



Utilization of Mobile-Based Educational Applications (E-Stunted) to Improve Mothers' Knowledge About Stunting: A Quasi-Experimental Study

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Abstract

Background: Stunting remains a major public health concern in Indonesia, particularly in rural areas where access to health education is limited. Enhancing maternal knowledge through digital interventions offers a promising solution.. **Objective:** This study aimed to evaluate the effectiveness of a mobile-based educational application (E-Stunted) in improving maternal knowledge about stunting prevention.

Methods: A quasi-experimental design with a non-equivalent control group pretest- posttest was conducted in Brebes, Indonesia. A total of 138 mothers of children under five were purposively assigned to either an intervention group (n=70) that received the E-Stunted application or a control group (n=68) that received standard health education. Knowledge scores were measured using a validated 20-item questionnaire before and after the 7-day intervention. Statistical analysis included paired and independent t-tests, and Cohen's d to assess effect size.

Results: The intervention group showed a significant increase in knowledge scores from 10.7 ± 2.8 to 16.2 ± 2.1 ($p < 0.001$), while the control group improved modestly from 10.5 ± 2.7 to 12.1 ± 2.5 ($p < 0.001$). Between-group differences post-intervention were statistically significant ($p < 0.001$), with a large effect size (Cohen's $d = 1.58$).

Conclusions: The E-Stunted application significantly improved maternal knowledge on stunting prevention and holds potential as a scalable digital health education tool in rural settings.

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INTRODUCTION

Stunting is a condition of growth failure in children due to chronic malnutrition, characterized by height below the standard for their age. Although its global prevalence has declined slightly, approximately 149 million children under five worldwide are still affected, with long-term impacts on cognition, health, and economic productivity (WHO). Stunting is the result of chronic and recurrent malnutrition, characterized by a child's height being shorter than expected for their age, leading to impaired physical and cognitive growth (Bharali et al., 2019), as well as a lack of stimulation during the formative years of a child, particularly in the first 1000 days of life (from pregnancy to 2 years of age) (Yeboah et al., 2024). In Indonesia, stunting is a national priority, especially in rural areas that face limited sanitation, inappropriate feeding practices, and low access to nutrition education. Multisectoral interventions are needed, especially during the first 1,000 days of life, which are crucial for child growth and development.

Babies with low birth weight (LBW) have a higher risk of stunting (Abbas et al., 2021); (Dharminto et al., 2025); (Azizah et al., 2025). Factors contributing to LBW include economic status, pregnancy complications, and multiple pregnancies (Rahmadani & Santik, 2024). Exclusive breastfeeding may protect low-income children against stunting. Health promotion to improve caregiver motivation to exclusively breastfeed is critical in the present setting and beyond (Hadi et al., 2021). Additionally, environmental conditions during pregnancy also influence the occurrence of low birth weight (LBW) (Widyawati et al., 2020). Parenting practices, nutrition knowledge, and knowledge about exclusive breastfeeding are also associated with stunting (Widyawati et al., 2022). Mothers' knowledge about nutrition and parenting practices significantly influences the implementation of complementary feeding practices and children's growth and development (Gemede et al., 2025).

The development of digital technology, particularly the use of smartphones in rural areas, has opened up new opportunities for delivering nutrition education. Digital media such as videos, infographics, and

WhatsApp messages can convey health messages repeatedly and attractively at low cost. Several international studies show that digital interventions can improve mothers' nutrition knowledge and practices. However, studies on the context in rural Indonesia are still limited. Therefore, locally-based Research is needed to evaluate the effectiveness of digital interventions in preventing stunting. Several quasi-experimental studies have assessed integrated nutrition interventions such as education and home gardening on changes in nutritional behavior. For example, studies in Africa reported improvements in supplement consumption and breastfeeding practices, although these did not significantly reduce stunting (Elisaria et al., 2021). Similar Research in Indonesia also highlights challenges with intervention duration and multisectoral implementation, which have led to suboptimal results in reducing stunting prevalence (Beatty et al., 2024) (Sufri et al., 2024). Furthermore, systematic reviews indicate that family- and community-based interventions can improve nutritional behavior support, but their effectiveness is highly dependent on local adaptation and community involvement. Efforts to address stunting must include behavioral changes in nutritional practices and child-rearing, not just a focus on infrastructure.

At the local level, various nutrition education efforts have been carried out through groups of pregnant and breastfeeding mothers, for example, through participatory approaches and interactive discussions that can raise awareness of the importance of balanced nutrition (Mukty et al., 2024). However, face-to-face approaches have limited reach, especially in areas with limited health workers and high mobility. Many educational media have been used (websites, videos, applications). Sharing various approaches can be done by providing nutrition education, brainstorming, and demonstrations. Nutritional health education methods and media can be in booklets, guidebooks, leaflets, and internet technology applications (Prasetyo et al., 2023). Based on this background, this study developed and evaluated a mobile-based nutrition education application called E-Stunted, designed for the local context of Glonggong Village, Wanasari

Subdistrict, Brebes District. This study aims to test the effectiveness of E-Stunted in improving mothers' knowledge about stunting prevention. If proven effective, E-Stunted can be widely adopted by posyandus and puskesmas and serve as a reference for digital nutrition education policies at the regency level.

METHODS

Participant Characteristics and Research Design

This study used a quasi-experimental design with a non-equivalent control group pretest–posttest model to evaluate the effectiveness of the E-Stunted digital media in increasing mothers' knowledge about stunting prevention. E-Stunted is a mobile-based educational application developed to improve mothers' knowledge about stunting and its prevention. The application provides educational content covering the definition of stunting, risk factors, impacts, nutritional requirements, and stunting prevention strategies based on national guidelines and scientific literature. Prior to implementation, the application underwent an expert judgment process conducted by public health experts and media experts to assess the validity, appropriateness, and feasibility of both the content and the media design. The intervention group received a digital education package, while the control group received standard posyandu education. This design was chosen because it is suitable for community Research where full randomization is difficult to implement, and it allows comparisons of groups with similar characteristics in real-world conditions. Participants who met the inclusion criteria were assigned to either the intervention group or the control group. Both groups completed a pre-test using a validated stunting knowledge questionnaire. The intervention group used the E-Stunted application for seven days, while the control group received conventional health education. Following the intervention, both groups completed a post-test to assess changes in their knowledge of stunting.

The study was conducted in Glonggong Village, Wanasari Subdistrict, Brebes District, which was purposively selected for its high stunting prevalence and the readiness of its

integrated health service post (posyandu) infrastructure. To ensure homogeneity, a control village was selected from the same subdistrict with similar demographic profiles, access to health services, and maternal characteristics, but without exposure to digital interventions.. A seven-day intervention period was selected to evaluate the immediate educational effect and to assess short-term knowledge recall. Therefore, the study was not intended to measure long-term knowledge retention or changes in health behavior.

Sampling Procedures and Sample Size

The study population consisted of mothers with children under five (0–59 months). Inclusion criteria included: residing in the study location, being able to read/write, owning a mobile phone, and being willing to participate in the study. Respondents who were absent during the pretest or posttest were excluded. The sample was purposively selected based on the inclusion criteria, participants were mothers who had children under five years of age, were willing to participate as respondents, and were able to use a smartphone. The respondents were then divided into intervention and control groups based on the study area to minimize information contamination between groups. The minimum required sample size was 60 respondents (30 in the intervention group and 30 in the control group). In practice, a total of 138 eligible mothers were recruited, consisting of 70 in the intervention group and 68 in the control group. In practice, 138 mothers met the criteria (70 in the intervention and 70 in the control). E-Stunted contains short educational videos, digital modules/leaflets, WhatsApp infographics, reinforcement quizzes, and face-to-face posyandu sessions. The objective of this intervention was to increase the knowledge of mothers of toddlers about stunting: its definition, causes, effects, prevention, and growth and development monitoring.

This study has been ethically reviewed and approved by the Universitas Ngudi Waluyo Ethical Clearance Commission with registration number: 236/KEP/EC/UNW/2025. All participants provided written informed consent before participation.

Measures, Covariates, and Data Analysis

The E-Stunted intervention consists

of educational videos (5–7 minutes), digital infographics, PDF modules, reinforcement quizzes, and short reinforcement sessions by cadres. The materials are provided in stages over seven days via WhatsApp. The control group continues with routine posyandu education without additional digital materials. The main outcome is mothers' knowledge about stunting, measured using a 20-item questionnaire (score 0–20), which has been tested for validity and reliability. The validity test using Pearson's correlation and the reliability test using Cronbach's alpha showed a value >0.70 . Measurements were taken before

the intervention (pretest) and seven days after all materials were delivered (posttest).

The analysis was performed using SPSS 25, covering descriptive statistics, normality tests (Shapiro–Wilk), tests for differences within groups (paired t-test or Wilcoxon), and between groups (independent t-test or Mann–Whitney). The choice of statistical test was adjusted according to the results of the normality test for each variable. Effect size (Cohen's d) was calculated to determine the strength of the intervention. Significance was set at $p < 0.05$.

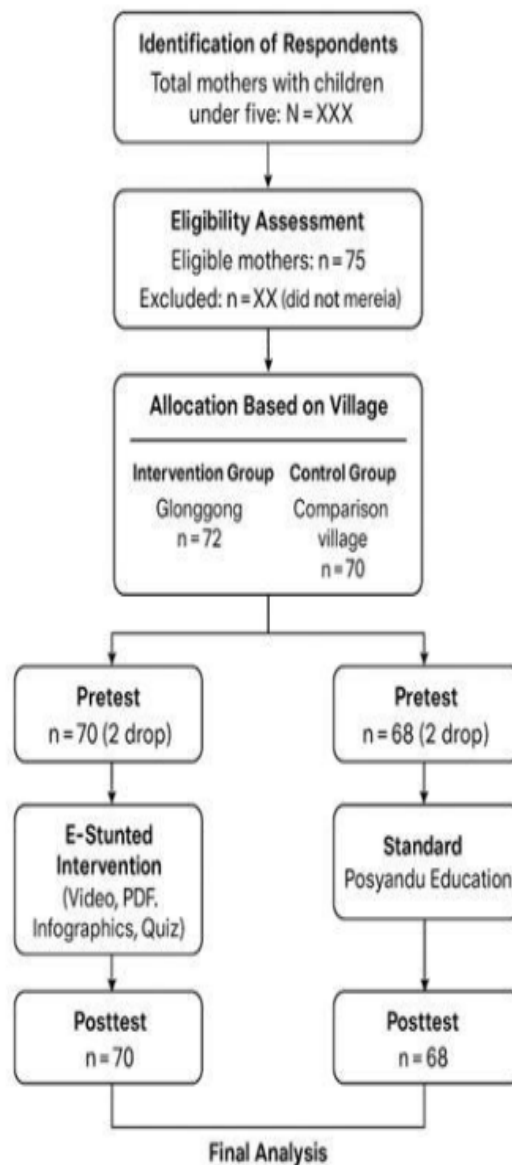


Figure 1. Sampling Technique

RESULTS AND DISCUSSIONS

1. Respondent Characteristics and Baseline Knowledge

Table 1. Respondent Characteristics

Characteristics	Intervention (n=70)	Control (n=68)	p-value
Mother's age (mean $\pm$ elementary school)	29.8 $\pm$ 5.1 years	30.1 $\pm$ 4.9 years	0.68
Education $\leq$ junior high school	38 (54.3%)	37 (54.4%)	0.99
Education $\geq$ high school	32 (45.7%)	31 (45.6%)	0.99
Own a smartphone	62 (88.6%)	59 (86.8%)	0.76
Regular visits to the health center	44 (62.9%)	42 (61.8%)	0.89

Basic characteristic analysis shows that the intervention group (n=70) and the control group (n=68) have very similar profiles. There were no significant differences in maternal age ($p = 0.68$), education level ($p = 0.99$), smartphone ownership ($p = 0.76$), or frequency of posyandu visits ($p = 0.89$). This baseline equivalence strengthens the internal validity of the study and reduces the possibility of confounding bias. The high proportion of smartphone ownership in both groups ($\approx 87\%$) supports the feasibility of digital interventions such as E-Stunted. In

addition, the majority of respondents regularly attended posyandu, reflecting relatively good health-seeking behavior, so that digital-based educational interventions could be easily absorbed.

The results of the independent t-test on the pre-test scores showed no significant difference between the intervention and control groups ($p > 0.05$). This indicates that both groups had comparable baseline levels of knowledge prior to the intervention. The results are presented in the following table:

Table 2. Baseline Knowledge

Variable	Group	Mean $\pm$ SD	n	t-value	df	p-value
Posttest Knowledge Score	Intervention	10.7 $\pm$ 2.8	70	0.43	136	0.67
	Control	10.5 $\pm$ 2.7	68			

2. Comparison of Knowledge Score Changes Between Intervention and Control Groups

Table 3. Pre-test and Post-test Knowledge of the Intervention Group and Control Group

Group	Pretest (Mean $\pm$ SD)	Posttest (Mean $\pm$ SD)	Mean Difference (Δ)	95% CI for Δ	t-value	p-value	Cohen's d
Intervention (n=70)	10.7 $\pm$ 2.8	16.2 $\pm$ 2.1	+5.5	4.8- 6.2	16.84	<0.011	1.58
Control (n=68)	10.5 $\pm$ 2.7	12.1 $\pm$ 2.5	+1.6	0.9-2.3	4.21	<0.011	0.41

In the intervention group, knowledge scores increased significantly from 10.7 $\pm$ 2.8 to 16.2 $\pm$ 2.1 ($\Delta = +5.5$). This indicates that the content in the E-Stunted application was able to provide substantial new understanding regarding stunting. An increase of 5.5 points from a total score of 20 indicates a 27.5% increase in knowledge, which is very significant in the context of short-term educational interventions. In contrast, the control group only experienced a small increase from 10.5 $\pm$ 2.7 to 12.1 $\pm$ 2.5 ($\Delta = +1.6$). This increase can be attributed to exposure to information from health centers or other media that is general in nature, but not structured and interactive like digital interventions.

The results of the paired t-test in the intervention group showed a t-value of 16.84, $p < 0.001$. This is a very large t-value, indicating a statistically and clinically significant change. Mothers of toddlers who used E-Stunted experienced a significant increase in knowledge. These results support the hypothesis that an interactive multimedia-based approach is more effective than conventional education. E-Stunted is an effective digital educational medium based on videos, informative PDFs, and interactive quizzes. The results of the paired t-test in the Control Group showed a t-value of 4.21, $p < 0.001$. Although significant, the increase was much smaller. This indicates that although routine exposure to information

(e.g., posyandu counseling) remains beneficial, the intensity and quality of the information are not comparable to the E-Stunted media.

The test results show a highly significant difference between the two groups ($p < 0.001$). The mean difference of nearly four points out of a total of 20 items reflects a substantial practical impact of education in the context of public health promotion. The test results ($t = 9.12$; $p < 0.001$) with a 95% CI: 3.1 – 4.7 show that: The increase in knowledge in the intervention group far exceeded that of the control group. The intervention effect was not coincidental, but rather a real effect of using E-Stunted. Statistically, a difference of 4 points out of a total of 20 is equivalent to a 20% increase, reflecting significant effectiveness in a short period of time.

Analysis of effect size using Cohen's d shows a very significant difference in impact between the two groups. In the intervention group, a d value of 1.58 indicates a very large effect. In health education research, effect sizes above 1.0 are relatively rare, so this finding confirms the effectiveness of the interactive digital media E Stunted in increasing knowledge. However, the magnitude of this effect size must also be interpreted with caution because this study only measured short-term knowledge and did not evaluate behavioral changes or long-term impacts. In contrast, the control group showed a d value of 0.41, which is classified as a small effect. Overall, this difference confirms that E Stunted is capable of promoting much stronger knowledge changes than non-intervention approaches.

The results of this study indicate that digital intervention through E-Stunted significantly improves the knowledge of mothers of toddlers regarding stunting prevention. These findings are in line with previous literature on the effectiveness of digital media in maternal nutrition education. Furthermore, the clinical trial of the MyKid'sNutrition protocol (Hojati et al., 2023) confirms the potential of mobile applications in improving maternal nutrition knowledge and the nutritional status of preschool children. Although the final results have not yet been published, this study reinforces the use of E-Stunted as an educational and growth

monitoring medium. In the realm of predictive technology, a study by a team in Bogor (2023) developed a stunting risk detection application based on nutrition and sanitation indicators. This application expands the scope of digital intervention functions towards screening and risk prediction, not just education (Jalaludin et al., 2025).

From a local implementation perspective, the WhatsApp approach has also proven effective. This application is contextually relevant because it utilizes a platform that is familiar and widely available in the community. The prevalence of stunting in rural areas of Indonesia reaches 53.3% compared to 34.9% in urban areas. Stunting in rural areas is mainly influenced by structural and service limitations, including limited health, sanitation, and maternal education services. Conversely, stunting in urban areas is more influenced by behavioral factors, particularly unhealthy eating practices such as excessive consumption of snacks. This emphasizes the importance of contextual interventions, prioritizing structural improvements in rural areas and encouraging healthy eating behaviors in urban areas (Fanny Dewi et al., 2025). Additionally, other technological innovations such as IoT are beginning to be applied in stunting education. This study shows the potential for synergy between smart technology and community health education, although resource challenges still need to be addressed (Solikhah & Arrozhi, 2024).

In the context of pregnancy education, research by (Muhamad et al., 2023) shows that nutritional education interventions for pregnant women with short stature can improve nutritional understanding. This highlights the importance of interventions during pregnancy to prevent stunting comprehensively. Stunting is influenced by several factors and is not only caused by nutritional intake experienced by pregnant women and children under five years of age. Therefore, interventions must also be multifactorial (Haney et al., 2023). Other researchers have also developed stunting education applications at the community level. The results of the MNBS study in Ngawi underscore that application-based education can improve health literacy if integrated with

the local health system (Kurniawan Erman Wicaksono et al., 2024) . Early stunting prevention can begin by increasing community understanding and involvement in stunting prevention and enhancing early detection programs for toddlers, which are expected to directly reduce this problem (Erika et al., 2024).

Further interpretation of the highly significant score improvement in this study can be explained through the multimodal learning mechanism. Learning models involving various media formats have been proven to strengthen understanding and short-term information retention. However, it must be acknowledged that the increase in knowledge achieved does not automatically lead to behavioral changes or a decrease in the prevalence of stunting. Long-term effectiveness requires a comprehensive approach, including nutrition-sensitive interventions and changes in the socioeconomic environment (Abdullahi et al., 2021). Nutrition-sensitive interventions are carried out by the government outside the health sector as prevention and promotion efforts, while nutrition-specific interventions are mostly carried out by the health sector with specific targets, namely pregnant women, breastfeeding mothers, and mothers of toddlers (Moorthy et al., 2020) . The significant effects observed in the intervention group indicate that E-Stunted not only has practical significance but is also relevant for adoption as a health education strategy. However, further research with a longer duration and broader coverage is needed to confirm the long-term effects and sustainability of implementation. This study has several limitations, including the short duration of the intervention, which was only seven days. Therefore, the findings primarily reflect short-term knowledge recall following the use of the E-Stunted application. In addition, the use of a self-report questionnaire may introduce response bias. Future research is recommended to employ a longer follow-up period and to include behavioral measurements in order to assess the long-term effectiveness of the intervention.

CONCLUSION

The Mobile-Based Education Application (E-Stunted) has proven to be an accessible

and effective medium for improving mothers' knowledge about stunting prevention. This program has the potential to be integrated into health promotion strategies at Community Health Centers (Puskesmas) and Integrated Health Service Posts (Posyandu), as part of a modern mHealth approach based on digital technology.

To optimize the Mobile-Based Education Application (E-Stunted), systemic support is needed, including training for health cadres, integration with a dashboard-based health information system, and long-term monitoring and evaluation.

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