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Review Article

Mobile application intervention to improve nutritional literacy of mothers with stunting children: A systematic review

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ABSTRACT

Introduction: The lack of maternal nutritional literacy has a high impact on the health of stunted children. This can be overcome by providing information to the mother with the help of a mobile application. The purpose of this review is to identify and systematically analyze mobile application interventions on maternal nutritional literacy, including increasing knowledge, attitudes, and feeding practices in stunted children.

Methods: This systematic review was based on PRISMA, with inclusion criteria including samples of stunted children aged under 5 years, mobile application interventions, and measures of knowledge, attitudes, and practices. Most of the studies in this review utilized randomized controlled trial designs. The literature search was conducted using multiple databases, including Scopus, Web of Science, EBSCO, ProQuest, and PubMed. The search was restricted to full-text articles published between 2018 and 2022.

Results: There are 3 forms and media of mobile application interventions. This systematic review shows that mobile application interventions significantly improve maternal literacy related to increasing knowledge, attitudes, and practices in mothers with stunted children, the duration of mobile applications used in each session is 1 minute to 25 minutes per week. With application content on nutritional principles based on children's age, the introduction of appropriate complementary foods and semi-solid foods according to age, food diversity, and providing special supplementary foods and infant and child feeding training.

Conclusion: The form and media of application video intervention and counseling in mobile application intervention show a positive impact in increasing nutritional literacy in mothers including knowledge, attitudes, and feeding practices for stunted children under 5 years old.

Keywords: mothers with stunted children; mobile application; nutritional literacy

INTRODUCTION

Stunting, characterized by impaired growth and development in children as a result of prolonged malnutrition, represents a significant public health concern impacting millions of children globally (Ali, 2021; Dukhi, 2020; Montenegro et al., 2022). The World Health Organization (WHO) estimates that around 21.3% of children under the age of five are affected by stunting worldwide, with the greatest burden observed in low- and middle-income countries (World Health Organization, 2020). The long-term consequences of stunting include poor cognitive development, increased susceptibility to diseases, and reduced economic productivity in adulthood (Hasan & Muhammad, 2023). Addressing stunting requires multifaceted approaches, one of which is enhancing the nutritional literacy of mothers, who play a pivotal role in the dietary practices and health behaviors of their children (Hasan & Muhammad, 2024).

Nutritional literacy is the capacity to acquire, comprehend, and utilize the essential nutrition information and services necessary for making informed health decisions (Silva et al., 2023; Truman et al., 2020). For mothers, particularly in resource-limited settings, improving nutritional literacy can lead to better feeding practices, which are crucial in preventing and mitigating stunting (Brou et al., 2023; Katenga-Kaunda, 2023; Shenoy et al., 2023). However, traditional methods of delivering nutritional education, such as in-person counseling and printed materials, face several barriers including limited reach, high costs, and varying literacy levels among mothers.

The rapid proliferation of mobile technology presents a unique opportunity to overcome these barriers. Mobile applications (apps) can deliver tailored nutritional information directly to mothers' fingertips, irrespective of their geographical location or socio-economic status (Anurogo et al., 2023; Thapa & Acharya, 2023). These apps can provide interactive content, real-time feedback, and personalized advice, which have been shown to enhance user engagement and retention of information (Amagai et al., 2022). Furthermore, mobile apps can facilitate continuous learning and behavior change through reminders and progress-tracking features. The incorporation of mobile health (mHealth) interventions has shown encouraging

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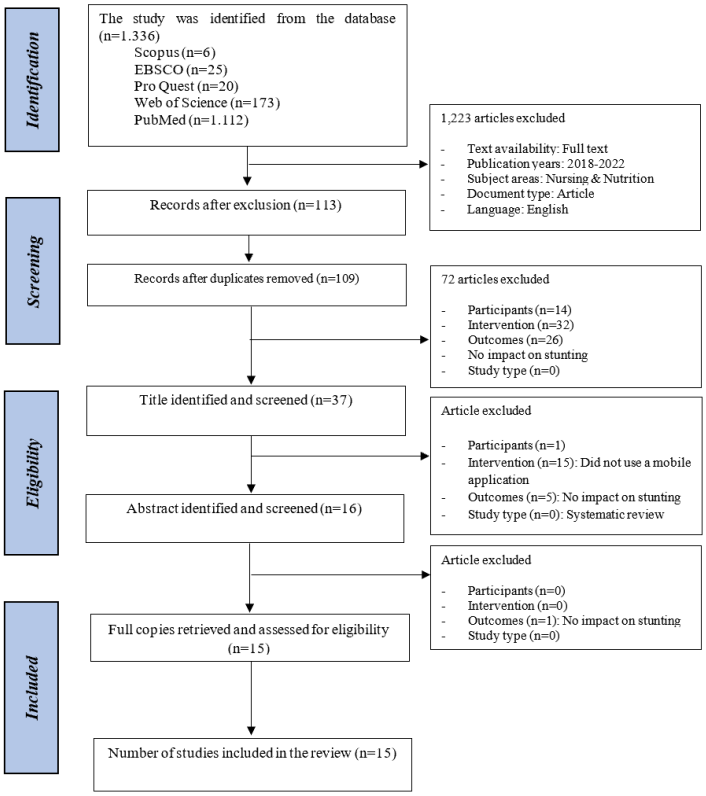

Figure 1. Reporting Options for Systematic Review of Literature Search Flow Diagram

outcomes across different health areas, such as maternal and child health, chronic disease management, and lifestyle changes (Aboye et al., 2023; Zolfaghari et al., 2021). Despite these advancements, however, there remains a significant gap in systematically evaluating the effectiveness of mobile apps specifically designed to improve nutritional literacy among mothers with stunting children. This gap highlights the need for a comprehensive systematic review to synthesize existing evidence, identify best practices, and inform future interventions and policy decisions.

Although the literature on mHealth interventions is expanding, research specifically targeting mobile applications designed to enhance nutritional literacy among mothers of stunted children remains limited. Current studies often suffer from small sample sizes, brief intervention periods, and varied methodologies, which complicates the ability to reach definitive conclusions about their effectiveness. Moreover, there is a lack of standardized metrics for assessing nutritional literacy, further complicating the evaluation of intervention outcomes. Previous reviews on mHealth interventions have primarily focused on broader health outcomes or specific populations, such as pregnant women or individuals with chronic diseases (Davis et al., 2020; Sakamoto et al., 2022). Few have concentrated on the intersection of mobile technology, nutritional literacy, and child stunting. This systematic review aims to fill this gap by providing a comprehensive analysis of the existing evidence on mobile app interventions targeting mothers with stunting children, evaluating their impact on nutritional literacy and related health outcomes.

A systematic literature review is crucial for several reasons. First, it provides a rigorous and transparent method for identifying, evaluating, and synthesizing relevant studies, ensuring that the conclusions drawn are based on comprehensive and unbiased evidence. This is particularly important in the field of mHealth, where rapid technological advancements can lead to a proliferation of studies with varying quality and methodologies. Second, a systematic review can highlight key gaps in the current knowledge base, guiding future research priorities. By identifying the strengths and limitations of existing interventions, researchers and practitioners can design more effective and targeted programs. For instance, understanding which app features (e.g., interactive content, personalized feedback) are most effective in improving nutritional literacy can inform the development of future mHealth tools. Third, this review can provide valuable insights for policymakers and public health practitioners. By synthesizing evidence on the effectiveness of mobile apps in enhancing nutritional literacy among mothers with stunting children, this review can support the integration of such interventions into broader public health strategies. This is particularly relevant in LMICs, where the burden of stunting is highest and traditional healthcare infrastructure is often inadequate.

METHODS

This study employed a literature review methodology. A literature review systematically examined, analyzed, and synthesized existing research and relevant sources to gain insights and provide clarity on a specific topic or issue In this study, the literature review was used to evaluate and summarize existing research on mobile application interventions aimed at improving nutritional literacy among mothers with stunted children. The reference search for this literature review was conducted using five high- and medium-quality databases: Scopus, Web of Science, EBSCO, ProQuest, and PubMed. The review was restricted to publications from the last five years (2018 to 2022) and included only full-text articles available in English. The keywords used for the search were

Tabel 1. PICOS Criteria

Criteria	Inclusion	Exclusion
Population	Mothers with stunted children OR Stunting	Mothers with healthy children, not stunted
Intervention	Mobile application	Besides Mobile Application
Comparison	Non Intervention	
Outcome	Nutrition Literacy	In addition to Nutrition Literacy
Study Design	Randomized control trial and quasi-experimental	Literature review, systematic review, narrative review
Year of Publication	After 2018 - 2022	Before 2018 - 2022
Language	UK and Indonesia	In addition to English and Indonesian

"Mothers with stunted children OR Stunting" AND "Mobile application" AND "nutrition literacy" AND "randomized control trial OR randomized controlled trial." This systematic review followed the guidelines outlined by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).

After identifying relevant articles, the authors analyzed and synthesized them based on established inclusion and exclusion criteria. The inclusion criteria for this systematic review encompassed mothers with children under five years old who are stunted, interventions involving mobile applications, and measures related to knowledge, attitudes, and practices. The article search was conducted in March 2023. The data retrieved were screened to assess the relevance of the articles and to remove duplicates. The selected articles were then analyzed and categorized to extract results, which were subsequently discussed based on insights from the selection process.

During the article selection phase, articles retrieved using predefined keywords were evaluated. The PICOS format was utilized to assess the relevance of the articles. The PICOS criteria applied are detailed in Table 1.

RESULTS

The initial literature search yielded a substantial number of articles, totaling 1,336 (6 from Scopus, 173 from WoS, 25 from Ebsco, 20 from ProQuest, and 1,112 from PubMed). After a rigorous screening and eligibility process, which included reviewing abstracts for relevance and alignment with inclusion criteria, one article was excluded from the full-text review of the 16 articles obtained due to its lack of relevance to the non-intervention group for children aged 0-59 months and mothers with children aged 0-59 months. Consequently, 15 articles were selected for review, as depicted in Figure 1.

Fifteen articles meeting the inclusion criteria indicate that mobile application interventions significantly enhance mothers' nutritional literacy, improving their knowledge, attitudes, and practices regarding child stunting. The duration of mobile application usage ranged from 1 to 25 minutes per session each week. The studies were conducted across various continents, with 10 studies in Asia and five in Africa. In Asia, the studies took place in India, Indonesia, and Bangladesh, while in Africa they were conducted in Benin, Ethiopia, and South Africa.

The analysis of these 15 international articles reveals that health education through mobile applications, including educational classes, TV advertisements, health counseling, and online videos, positively influences mothers' nutritional literacy concerning stunted and malnourished children, as well as pregnant women. Some of the videos used include animated videos (Hall et al., 2018), two TV advertisements (Mbogori et al., 2015;Meshram et al., 2019), and two videos on the WhatsApp platform (Syed-Abdul et al., 2020; Vorrink et al., 2016). Additionally, 10 other educational videos were provided through various means besides animation, TV advertisements, and WhatsApp (Al-Silwadi et al., 2015; Bodjrenou et al., 2020;Carmichael et al., 2019; Daum et al., 2018; Debong et al., 2019; Dorsey et al., 2018; Hanna et al., 2018; Hati & Pratiwi, 2019; Hull et al., 2017).

The findings from these 15 international articles on mobile applications' role in improving mothers' nutritional literacy illustrate the diverse methods employed, such as videos and advertisements. The video durations varied depending on the medium used. TV advertisement videos were shorter, approximately one minute or 60 seconds (Hati & Pratiwi, 2019;Hull et al., 2017), compared to videos shown in classes or other settings, which lasted around five minutes (Al-Silwadi et al., 2015; Bodjrenou et al., 2020; Carmichael et al., 2019; Daum et al., 2018; Debong et al., 2019).

Health education through mobile applications has positively impacted mothers' nutritional literacy regarding child nutrition. All audiovisual videos enhanced mothers' knowledge. The improvements include increased knowledge and awareness about supplementary feeding (Vorrink et al., 2016), better practices in child feeding (Debong et al., 2019;Dorsey et al., 2018;Hanna et al., 2018), understanding the importance of fruits, vegetables, and animal protein for nutrition (Al-Silwadi et al., 2015), and exclusive breastfeeding (Mbogori et al., 2015;Meshram et al., 2019).

Overall, the findings from this literature review indicate that mobile application interventions significantly improve maternal nutritional literacy, especially in regions with high child stunting rates. Additionally, research conducted in Asia and Africa confirms that these interventions enhance mothers' knowledge, attitudes, and practices regarding child nutrition. Various formats, including educational videos, TV advertisements, and WhatsApp-based content, were utilized, with session durations ranging from 1 to 25 minutes per week. This educational content effectively raised awareness about supplementary feeding, proper child feeding practices, and the importance of a balanced diet, including fruits, vegetables, and animal proteins. These interventions had a substantial impact in remote and underserved areas, demonstrating that mobile applications can be an effective tool for health education. The consistent improvement in maternal nutritional literacy highlights the potential of mobile health applications to address child stunting and malnutrition on a broader scale.

DISCUSSION

Nutritional literacy among mothers is crucial for the health and well-being of both mothers and their children. It emphasizes the ability to understand and implement nutritional concepts across various aspects of life, particularly focusing on balanced diets for vulnerable age groups. Research indicates that nutritional literacy encompasses knowledge about breastfeeding and complementary feeding, which are vital for child development (Ipa et al., 2020;Mbogori et al., 2015; Sirajuddin et al., 2020). Proper feeding practices during infancy and early childhood can significantly reduce the risk of stunting, which remains a pressing issue in many developing regions. Moreover, the educational level of mothers plays a crucial role in determining the health outcomes of their children (Igbokwe et al., 2017).

Mobile applications have emerged as a promising tool in the realm of mHealth, designed to support children's nutritional needs effectively. These applications serve as an innovative means to educate mothers about proper nutrition and health practices. Studies have shown that mobile applications can address various health issues, such as breastfeeding practices and childhood obesity, with promising results (Nyumbeka & Wesson, 2014;Soofi et al., 2022). These digital tools offer an accessible and engaging way to deliver crucial health information, particularly in remote and underserved areas.

One of the key advantages of mobile applications is their versatility and ease of use. These applications can deliver educational content through various formats, including short films, videos, advertisements, animations, and graphic videos. This variety helps keep the participants engaged and reduces the monotony often associated with traditional lecture methods that rely on posters and flipcharts. Audiovisual media, in particular, has proven to be effective in conveying complex information about nutrition, dietary practices, the importance of carbohydrates, proteins, and maintaining a clean environment (Debong et al., 2019).

The multisensory engagement provided by mobile applications—stimulating both sight and hearing—enhances the learning experience, allowing mothers to focus better on the material presented (Bodjrenou et al., 2020). The combination of visual and auditory elements aligns with educational principles that emphasize experiential learning, making information delivery clearer and more precise. For instance, mobile applications can demonstrate how to prepare balanced meals, highlighting the nutritional content of various foods, such as carbohydrates, proteins, and minerals, and their roles in child development.

The effectiveness of mobile applications in health education extends to their ability to deliver concise, clear, and engaging information. Audiovisual media, with its dynamic and interactive nature, facilitates rapid absorption of information, which is crucial for busy mothers. Videos, being a common part of daily life, are particularly effective in educational settings compared to static lecture methods (Al-Silwadi et al., 2015). The impact of mobile application interventions on mothers' nutritional literacy is significant. These interventions lead to improved feeding practices and nutritional understanding according to balanced nutrition guidelines. They also bring about positive behavioral changes in mothers regarding child nutrition, highlighting the importance of supplementary feeding and a diverse diet that includes fruits, vegetables, and proteins. Such knowledge is instrumental in reducing the prevalence of stunting and malnutrition among children.

The reviewed studies consistently indicate that mobile applications are effectively implemented through short videos, typically consisting of 10-15 segments of 2-5 minutes each. These videos are delivered over multiple sessions, ranging from 1 to 12 months. TV advertisements also play a role in influencing mothers' knowledge and behavior. Most studies suggest that short, frequent TV ads aired 2-3 times daily for a year or more can effectively enhance nutritional literacy and practices among mothers. In terms of media variety, 15 articles used educational videos, while six utilized TV advertisements. Only one article reported using a longer video lasting 50 minutes. The findings indicate that shorter videos and advertisements are more effective in increasing mothers' knowledge and engagement. Longer videos, although informative, tend to be less effective due to their length, which can lead to decreased viewer retention and attention.

CONCLUSION

The findings of this review indicate that mobile application interventions significantly enhance mothers' nutritional literacy, particularly in terms of knowledge, attitudes, and practices regarding child stunting. The studies, conducted across various continents with a concentration in Asia and Africa, suggest that mobile applications can be effective tools for educating mothers about child nutrition. The duration of mobile application usage ranged from 1 to 25 minutes per session per week, and the educational media used included educational videos, TV advertisements, and WhatsApp-based content. These studies also show that audiovisual media, such as animated videos, TV advertisements, and videos on the WhatsApp platform, are highly effective in improving mothers' knowledge about supplementary feeding, the importance of fruits, vegetables, and animal proteins, and exclusive breastfeeding practices. Health education through mobile applications has proven to enhance mothers' nutritional literacy in remote and underserved areas, demonstrating the significant impact of mobile health applications in addressing child stunting and malnutrition.

The implications of these findings are that mobile applications can be widely adopted as public health intervention tools, especially in regions with high child stunting rates. Governments and health organizations should consider developing and implementing mobile-based nutrition education programs that include various media formats to maintain user engagement and interest. Additionally, these programs should be tailored to local conditions and cultural preferences to ensure maximum effectiveness. By appropriately utilizing mobile applications, significant improvements in maternal nutritional literacy can be achieved, which in turn can contribute to reducing the prevalence of child stunting and malnutrition. It is crucial for policymakers and health practitioners to consider integrating mobile technology into health education strategies, given its substantial potential to improve the health and well-being of children globally

Declaration of Interest

The authors declare that there is no conflict of interest.

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Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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