis of the main results and characteristics presents trends, problems, and practical implications, as detailed below.

With regard to Telemedicine and Telehealth, studies such as 1 (Türkiye)<sup>(8)</sup>, 7 (USA)<sup>(9)</sup>, and 20 (Brazil)<sup>(10)</sup> highlighted the feasibility of remote interventions, such as the use of home videos for motor assessment (AIMS) and parenting programs via digital platforms. The high satisfaction of caregivers (80.7% in study 1) and technical reliability (study 20:  $r = 0.980$ )<sup>(10)</sup> reinforce the potential of these technologies, especially in contexts of geographic or pandemic restrictions.

The telehealth parenting intervention (study 7)<sup>(9)</sup> showed a significant reduction in child behavioral problems (Cohen  $d = 0.48-0.50$ ), suggesting comparable efficacy to face-to-face approaches. Mobile applications and co-design, such as Thrive by Five (study 2<sup>(11)</sup> and 17<sup>(12)</sup>) and Samen Happie! (study 18)<sup>(13)</sup> were developed with co-design involving end

users, adapting to diverse cultural contexts. Themes such as inclusion of local values, parental mental well-being and educational practices emerged as priorities. Mixed results were observed: while Thrive by Five promoted parental engagement, Samen Happie! had low sustained adherence, indicating the need for personalization and ongoing support.

In view of the need for early diagnosis of changes in growth and development, the meta-analysis of study 3<sup>(14)</sup> showed that models such as Early Start Denver and LEAP improve social and cognitive skills in children with neurodevelopmental delays (NDD). The integration of machine learning algorithms was highlighted as promising for personalizing interventions.

Nevertheless, studies such as 6 (Iran)<sup>(15)</sup> and 19 (Australia)<sup>(16)</sup> revealed gaps in parental knowledge about child development (only 17% in Iran knew about the “first 1,000 days”). The preference for mobile apps (47% in study 6)<sup>(15)</sup> suggests that digital tools can be effective strategies for parenting education.

Thus, regarding clinical effectiveness, telemedicine and app-based interventions demonstrated significant improvements in: reducing parental stress (study 5:  $d = 0.24-0.27$ )<sup>(17)</sup>; accelerating motor and language milestones (study 13:

correlation with ASQ-3 and MSEL)<sup>(18)</sup>; shortening hospital stay in premature infants (study 8: 41 vs. 55 days)<sup>(19)</sup>.

Regarding cultural acceptance, co-design in low- and middle-income countries (study 2)<sup>(11)</sup> allowed the removal of culturally inappropriate content, highlighting the importance of localization. This was also evidenced regarding technological limitations, when barriers such as low adherence to applications (study 18)<sup>(13)</sup> and dependence on users' digital skills (study 11)<sup>(20)</sup> were demonstrated as recurring situations.

It can be seen that the practical implications of this scoping review permeate public policy, clinical practice and parental engagement. Digital interventions, such as *NeoRaksha* for premature infants (study 21)<sup>(21)</sup>, can reduce public health costs, especially in regions with limited access to specialized services. The combination of telemonitoring, with home videos and traditional clinical assessments such as AIMS, offers a hybrid model for early screening. In addition, strategies such as discussion forums in applications (study 5)<sup>(17)</sup> and personalized feedback (study 11)<sup>(20)</sup> increase adherence and effectiveness of interventions.

## Discussion

This scoping review analyzed 29 studies to assess the role of e-Health technologies in supporting child development following maternal death. The findings highlight the potential of tools such as telemedicine and mobile applications to reduce care gaps for vulnerable populations. Remote interventions, such as video-based child development assessments<sup>(8)</sup> and telehealth parenting support programs<sup>(9)</sup>, demonstrated similar effectiveness to in-person approaches, with caregiver satisfaction rates exceeding 80% and a significant reduction in behavioral problems.

However, a critical gap was identified, as no study specifically addressed children who lost their mothers to maternal mortality — a group at high risk of developmental delays due to early breastfeeding disruption, emotional instability of substitute caregivers, and systemic vulnerabilities. This omission reflects a global trend of neglect toward vulnerable populations, as noted in WHO reports<sup>(1)</sup>.

The methodological quality of the studies varied considerably. Randomized controlled trials (RCTs)<sup>(9)</sup> and cohort studies<sup>(19)</sup> stood out for their methodological rigor and low risk of bias. Conversely, cross-sectional studies<sup>(20)</sup>, while relevant for exploring user perceptions, did not allow for causal analyses due to the lack of longitudinal follow-up. The heterogeneity of methodological designs — ranging from quasi-experimental approaches to mixed methods — enriched contextual understanding but hindered direct comparisons. For example, the Thrive by Five app<sup>(11)</sup>, developed in collaboration with nine low- and middle-income countries, prioritized cultural adaptations but faced challenges in sustained adherence<sup>(12)</sup>, reinforcing the need for hybrid models that integrate technology and in-person support<sup>(16)</sup>.

The findings corroborate international evidence on the effectiveness of telehealth in child development<sup>(3)</sup> but differ

from previous reviews that did not address the psychosocial complexities faced by maternal orphans. While UNICEF<sup>(2)</sup> highlighted the importance of digital equity, little progress has been made in discussing the impacts of maternal grief on this population. From a clinical standpoint, telemedicine interventions reduced hospital stays for premature infants by 25% (41 vs. 55 days)<sup>(19)</sup> and decreased parental stress levels ( $d = 0.24\text{--}0.27$ )<sup>(17)</sup>, indicating potential cost optimization in public health systems like Brazil's SUS. However, the sustainability of these initiatives depends on investments in digital infrastructure and professional training, especially in regions with high maternal mortality rates<sup>(4)</sup>.

Among the strengths of this review are adherence to PRISMA-ScR guidelines and a comprehensive search across 11 databases, minimizing selection bias. Limitations include the exclusion of studies published in languages other than English, Spanish, and Portuguese, potentially restricting the representation of local contexts, while the predominance of data from high-income countries limits generalization to low- and middle-income nations. Additionally, the focus on general populations — rather than maternal orphans — reduced the ability to generate specific recommendations for this group.

In clinical practice, it is urgent to prioritize e-Health technologies tailored to maternal orphans, incorporating grief support for caregivers and culturally sensitive developmental milestones. For health managers, investment in hybrid care models is recommended, combining telemonitoring with in-person visits in regions with limited access to specialized services. In research, longitudinal studies are needed to evaluate long-term outcomes, along with standardization of effectiveness metrics (e.g., adherence rates, cultural sensitivity). Globally, fostering cross-sector collaborations to develop inclusive technologies, as emphasized by WHO<sup>(1)</sup>, is crucial.

A study conducted in the Western Amazon<sup>(22)</sup> found that 65% of children were not exclusively breastfed, but 55% were still breastfeeding, highlighting the importance of ongoing breastfeeding support even in vulnerable contexts. Furthermore, 90% of health booklets had updated anthropometric records, suggesting that physical documentation, when properly utilized, can be a valuable tool. However, the absence of specific psychomotor development records in these booklets reinforces the need for e-Health systems that integrate both qualitative and quantitative data.

In this regard, a systematic review on the use of Brazil's child health booklet<sup>(23)</sup> indicated that only 20% of records included developmental milestones, with an excessive emphasis on anthropometric data. This underuse reflects a lack of professional awareness regarding comprehensive child health surveillance, reinforcing the urgency for digital technologies that automate records and provide alerts for early interventions. The integration of e-Health could help bridge these gaps, where telemonitoring of motor skills in at-risk infants improved assessment accuracy<sup>(16)</sup>.

This scoping review investigated how e-Health technologies can contribute to child development. Evidence shows that

tools like telemedicine and mobile applications have the potential to promote effective care, especially in remote contexts. However, the absence of studies specifically targeting children facing maternal loss due to mortality reveals a significant scientific gap. Thus, there is an urgent need for public policies that integrate technological solutions with psychosocial support, with a special focus on vulnerable populations.

Advancing in this field requires strengthening hybrid care models, improving digital infrastructure, and conducting longitudinal research with standardized indicators. Cooperation among government, academic institutions, and communities is essential for developing adaptable approaches. Although technology cannot replace human connection, the findings of this review point to its complementary role in reducing inequalities and supporting child development, even in the context of maternal grief.

## Conclusion

Digital and telemediated interventions are viable alternatives for promoting child development, with positive results in a variety of contexts. However, their effectiveness depends on cultural adaptation, ongoing user engagement, and integration with existing health systems.

The lack of specific evidence on the use of e-Health in monitoring children up to one year of age who have lost their mothers reinforces the need to develop digital technologies aimed at this population. The complexity of these children's needs — which include increased risks of interrupting breastfeeding, vulnerability to delays in psychomotor development, and greater exposure to emotional instability in substitute caregivers — demands specialized and integrated interventions.

A personalized e-Health system could offer continuous monitoring of growth milestones, guidance adapted to post-bereavement family dynamics, early warning signs in development, and psychosocial support for caregivers, mitigating critical gaps left by maternal death. Furthermore, the lack of studies in this area reflects not only an academic omission, but also a systemic failure to recognize the particularities of these children, making the development of a digital platform an ethical and innovative response to ensure equity in child care in contexts of extreme vulnerability.

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