REVIEW ARTICLE

Assessing the Public-Health Impact and Scalability of Mhealth Interventions for Early Childhood Development: A Systematic Review Protocol

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Abstract

Background Enhancing children's development is essential for both individual well-being and societal progress. From a public health perspective, Mobile Health (mHealth) interventions offer scalable and accessible approaches that can support child development and strengthen health system delivery. Despite the growing adoption of mHealth tools, a comprehensive synthesis of their specific impact on developmental indicator in early childhood remains limited. This protocol presents the methodology for a systematic review assessing the effectiveness of mHealth interventions on developmental indicators in children under five years of age.

Methods A systematic review will be conducted using PubMed, Scopus, and Web of Science to identify English-language articles published from January 2000 to December 2024. The search strategy will employ Medical Subject Headings (MeSH) and relevant keywords. Study selection will follow the Participants, Interventions, Comparators, and Outcomes (PICO) framework. Two independent reviewers will perform study selection, data extraction, quality assessment, and risk of bias evaluation. Eligible studies will include those investigating mHealth interventions for children under five years old. Data will be synthesized narratively. The primary outcome will be the impact of mHealth interventions on children's developmental indicators, including cognitive, motor, language, and socio-emotional domains. Secondary outcomes will include: (i) the influence of mHealth on parental knowledge, attitudes, and practices; and (ii) a comparison of mHealth interventions with alternative developmental approaches.

Conclusion This review will provide evidence on the effectiveness of mHealth interventions in early childhood development and their potential influence on parents. It will also address the comparative benefits and limitations of mHealth strategies relative to other developmental methods. The protocol has been registered with PROSPERO and follows the PRISMA-P guidelines.

Keywords Child development, Early childhood intervention, mHealth, Systematic review

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1 Introduction

The promotion of early childhood development (ECD) is crucial for both the economic[1] and social[2] advancement of a nation, making it an important target for sustainable development objectives by 2030.[3] However, a significant portion of children, upwards of 43%, fail to achieve optimal growth during their early years.[4] This can be attributed to factors like poverty and unfavorable social conditions that have a detrimental impact on children's developmental progress.[5–7] In this regard, the home environment plays a significant role in shaping children's development by providing them with learning opportunities facilitated by parents.[8] Simple activities such as reading stories, having books,[9] and playing [9–11] can have positive effects on children's early development, thanks to their parents.[12] Nonetheless, research has shown that there is a lack of participation and family support when it comes to promoting the early development of children.[13,14]

Recent care approaches focus on the role of patients, their empowerment, and self-care.[15–19] Mobile health (mHealth) is currently being used to enhance collaboration,[20] improve communication, and optimize care processes between healthcare providers and patients.[21,22] mHealth interventions refer to the use of mobile and wireless technologies, such as smartphone applications, text-messaging (SMS), voice calls or wearables, to support healthcare delivery, health promotion, disease management and public health objectives.[23,24] Research has shown that mHealth interventions have a positive impact on certain aspects of children's development, such as cognitive and physical growth,[10,12,25] overcoming geographical barriers, addressing the shortage of specialized staff, and facilitating cognitive assessments.[26] However, findings remain inconsistent, with one study reporting no significant impact.[27] Given the significance of children's development and the increasing adoption of mHealth, it is crucial to conduct a systematic review of relevant studies in this field.

A comprehensive systematic review of 102 trials found that parenting interventions had significant positive effects on early childhood development (ECD) and notably greater cognitive gains in low- and middle-income countries (LMICs) compared to high-income countries (HICs).[28] Another review confirmed the effectiveness of parenting interventions, but none of the included studies addressed the use of mHealth and the scope of the studies was limited to children under two years of age.[29] This gap is significant given the growing body of studies on ECD [30] and the expanding role of mHealth in this area.[31]

Therefore, a critical gap exists in the synthesis of evidence specifically for mHealth-delivered parenting interventions for ECD. To address this, we present the protocol for a systematic review that will: (a) synthesize the efficiency of mHealth interventions on core domains of ECD (cognitive, motor, language and socio-emotional); (b) compare intervention effects between HIC and LMIC settings through structured grouping of studies; and (c) identify intervention characteristics associated with greater effectiveness by exploring sources of heterogeneity across studies. This review will provide timely evidence to guide the equitable scale-up of mHealth interventions as part of national public-health strategies for ECD.

2 Methods

Design

The review protocol will be developed using the Preferred Reporting Items PRISMA-P checklist[32] and registered with the International Prospective Register of Systematic Reviews (PROSPERO) in June 2022 (registration number: CRD42022339264). The review will be conducted and reported in compliance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines.[33] The timeline for conducting this study is shown in Table 1. Although the search was initially scheduled to conclude in May 2024 according the original protocol (Table 1), it will be updated to include studies published up to December 2024 to ensure comprehensiveness.

Search strategy

A comprehensive systematic search will be conducted across the electronic databases PubMed, Scopus, and Web of Science to identify full-text English-language journal articles and conference proceedings published between January 1, 2000, and December 31, 2024. While the original protocol scheduled the search to conclude in May 2024, the search period has been extended to December 2024 in this updated protocol to ensure comprehensiveness. The search strategy will incorporate a combination of Medical Subject Headings (MeSH) and relevant keywords tailored to the titles and abstracts within each database. Detailed search strategies are provided in Supplementary File 1. When necessary, corresponding authors will be contacted to obtain additional information, such as missing outcome data. Reference lists of all included studies will also be manually screened to identify further eligible publications. Moreover, consultation with health professionals will be undertaken to capture pertinent gray literature that may not have been retrieved through the database searches.

Table 1 Project Timeline

Task Name	2023								2024		
	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.*
Search											
Pilot search											
Search strategy development											
Database searching											
Data Collection & Management											
Screening											
Full-text assessment											
Data extraction											
Data Analysis											
Data synthesis											
Reporting											

* Note: Search updated to December 2024

Selection of studies

This review will focus on mHealth interventions for ECD. The eligibility criteria for included studies in the study will be developed using the participants, interventions, comparators, and outcomes (PICO) framework, which defines the study participants, interventions, comparators, outcomes of interest, and type of study (Table 2). These criteria will be selected to ensure that the review captures studies directly assessing the impact of mHealth technologies on early childhood developmental outcomes, while maintaining methodological consistency across included studies. This approach will allow for a focused synthesis of evidence relevant to the research question.

Exclusion criteria

Studies that do not meet any of the inclusion criteria will also be excluded (Table 2). The other exclusion criteria will be as follows:

- Non-English studies
- Review articles, opinion papers, editorials, letters to editor, and commentaries
- Abstracts presented in a congress

Table 2 Eligibility criteria for study inclusion

P : Participants		**Children under 5 years old and their parents**
I : Interventions		Smartphone / Tablet Applications
		Web-Based Platforms
		Basic Communications Services (e.g., SMS, voice calls)
		Social Media Platforms and Messaging Apps (e.g., WhatsApp, Telegram)
C : Comparators		Mobile-based applications intervention versus usual care
O : Outcomes	**Child Outcomes**	Gross motor
		Fine motor
		Communication
		Cognition
		Language
		Social emotional
	Parenting Outcomes	Knowledge
		Practices
		Parent-child interactions
		Attitude
T : Type of studies		All RCTs
		Case Control Studies
		Before and After Studies
		Cohort studies

Appraisal of the methodological quality of selected studies

The included studies will undergo rigorous quality assessment by two independent reviewers (Ghanbar Tavassoli and Tahereh Samimi) employing the Mixed Methods Appraisal Tool (MMAT). The MMAT is a standardized checklist designed to evaluate and characterize the methodological quality of empirical research, encompassing primary studies based on experimental, observational, or simulation designs.[34] Originally developed in 2006, the tool was subsequently refined to enhance the efficiency of quality appraisal and risk of bias evaluation, with demonstrated content validity and reliability.[35] For the purposes of this review, the most recent 2018 version of the MMAT will be utilized.

Data management and selection process

The results of the literature search will initially be imported into Microsoft Excel for data management. Following the removal of duplicate records, the refined dataset will be uploaded into Zotero version 5 for screening purposes. Within Zotero, three distinct tags will be established to facilitate the screening process: "Inclusion" for studies meeting eligibility criteria, "Exclusion" for studies deemed ineligible, and "Suspicious" for studies requiring further evaluation. Two independent reviewers (Ghanbar Tavassoli and Tahereh Samimi) will conduct title and abstract screening, assigning the appropriate tags to each record. A supervising reviewer (Bahlol Rahimi) will oversee this process in its entirety. Full-text articles corresponding to studies tagged as "Inclusion" will subsequently be retrieved for detailed assessment. Studies labeled as "Suspicious" will undergo re-evaluation by the same reviewers. In instances of disagreement between reviewers, consensus will be sought through consultation with the third reviewer (Bahlol Rahimi).

Data extraction

Two reviewers (Ghanbar Tavassoli and Tahereh Samimi) will independently extract data from the selected studies (Table 3) into two predefined categories: "Study Description" and "Intervention Description," utilizing a standardized Excel spreadsheet. To ensure data accuracy and consistency, the extracted information will be cross-verified by both reviewers. Any discrepancies identified during this process will be resolved through discussion and, if necessary, consultation with a third reviewer.

Data synthesis

The results of the search strategy will be presented in a PRISMA flowchart.[33] The heterogeneity among the included studies and their distributions will be assessed, followed by the construction of a funnel plot to evaluate potential publication bias. If the studies demonstrate sufficient homogeneity, a meta-analysis will be conducted using a random-effects model, with results visually summarized in a forest plot. In the presence of significant heterogeneity, findings will instead be synthesized narratively. For the narrative synthesis, we will follow a structured approach that includes: (1) grouping studies by key characteristics (e.g., type of intervention, targeted developmental domain, and country income level); (2) summarizing the direction and consistency of results within these groups; and (3) exploring potential reasons for heterogeneous findings across studies, considering variations in intervention design, implementation context, and methodological quality. Additionally, descriptive and pertinent information relevant to the review question will be systematically compiled and presented in a summary table. The main subgroup analysis will be conducted by country income level (based on the World Bank classification). Intervention effects will be examined separately in LMICs and HICs and the results will be presented disaggregated to allow comparison across settings. This approach will enable interpretation of the findings taking into account critical components related to scalability and generalizability across diverse public-health resource contexts.

Table 3 Extracted data from selected studies

Data items	
Study description	**Intervention description**
Authors	Field of development
Year of publication	Tools of development
Aim of study	Target providers (Study participants)
Research method	Range of child age
Study type	
Country	
Main finding	

3 Discussion

This systematic review protocol outlines a comprehensive plan to evaluate the impact of mHealth applications on child development in comparison to standard care. The review focuses on electronic screening tools, clinical guidelines, and parenting interventions targeting children within the first five years of life. The methodological choices, including the selection of databases, inclusion criteria, and outcome measures, will be designed to ensure a transparent and systematic synthesis of the available literature.

Despite its strengths, this review protocol has several limitations. First, methodological limitations will include the restriction to English-language publications, which may introduce language bias and resulted in the exclusion of relevant studies published in other

languages. Expected heterogeneity in study designs and outcome measurement tools may also limit the comparability and synthesis of findings. Additionally, the omission of CINAHL (Cumulative Index to Nursing and Allied Health Literature) and PsycINFO from the database search may reduce the identification of studies with a nursing or psychological focus; however, manual reference screening and expert consultation will be undertaken to minimize this limitation.

Beyond these methodological considerations, several contextual factors may affect the review findings. Differences in technological infrastructure, digital literacy, and access across geographic and socioeconomic contexts are likely to influence both the implementation and effectiveness of mHealth interventions. As such, these factors should be considered when applying the review findings to inform policy decisions in diverse settings.

Declarations

Acknowledgments
Not applicable.

Artificial Intelligence Disclosure
No artificial intelligence (AI) tools were used to generate scientific content, analyze data, or draw conclusions. All interpretations, analyses, and conclusions are those of the authors. AI tools were used solely to assist with language correction and clarity.

Authors' Contributions
This study was conceived and designed by the Ghanbar Tavassoli and Bahlol Rahimi. All authors contributed to the development of the search strategy and selection criteria. Ghanbar Tavassoli and Tahereh Samimi piloted the database search strategy and drafted the first version of this manuscript. The manuscript was reviewed, and all authors approved the final draft. Bahlol Rahimi is the guarantor.

Availability of Data and Materials
The full search strategy has been submitted as an online supplementary file.

Conflict of Interest
The authors declare that they have no competing interests.

Consent for Publication
Not applicable.

Ethical Considerations
Not applicable, as this is a systematic review protocol of published literature with no primary data collection.

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