Review Article

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Leveraging Mobile Applications for Stunting Prevention in Indonesia: A Scoping Review

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ABSTRACT

Background: Stunting, a critical public health issue in Indonesia, affects child growth and development, with long-term impacts on cognitive and economic potential. Mobile applications (mHealth) are emerging as transformative tools for addressing stunting by enhancing early detection, education, and intervention. However, their effectiveness in improving maternal knowledge and child nutritional outcomes remains underexplored. **Objective:** This scoping review evaluates the role of mobile applications in stunting prevention in Indonesia. **Methods:** A scoping review was conducted following PRISMA-ScR guidelines. Relevant studies published between 2018 and 2024 were identified using electronic databases, including PubMed, Scopus, and Web of Science. Studies were included if they focused on mobile-based stunting prevention applications in Indonesia and reported outcomes related to child growth, maternal knowledge, or nutritional improvements. Quality appraisal was performed using validated tools, and thematic analysis was applied to synthesise data. **Results:** Out of 106 identified records, 12 studies met the inclusion criteria. These studies highlighted the diverse functionalities of mHealth applications targeting stunt prevention, including early detection, educational interventions, behavioural change support, and monitoring systems. Applications like AECAS and Edu Stunting significantly improved maternal knowledge and attitudes ($p < 0.05$), while tools like SCATION enhanced skills for early stunting detection. Monitoring systems, such as Smart Ting, facilitated growth tracking and resource allocation. Although users reported high satisfaction, challenges such as limited long-term impact on nutritional outcomes and cultural misconceptions were noted. **Conclusion:** Mobile applications exhibit promising potential in addressing stunting through early detection, education, and intervention. Future research should prioritise longitudinal studies and user-centred designs to enhance scalability and sustainability.

Keywords: Child Nutrition; Early Detection; Health Interventions; Mhealth; Mobile Applications; Scoping Review. Stunting Prevention

INTRODUCTION

Stunting, a condition marked by impaired growth and development due to chronic malnutrition, remains a pressing global health challenge, especially in Indonesia (UNICEF, 2020). Mobile applications (apps) are integral to this shift, particularly in monitoring child growth and development. One example is the WHO Anthro app, which provides basic growth monitoring but lacks the comprehensive features necessary for holistic assessments, offering parents limited insights into their child's development relative to age (WHO, 2020a). Smartphone-based interventions for growth stimulation have shown potential in improving maternal understanding of nutritional status but have produced inconsistent results regarding measurable health outcomes (Pratiwi *et al*., 2023). Recent research highlights the potential of Android-based technology to reach broader audiences, provide accessible health information, and leverage modern scientific knowledge to support informed health decisions (Bitomsky *et al*., 2024). In 2021, global smartphone penetration was estimated at 69%, with approximately 63% of the global population having internet access, underscoring the widespread availability of mHealth interventions (Ding, 2025). Moreover, a significant majority of mobile

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users engage with apps, creating opportunities to enhance healthcare accessibility across diverse demographics (Nyapwere, Dube, & Makanga, 2021).

In recent years, various applications have been developed to support health monitoring and education. For instance, the Android-based Nosting app facilitates monitoring children's growth and development while addressing stunting prevention (Bagus & Romli, 2024). The Android-based GiAS (Gizi Anak Stunting) app assists in assessing macronutrients, zinc, and calcium intake in children aged 12–24 months, facilitating the differentiation between stunted and non-stunted children (Hidayat *et al*., 2021). Similarly, the e-PPGBM (Electronic Community-Based Nutrition Recording and Reporting) application has been utilised in Indonesia to monitor child growth and nutritional status, aiming to provide accurate and timely data for policymakers (Karim & Ariatmanto, 2024). Mobile health interventions, such as the e-PPGBM module, have been introduced to combat stunting. However, studies reveal challenges such as delays in providing accurate, timely data, hindering effective policymaking (Karim & Ariatmanto, 2024). A systematic literature review highlighted that the prototype method is frequently employed in developing stunting prevention applications, as it allows for iterative feedback from users, enhancing the application's relevance and user-friendliness (Hossain *et al*., 2017). However, despite progress, many existing apps lack comprehensive guidelines for tackling critical health issues, such as stunting, particularly in low- and middle-income countries (LMICs) (Rinawan *et al*., 2022; Seyyedi *et al*., 2019).

Mobile health applications offer a powerful avenue to improve healthcare access across time and location boundaries. By facilitating real-time interactions between nurses, midwives, and communities especially in remote or resource-limited settings, these technologies can strengthen the delivery and quality of nursing care. One notable use is in nurse-led digital interventions aimed at preventing stunting, which often incorporate modules on exclusive breastfeeding, age-appropriate complementary feeding, immunisation schedules, and healthy lifestyle promotion as cornerstones of maternal and child health nursing (Erika *et al*., 2024; Strika *et al*., 2025).

However, the effectiveness of such tools is often challenged by persistent knowledge gaps among mothers, particularly those shaped by cultural beliefs. For example, community nurses frequently encounter pregnant women avoiding nutrient-dense foods like seafood due to misconceptions about labour complications or breastfeeding difficulties (Abdalla *et al.*, 2024). While many mobile health (mHealth) programs have shown initial promise, there remains a lack of comprehensive, long-term evaluations assessing their impact on maternal knowledge, sustained behaviour change, and improvements in toddler nutrition domains that are critically aligned with public health and nursing priorities (Hasan *et al*., 2024).

To enhance impact, future mHealth app development should prioritise the integration of behaviour change strategies, culturally adapted educational content, and ongoing support through nurse-facilitated virtual coaching. These elements can help optimise user engagement, promote sustained maternal involvement, and empower nurses to serve as digital health champions. Ultimately, such innovations support a more holistic, evidence-informed approach to stunting prevention that is both accessible and responsive to the needs of mothers and children (Bhandari *et al.*, 2025).

Despite the growing development of stunting prevention apps, there remains a lack of systematic evaluation of their effectiveness in improving maternal knowledge and child nutritional outcomes, particularly in LMICs like Indonesia. This systematic review aims to evaluate the role of mobile applications in stunting prevention, focusing on their effectiveness in enhancing maternal knowledge, monitoring child growth, and improving nutritional outcomes. This review evaluates the effectiveness of mobile applications in stunting prevention by examining their impact on maternal knowledge, child growth monitoring, and nutritional outcomes. It seeks to identify strengths and address gaps to inform future mHealth development.

METHODOLOGY

Study Design

This scoping review was conducted to explore the use of mobile-based applications for stunting prevention in Indonesia. The review adhered to the guidelines outlined in the Preferred Reporting Items for

Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) (Tricco *et al*., 2018).

Search Strategies

The search strategy involved identifying relevant studies from electronic databases, including PubMed, Scopus, Web of Science, and Google Scholar. Searches were conducted using a combination of keywords and Medical Subject Headings (MeSH) terms: "stunting prevention", "mobile applications", "health interventions", and "Indonesia". Boolean operators (AND, OR) were employed to combine search terms effectively. The search was limited to studies published in English from January 2019 to December 2024 to ensure the inclusion of recent evidence. A manual search of reference lists from included studies was also performed to identify additional relevant studies.

Inclusion Criteria

Inclusion criteria were studies focusing on mobile-based applications designed for stunting prevention, studies conducted in Indonesia or involving Indonesian populations, peer-reviewed articles published between 2018 and 2024, and studies reporting outcomes related to stunting prevention, such as nutritional improvement, behaviour change, or maternal and child health.

Exclusion Criteria

Exclusion criteria were studies not involving mobile-based applications, studies published in languages other than English, review articles, conference abstracts, and editorials, and studies with insufficient data or those not addressing stunting prevention explicitly.

Data Extraction

Data were extracted independently by two reviewers using a standardised data extraction form. Extracted data included the following: 1) Study characteristics: author(s), year of publication, study design, and location. 2) Intervention details: mobile application features, target population, and duration. 3) Outcome measures: stunting-related outcomes and other health indicators. 4) Key findings and limitations. Discrepancies between reviewers were resolved through discussion or consultation with a third reviewer.

Quality Assessment

To assess the quality of the included studies, a validated appraisal tool was utilised based on the study design. For randomised controlled trials (RCTs), the Cochrane Risk of Bias Tool was employed, while observational studies were assessed using the Newcastle-Ottawa Scale. Studies were classified as high, moderate, or low quality based on the scoring criteria of these tools. Only studies rated as moderate to high quality were included in the synthesis. Quality appraisal results were independently verified by two reviewers, with disagreements resolved by a third reviewer to ensure reliability.

Data Analysis

Thematic analysis was applied to identify recurring themes and patterns in the features and effectiveness of mobile applications targeting stunting prevention. Quantitative results, where available, were summarised descriptively. Data synthesis included mapping the applications' functionalities, target audiences, and reported outcomes.

RESULTS

Searching Results

Figure 1 depicts Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram. In the identification phase, 106 records were retrieved from database searches and 4 additional records from other sources, such as reference lists or expert recommendations. After removing duplicates, 88 unique records were screened based on their titles and abstracts, resulting in 72 relevant articles. Of these, 43 were excluded for not meeting inclusion criteria. In the eligibility phase, 29 full-text articles were assessed, and 17 were excluded due to issues like irrelevant data, poor methodology, or population mismatch. Ultimately, 12 studies were included in the qualitative synthesis, meeting the established review criteria.

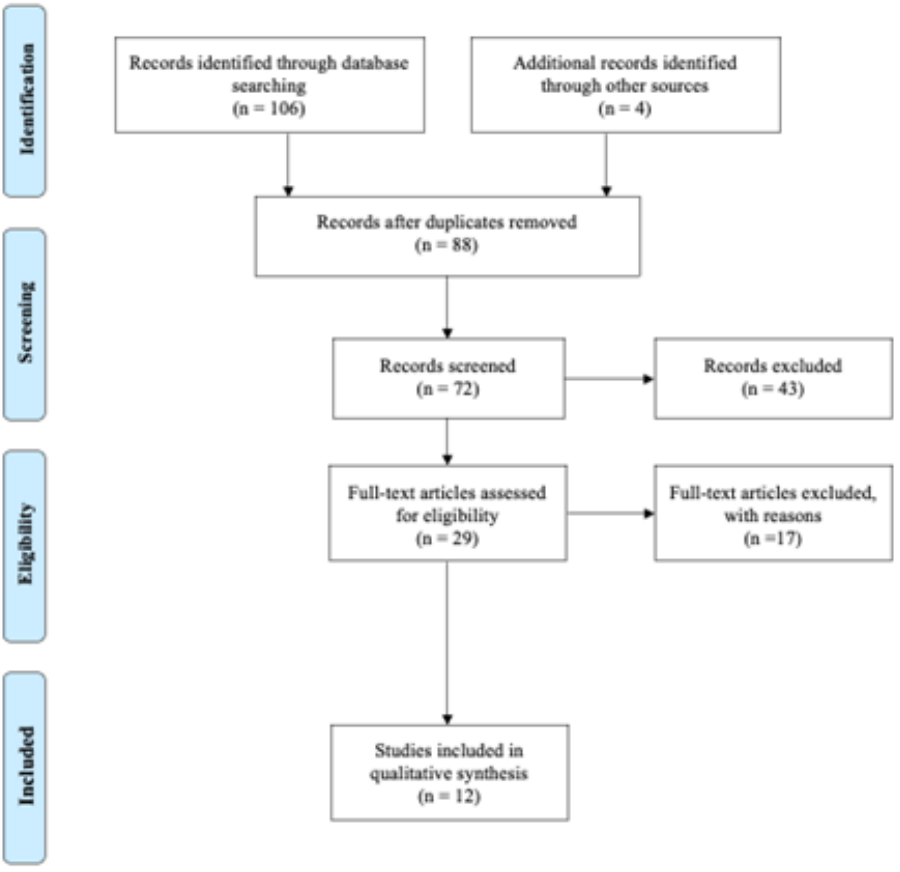

Figure 1: PRISMA Flow Chart

Quality of Study

Out of the 12 studies included in this review, 5 studies were rated as high quality, and 7 were classified as moderate quality. None of the studies were deemed low quality. Quality ratings were independently verified by two reviewers, with disagreements resolved by a third reviewer. This process ensured reliability and minimised bias in the inclusion of studies (Hidayat *et al*., 2021; Indrayana *et al*., 2022; Marlinawati, Rahfiludin, & Mustofa, 2023; Nurfajriyani & Andhini, 2022; Nurisna, Kundarti, & Rahmaningtyas, 2023; Pangaribuan *et al*., 2023; Permana *et al*., 2021; Prasiska, Widodo, & Suryanto, 2020; Saleh *et al*., 2021; Setyawati & Herlambang, 2018; Sihombing, 2024; Stasya & Sulistiadi, 2020). The high-quality studies provided robust evidence, with well-defined methodologies and comprehensive reporting, while moderate-quality studies had minor limitations but still contributed valuable insights. The detailed characteristics and quality ratings of the included studies are summarised in Table 1.

Main Finding

The characteristics of studies in Table 1 provide an insightful overview of the landscape of mobile application-based interventions addressing stunting prevention and management. The thematic analysis identified recurring themes and patterns in the features and effectiveness of mobile applications targeting stunting prevention. The findings highlight the diverse functionalities, target audiences, and reported outcomes of these applications.

Applications for Early Detection and Screening

Several applications focused on early detection and screening for stunting, leveraging features such as growth monitoring and nutritional assessments. For example, the Ojo Stunting Application (Prasiska, Widodo, & Suryanto, 2020) effectively detects stunting risk factors and supports health workers, achieving a Mobile

Application Rating Scale (MARS) score of 3.77. Similarly, the SITEKSTAGI app (Indrayana *et al*., 2022) was found to be feasible and effective for early stunting detection and screening. The hosting application (Nurisna, Kundarti, & Rahmaningtyas, 2023) demonstrated ease of use and reliability in growth screening for children aged 12–24 months.

Educational Interventions

Educational applications were designed to enhance knowledge and attitudes about stunting prevention. The AECAS application (Simamora *et al*., 2023) significantly improved stunting prevention perceptions among users ($p < 0.0001$). The Edu Stunting app (Marlinawati, Rahfiludin, & Mustofa, 2023) enhanced knowledge and attitudes about stunting prevention in adolescents ($p < 0.05$). Similarly, the Mobile-Based Nutrition Education application (Setyawati & Herlambang, 2018) improved maternal knowledge on stunting through a structured questionnaire.

Comprehensive Nutritional Tools

Some applications offered comprehensive tools to address nutritional needs. For instance, the Mobile Health Nutrition Book (Permana et al., 2021) provided features for monitoring toddler growth and development using UML system design, while GiAS (Stunting Child Nutrition) (Hidayat *et al*., 2021) differentiated stunted and non-stunted toddlers based on macronutrient, zinc, and calcium levels.

Behavioural and Perceptual Changes

Applications targeting behavioural changes, such as Stunting Care Application (SCATION) (Pangaribuan *et al*., 2023), improved mothers' knowledge and skills for stunting detection. Application of "Stunting Prevention" (Saleh *et al*., 2021) increased maternal knowledge, although it had no significant impact on infant nutritional status.

Monitoring and Mapping Systems

Monitoring tools like Smart Ting (Stasya & Sulistiadi, 2020) simplified toddler growth monitoring through data visualisation and mapping features. These systems supported health professionals in identifying stunting cases.

User Engagement and Satisfaction

User satisfaction ratings underscored the usability and effectiveness of applications. For example, AmiGrow (Sihombing, 2024) received high satisfaction ratings, with 64.4% of users rating it as very good and 35.6% as good.

Table 1: Characteristics of Included Studies

Authors, Year	Study Design	Application Name	Operating System	Purpose	Content	Measurement	Results
Prasiska, Widodo, & Suryanto, (2020)	Social standard exploration techniques (qualitative)	Ojo Stunting Application	Android	Early detection of stunting risk factors	Without registering an account	Mobile Application Rating Scale (MARS)	Effectively detects stunting risk factors, aids health workers, and contributes to societal empowerment with an average quality value of 3.77.
Permana *et al*., (2021)	Object-oriented approach	Mobile Health Nutrition Book	Android	Toddler growth and development, stunting prevention	Toddler and child growth and development	UML system design	Produced and used on Android phones; facilitates growth and development tracking.
Simamora *et al*., (2023)	Pre-post RCT	Educational Application to Prevent Stunting Children (AECAS)	Android	Stunting prevention materials	Nutrition during pregnancy, breastfeeding, complementary feeding	Stunting prevention perception questionnaire	AECAS application significantly improved stunting prevention perceptions ($p < 0.0001$).

Marlinawati, Rahfiludin, & Mustofa (2023)	Quasi-experimental	Edu Stunting	Android	Stunting prevention for adolescents	Features include educational materials, nutritional consultations, and quizzes.	Knowledge and attitude	Significantly improved knowledge and attitudes about stunting ($p < 0.05$).
Pangaribuan *et al*., (2023)	Quasi-experimental	Stunting Care Application (SCATION)	Android	Early detection of stunting	Features education on stunting and appropriate feeding for toddlers	Knowledge and skills scores	Enhanced mothers' knowledge and skills for early stunting detection.
Stasya & Sulistiadi , (2020)	Application development cycle	Stunting Monitoring and Mapping Systems (Smart Ting)	Android	Monitoring toddler growth and development	Growth charts, mapping features, and data visualization	-	Simplifies growth monitoring and supports health professionals in stunting detection.
Setyawati & Herlambang, (2018)	Quasi-experimental	Mobile-Based Nutrition Education	Android	Improved maternal knowledge about stunting	Stunting and parenting education	Questionnaire with 18 items	Significantly enhanced maternal knowledge about stunting.
Saleh *et al*., (2021)	One-group pretest-posttest	Application of "Stunting Prevention"	Android	Stunting education and prevention	Exclusive breastfeeding, complementary feeding, immunization	Stunting prevention and nutritional status	Improved maternal knowledge but no significant impact on infant nutritional status.
Indrayana *et al*., 2022	System development	SITEKSTAGI	Android	Nutrition status detection	Includes login, user accounts, questionnaires, and information pages	Usability testing	Effective and feasible for early stunting detection and screening.
Hidayat *et al*., (2021)	Cross-sectional	GiAS (Stunting Child Nutrition)	Android	Nutrition problem detection in toddlers	Macronutrients, zinc, calcium levels	Weight and height measurements	Differentiates stunted and non-stunted toddlers based on nutritional indicators.
Nurisna, Kundarti, & Rahmaningtyas, (2023)	Research and development	Nosting	Android	Early detection and growth screening	Navigation, ease of use, response time, and security features	Usability testing	Effective for early detection and growth screening for children aged 12-24 months.
Sihombing *et al*., (2024)	-	AmiGrow	Android	Early diagnosis of stunting and growth delays	User responses from toddler's mothers	User satisfaction responses	64.4% of users rated the application very good, and 35.6% rated it good.

DISCUSSION

This scoping review highlights the diverse strategies employed by mobile applications to address stunting, with a focus on early detection, education, and intervention. Stunting, a persistent global health challenge, necessitates innovative approaches to ensure timely prevention and management. Mobile health (mHealth) technologies have emerged as a promising tool to tackle stunting by enhancing accessibility, education, and engagement across diverse populations.

Applications designed for early detection, such as the Ojo Stunting Application and SITEKSTAGI, prioritise growth monitoring and nutritional assessments (Prasiska, Widodo, & Suryanto, 2020). These tools demonstrate practicality and effectiveness by identifying risk factors for stunting in a timely manner (Indrayana *et al*., 2022). The integration of user-friendly interfaces and automated analyses facilitates early diagnosis and intervention, aligning with previous research that underscores the importance of early nutritional assessments in mitigating stunting risks (WHO, 2020). Such tools empower health professionals and caregivers to make informed decisions, highlighting the critical role of technology in community-based health initiatives.

Educational applications, including AECAS (Simamora *et al*., 2023) and Edu Stunting, have significantly

enhanced knowledge and attitudes toward stunting prevention. These applications target diverse populations, particularly mothers and adolescents, to promote awareness and behavioural change (Ayed, Ali, & Sayed, 2021; Mukodri *et al*., 2024). Evidence suggests that increasing maternal knowledge about nutrition and health positively influences child growth outcomes (Wirawan, Yudhantari, & Gayatri, 2023). By incorporating interactive modules, gamification, and culturally tailored content, these applications not only disseminate information but also foster sustained engagement, addressing key barriers to effective stunting prevention. Comprehensive nutritional applications, such as the Mobile Health Nutrition Book and GiAS, offer in-depth monitoring and analysis of toddler growth and nutritional needs. These tools align with the growing emphasis on personalised health interventions, which consider individual dietary requirements and growth trajectories. The systematic monitoring provided by these applications aligns with findings from longitudinal studies emphasizing the importance of tailored nutritional plans in improving child growth outcomes (Prendergast & Humphrey, 2014). Their integration into routine health practices can bridge gaps in traditional health services, particularly in low-resource settings.

Behavioural change-focused applications, such as SCATION, aim to enhance maternal skills and knowledge for stunting prevention. By utilising motivational techniques and skill-building modules, these tools address psychosocial barriers that often hinder effective parenting practices. While tools like SCATION show promise, others, such as the "Stunting Prevention" app, have exhibited limited impact on nutritional outcomes. This discrepancy underscores the need for iterative development and rigorous evaluation of behavioural change strategies in mHealth applications. Research highlights that behavioural interventions must be evidence-based and contextually relevant to achieve meaningful impact (Michie *et al.*, 2017).

Advanced monitoring systems, such as Smart Ting, utilise sophisticated data visualisation and mapping techniques to support health professionals in tracking stunting cases. These features not only enhance the accuracy of stunting surveillance but also facilitate resource allocation and policy-making. The adoption of such tools aligns with global health initiatives advocating for data-driven approaches to public health challenges (UNICEF, 2018). Their implementation can strengthen health system capacities, particularly in regions with high stunting prevalence. Moreover, user engagement metrics reveal high satisfaction with applications like AmiGrow, emphasizing their usability and perceived effectiveness in addressing stunting-related challenges. High user satisfaction is a critical determinant of sustained app usage, particularly in resource-limited settings where alternative health services may be scarce. Studies indicate that user-centric design, incorporating feedback from target populations, significantly enhances the adoption and effectiveness of mHealth applications (Baumel, 2022).

The findings of this scoping review underscore the critical role of nurses in leveraging mobile health (mHealth) technologies to address stunting. Nurses are uniquely positioned to integrate mHealth solutions into their practice, particularly in community and primary care settings, where early detection and prevention of stunting are paramount. By utilising mobile applications, nurses can enhance health education, provide timely interventions, and support caregivers in adopting evidence-based practices to mitigate stunting. Additionally, mHealth tools can facilitate better tracking of child growth and development, enabling nurses to identify at-risk children promptly and implement targeted interventions. The accessibility of these technologies allows nurses to extend their reach, especially in remote or underserved areas, ensuring equitable healthcare delivery. Training and capacity building in using mHealth applications should be prioritised to empower nurses with the skills needed to maximise the benefits of these tools. Furthermore, incorporating mHealth technologies into nursing practice supports data-driven decision-making, fosters continuous professional development, and aligns with global health initiatives aimed at reducing stunting and improving child health outcomes.

Limitation

This scoping review explores the utilisation of mobile-based applications for stunting prevention in Indonesia, though it is subject to certain limitations inherent to its design. As a scoping review, its primary objective is not to rigorously evaluate intervention effectiveness but rather to map the available evidence. Consequently, this limits its capacity to establish causal relationships or compare the effectiveness of the interventions reviewed. Additionally, the study's reliance on published literature introduces the potential for publication bias, as it does not extensively include unpublished or grey literature. The exclusion of studies in languages other than English may further result in the omission of relevant information, which could affect the generalisability of the findings.

CONCLUSION

This review highlights the potential of mHealth applications to address stunting through diverse strategies encompassing early detection, education, intervention, and monitoring. While many applications demonstrate effectiveness in improving knowledge, attitudes, and practices, challenges related to scalability, sustainability, and rigorous evaluation remain. Future research should focus on longitudinal studies to assess the long-term impact of these tools on nutritional and growth outcomes. Additionally, integrating mHealth applications with broader health systems and policies can amplify their reach and impact. Collaborative efforts involving policymakers, developers, and end-users are essential to optimise the design and implementation of mHealth interventions, ensuring equitable access and improved health outcomes.

Conflict of Interest

The authors declare that they have no competing interests

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