



## DIGITAL EDUCATION AS AN INNOVATIVE STRATEGY FOR STUNTING PREVENTION: A LITERATURE REVIEW

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### ABSTRACT

Stunting is a public health problem that is still high in Indonesia and other developing countries. Prevention efforts require an innovative approach, one of which is through digital education that is able to reach targets quickly and effectively. This article aims to examine the various digital education interventions used in stunting prevention and analyze their effectiveness based on evidence from original research. This study is a review of the narrative literature on 11 original research articles published between 2020–2025. A total of 372 articles were initially identified through database searches (PubMed, ScienceDirect, Google Scholar, Garuda, and ResearchGate). After applying the inclusion and exclusion criteria and removing duplicates, 11 articles met the eligibility criteria and were included in the analysis. Article selection follows the PICOS criteria and the PRISMA process. Digital education in the form of mobile applications, voice and text messages, and online media has been proven to improve nutrition knowledge, change feeding behavior, and improve children's nutritional status. The effectiveness of interventions is greatly influenced by consistent message exposure, support of health cadres, and readiness of digital infrastructure. Digital education is a relevant and adaptive strategy in stunting prevention. Integration with community and cross-sector approaches is critical to ensuring the success and sustainability of the program.

Keywords: digital education; mobile application; nutrition literacy; prevention; stunting

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## INTRODUCTION

Stunting is still a complex global health challenge. The latest data from the Joint Child Malnutrition Estimates (JME) 2025 Edition released by UNICEF, WHO, and the World Bank show that the problem of stunting in children under five is still a significant global challenge. By 2024, an estimated 150.2 million children under five worldwide will be stunted, representing 23.2% of the total population of children under five years old. Despite the decline in the prevalence of stunting globally from year to year, the rate of decline is still relatively slow and not enough to achieve the nutrition targets that have been set. The majority of children under five who are stunted are concentrated in two main regions: Sub-Saharan Africa and South Asia. In these two regions, about one-third of all children under five are stunted, indicating a very high burden of malnutrition there. South Asia, in particular, accounts for the largest number of stunted children with around 56 million children (JME, 2025; UNICEF, 2025; WHO, 2025; World Bank, 2024). Based on the results of the 2024

Indonesian Nutrition Status Survey (SSGI), the national stunting prevalence has managed to show a significant decrease to 19.8%. This figure not only continues the positive trend, but also exceeds the set targets, indicating the success of the intervention programs that have been implemented. However, challenges still exist, considering that stunting is not only related to nutrition after birth, but also from the womb. In addition, there are still variations between regions, with 11 provinces actually experiencing an increase in prevalence. This data is an important guide for the government to continue to identify priority areas and design more targeted interventions to achieve the target of reducing stunting to 14% by 2024 (Kemenkes, 2025).

A longitudinal study from Ethiopia showed that children who experience stunting at an early age have significantly lower scores in various aspects of cognitive function. The children were recorded to have a decrease in working memory by 12.6% and inhibitory control by 5.8% of the standard deviation, compared to children who grew normally. These findings show that stunting not only has a physical impact, but also a significant effect on an individual's memory and reasoning abilities as they enter adolescence (Astatkie, 2020; Marta et al., 2022). This cognitive impact also has implications for potential economic productivity in the future. Study by Dessie et al., (2025) notes that children who are stunted have lower academic achievements, including math and language scores, which in turn affects the quality of job skills as adults. The decline in cognitive function due to stunting contributes to low labor capabilities, as well as negatively impacts long-term economic growth, especially in low- and middle-income countries (Akseer et al., 2022; Suryana & Azis, 2023). Meanwhile, the factors that cause stunting are multidimensional, including inadequate nutritional intake, recurrent infections, inappropriate parenting, and limited access to adequate health and sanitation services (Centis et al., 2024; Haile & Legisso, 2024; Matrutty et al., 2024; Sarwuna & Khoeriyah, 2024; Yulnefia, 2021).

Various nutrition and health interventions have been pursued by the government and health partners to overcome and prevent stunting, including through micronutrient supplementation programs, food fortification, and nutrition education that are carried out regularly at posyandu (Ernawati et al., 2021; Miranda et al., 2023). However, the effectiveness of these programs still faces various structural and social challenges. Intervention coverage is often uneven, especially in remote and rural areas, which are constrained by geographical factors such as poor road access, limited means of transportation, and lack of health infrastructure (Lowe et al., 2021; Siramaneerat et al., 2024; Zaleha & Idris, 2022). In addition, the number and distribution of health workers, including posyandu cadres, are not enough to reach the entire target population optimally (Milwan & Sunarya, 2023; Pandey et al., 2020; Scott, 2023). Low nutritional literacy among the community, especially in mothers and caregivers of children under five, is also a major obstacle in the implementation of healthy living behaviors and the utilization of available nutrition services. As a result, many families are unaware of the importance of intervention from the first 1,000 days of life, or are inconsistent in following supplementation and supplementation programs (Amalia et al., 2021). This condition raises the need for a new approach that can reach the community more widely and effectively, one of which is through the use of digital technology.

The rapid development of digital technology in recent years offers significant opportunities to strengthen stunting prevention efforts. In Indonesia, smartphone penetration has reached 79.50% of the population (, 2024) has opened up great potential for the dissemination of health information through digital platforms such as mobile applications, social media, and telemedicine. Several recent studies prove the effectiveness of digital interventions in improving public health knowledge and behavior. Study Rahmadani et al., (2025) It shows that nutrition education with videos significantly improves maternal knowledge, attitudes, and

practices in stunting prevention. Meanwhile, research Sudiati et al., (2023) found that education about stunting, early detection through the Internet of Things (IoT) system in brides-to-be, pregnant women and breastfeeding mothers proved to be effective in preventing stunting. In addition, the digitalization of healthcare services enables cross-sector data integration that can strengthen evidence-based policymaking. According to WHO (2021), digital technology has great potential in improving the quality of maternal and child health services if applied in an inclusive and sustainable manner. Therefore, the integration of digital technology into the national strategy for stunting prevention is a strategic step that is not only relevant to the times, but also has the potential to accelerate the achievement of the target of reducing stunting prevalence. Based on the description above, this literature review aims to analyze the role of digital education as an innovative strategy in stunting prevention, taking into account its effectiveness, challenges, and development opportunities in various geographical and social contexts. By reviewing the latest empirical evidence, it is hoped that this paper can provide data-driven recommendations to strengthen stunting prevention policies and programs in Indonesia and other low-middle-income countries.

## **METHOD**

This research is a narrative literature review study that aims to identify, analyze, and synthesize scientific evidence regarding the use of digital education as an innovative strategy in stunting prevention. The screening process is carried out following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) 2020 flow. Article searches were conducted systematically on four online scientific databases, namely PubMed, ScienceDirect, Google Scholar, and Garuda to cover international and national literature. The keywords used in the search process were: "digital education" OR "digital intervention" OR "mobile application" OR "e-health" OR "online nutrition education" AND "stunting prevention" OR "child malnutrition" OR "1000 HPK" OR "growth faltering". For Indonesian literature, a combination of keywords is used: "digital education" OR "digital intervention" OR "mobile application" OR "online health education" AND "stunting prevention" OR "child malnutrition" OR "first 1000 days of life".

The inclusion criteria in this study include: scientific articles in the form of original research, published between 2020 and 2025, available in full-text form, and discussing interventions or digital education programs aimed at stunting prevention. The target population in the article includes pregnant women, breastfeeding mothers, parents of children under five, adolescents, posyandu cadres, or health workers. The exclusion criteria include articles in the form of systematic review, meta-analysis, opinions, editorials, and articles that are not available in full text or are not relevant to the topic being reviewed. The following diagram 1. explains the article selection process

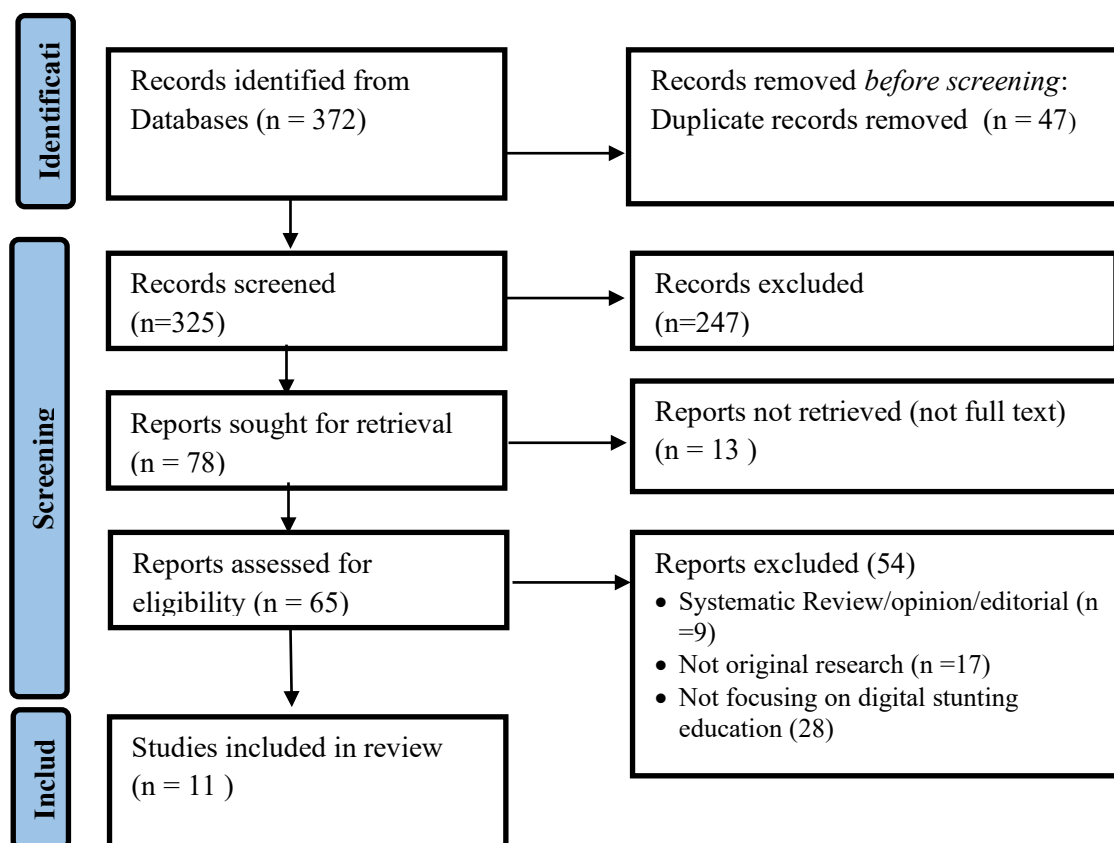


Diagram 1. Identification studies via databases

From the initial search results that obtained a total of 372 articles, duplication was eliminated, filtered by title and abstract, and full content review was carried out to assess suitability with inclusion criteria. After going through the selection stage, as many as 11 articles that met the criteria were further analyzed narratively to describe the trends, effectiveness, and challenges of implementing digital education in stunting prevention efforts.

## RESULT

This review includes 11 original research articles on digital education as a strategy for preventing stunting in children. The interventions examined—such as mobile apps, messaging systems, and online platforms were selected based on PICOS criteria.

Table 1.

Extraction of the article (n=11)						
No	Author (Year)	P (Population)	I (Digital Intervention)	C (Control/Comparator)	O (Results)	S (Study Design)
1	Faridah et al.(2024)	Mother with a stunted toddler	Education via WhatsApp + e-module	Control group	↑ Knowledge, insignificant in attitude	Quasi-experimental
2	Erika et al. (2024))	Stunting toddler mother	Android application "SEHATI"	Before after (pre-post)	↑ Significant knowledge (p = 0.001)	Delphi + pilot test
3	Yenita et al. (2025)	Stunting toddler mother	Application of "ANACETING" (education & monitoring)	Not mentioned	↑ Mother's knowledge; Comprehensive Features	R&D
4	Nurcahyani et al. (2024)	Cadres and families at risk of stunting	Android-based "PaSti PenTing" educational media	Not mentioned	↑ Knowledge, attitudes, and behaviors	R&D

No	Author (Year)	P (Population)	I (Digital Intervention)	C (Control/Comparator)	O (Results)	S (Study Design)
5	George et al. (2021)	Mother and child <2 years old, Bangladesh	mHealth-based WASH and text messaging	Control community	↓ Stunting 27–29%, ↓ Giving	Cluster RCT
6	Ferdous et al. (2024)	Pregnant women & toddlers, Bangladesh	Educational tablets + LNS tracking by cadres	Standard service	↑ Cadre acceptability, support nutrition education	Cluster RCT
7	Hojati et al. (2023)	Mothers of toddlers 2–6 years old, Iran	MyKid'sNutrition App	Control group	↑ Nutrition knowledge & practice (in analysis)	RCT
8	Azimi et al. (2024)	Pregnant and lactating mothers, Malaysia	mHealth App "MiNd"	Control group	HPK-based nutrition education; Positive initial effectiveness	R&D + Quasi-eksperimen
9	Safitri & Mukodri, (2024)	Mother-in-law, Riau Province	"Bocesting" vs Booklet App	Control group	↑ Knowledge (p=0.001); Android is superior	Quasi-experiment
10	Kusumawati et al. (2025)	22 toddlers from poor families, Kediri	Nutritional Rangers + Live Barn app integration	No explicit peer groups	↑ Z-score BB/U, TB/U, BB/TB signifiers	Mixed-method
11	Downs et al. (2023)	Mother, father, child 6–23 months, Senegal	mHealth education IYCF via SMS and audio	Control group	↑ MAD (proper eating practices), ↓ child anemia	Cluster RCT

Thematic analysis of the reviewed articles shows that digital education consistently improves parents' nutritional knowledge and feeding practices, particularly among mothers. Interventions such as Bocesting (Safitri & Mukodri, 2024), HALF (Erika et al., 2024), and MyKid'sNutrition (Hojati et al., 2023) significantly increased awareness about stunting and nutrition during the first 1000 days of life. Beyond knowledge gains, behavior changes were also observed, including more regular feeding schedules and improved food diversity (Faridah et al., 2024; Yenita et al., 2025). Some interventions even showed measurable improvements in nutritional status, such as reduced stunting rates (George et al., 2021) and improved Z-scores in children (Downs et al., 2023; Kusumawati et al., 2025). The presence of community health workers or cadres further strengthened intervention success (Ferdous et al., 2024; Nurcahyani et al., 2024). Nevertheless, challenges such as limited digital access, low digital literacy, and lack of technical support remain significant (Azimi et al., 2024; Kusumawati et al., 2025), underscoring the need for context-based adaptation and sustained guidance.

## DISCUSSION

The review of 11 original research articles revealed consistent thematic patterns related to the use of digital education in stunting prevention. Through thematic analysis, the researchers identified four major themes that explain the effectiveness of digital interventions such as consistent exposure to educational messages, self-efficacy as a foundation for sustained behavior change, social and community support to strengthen intervention impact, and the importance of contextual and user-centered program design. The following is a description of the themes that have been obtained

### **Repeated and Accessible Message Exposure as Behavior Catalyst**

A review of the articles by Faridah et al. (2024), Erika et al. (2024), Safitri & Mukodri (2024) showed that periodic exposure through apps or text messages once or twice per week significantly increased parents' knowledge of stunting and feeding practices. The researchers concluded that the high frequency of exposure to information and easy access was very influential in encouraging changes in family nutritional behavior. This assumption is supported by the Health Belief Model (HBM), which states that "cues to action" such as reminders or regular messages can trigger behavioral actions (Nenobais & Katmini, 2021). Jeihooni et al., (2022) in their meta-analysis found that HBM-based interventions improved maternal child growth and development monitoring behavior. Additional research by Riazi et al., (2024) shows that theory-based digital nutrition education is also able to meaningfully increase the consumption of micronutrients in pregnant women. Repeated exposure through mediums such as WhatsApp, short videos, or notifications is an effective strategy that is empirically proven to trigger preventive behavior.

### **Self-Efficacy as a Pillar for Sustained Change**

Apps such as *MyKid'sNutrition* (Hojati et al., 2023), *Nutritional Rangers* (Kusumawati et al., 2025), and *SEHATI* (Erika et al., 2024) show an increase in child feeding practices that correlate with parents' confidence in their ability to apply nutritional information. From this, researchers concluded that self-efficacy is an important component in maintaining long-term behavioral change. This assumption is very consistent with Social Cognitive Theory (SCT), which states that self-efficacy and outcome expectations are the main determinants of behavior. A study by Arefi et al. (2022) proves that SCT-based interventions increase self-regulation and motivation of pregnant women in choosing a structured diet. Research by Torkan et al. (2018) also confirms that self-regulation and outcome expectancy significantly affect the lifestyle of healthis. Meanwhile, a study from Nigeria by Sosanya et al., (2024) with BabyThrive offline game-based application showed a significant increase in IYCF knowledge compared to controls, as well as increased self-efficacy of adolescent mothers due to a motivating gamification interactive approach. Implicitly, then, is that digital design that builds confidence will be more likely to result in sustainable behavior change.

### **Community Support Enhances Adoption and Engagement**

In many studies, such as Nurcahyani et al. (2024) and Ferdous et al. (2024), the effectiveness of digital education increases when accompanied by health cadres or posyandu cadres. The researchers assume that social support and community engagement strengthen the use and sustainability of digital interventions. This is in line with the Diffusion of Innovations Theory, which states that technology adoption is more successful when facilitated by local opinion leaders. Fan et al. (2024) also added that digital literacy is not enough without community mentorship to support application understanding. Similar support was found in peertopeer models in Zimbabwe and Kenya (Care Group approaches), which significantly increased engagement and the effect of behavior change in the context of child nutrition. These findings emphasize that digital education is most effective when it is not independent, but accompanied by social networks that strengthen and guide users.

In many studies, such as those conducted by Nurcahyani et al. (2024) and Ferdous et al. (2024), the effectiveness of digital education in stunting prevention increases significantly when interventions are carried out with assistance from health cadres or local facilitators. The researchers assume that social support and community engagement not only strengthen early adoption of digital apps, but also ensure sustainability of use and behavioral consistency. This is in line with the Diffusion of Innovations Theory, which states that technology is faster to adopt and more easily accepted when introduced through *opinion leaders* or trusted local figures in the community. A recent study by Fan et al. (2024) reinforces these findings, by

showing that low digital literacy is not a major barrier when it comes to community mentoring support. In the study, the group that received assistance from cadres showed a significant increase in the intention and frequency of using health apps compared to the group without social support. Similar results were reported by Moise et al. (2023) in a global review study on digital interventions during the COVID-19 pandemic, which found that active local community engagement—through cadres, mothers' groups, and peer-to-peer reinforcement—is a determining factor in the success of digital education in improving maternal and child health outcomes.

In addition, a qualitative study by Experiences of CHWs with mHealth (2023) found that the success of digital programs is greatly influenced by the experience and activeness of cadres in bridging technology and society. In the Indian context, the "Mobile for Mothers" program proves that digital messages are more effectively received when they are reconveyed by ASHAs (village health cadres) in direct interaction (Choudhury & Choudhury, 2022). These findings confirm that digital education is most effective when it is not stand-alone, but is strengthened by social structures and local actors that are able to adapt content and build interpersonal relationships with family goals.

### **Contextual and User-centered Design Drives Usability**

Some apps such as *Bocesting*, *HALF*, and *SEHATI* show high effectiveness because their designs are in accordance with the language, culture, and literacy abilities of users in each location. The researchers assume that contextual and user-friendly design greatly determines the success of digital interventions. This is reinforced by the SCT theory and the principle of user-centered design that emphasizes the importance of *modeling*, social reinforcement, and realistic outcome expectations. The narrative review by Islam et al., (2023) concluded that digital interventions that are culturally and socially relevant to the target population have higher engagement and outcomes. Research by Permatasari et al., (2025) in the context of stunting risk detection in Indonesia even highlights that mobile application-based nutrition and sanitation indicators are able to predict children's nutritional status with > 80% sensitivity and specificity, as long as the description of variables is contextually adjusted. This shows that apps that understand the social constellation and local nutrition appropriately will facilitate adoption and increase user retention.

The results of this thematic analysis reinforce the idea that digital education for stunting prevention is effective when it meets four conditions: consistent information exposure, supporting caregiver self-efficacy, involving community support, and contextually designed. To maximize impact, digital interventions should include regular notification and reminder schedules, provide features to monitor progress and set nutrition goals, build synergies with local cadres or health workers, tailored to local culture, language, and technology access, supported by health systems and interoperability between sectors through infrastructure, training, and policy monitoring. With this approach, digital education can transform from an information tool to a catalyst for sustainable family behavior and have a real impact on children's nutritional status.

### **CONCLUSION**

Digital education has proven to be an effective innovative strategy in stunting prevention. Interventions through mobile applications, online messaging, and community-based platforms can increase knowledge, change feeding behaviors, and improve children's nutritional status. The success of the program depends heavily on frequency of exposure, ease of access, social support, and contextually appropriate design. For optimal results, digital education needs to be integrated with a multi-sector approach and supported by infrastructure readiness and community assistance.

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