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Empowering Communities to Prevent Stunting: Leveraging Mobile Apps for Breastfeeding Monitoring

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ABSTRACT Stunting remains a major public health challenge, particularly in low- and middle-income settings, where chronic malnutrition during the first 1,000 days of life continues to impair child growth and cognitive development. Despite national efforts to reduce stunting prevalence, gaps persist in effective community-based monitoring of exclusive breastfeeding practices, which are critical for optimal infant nutrition. This study aimed to evaluate the effectiveness of community empowerment through the utilization of a mobile application designed to monitor breast milk expression and adequacy as a strategy for stunting prevention. The study employed a community service–based intervention conducted in Milangasri Village, Panekan District, Magetan Regency, Indonesia. Participants included breastfeeding mothers, Posyandu cadres, community leaders, and village health workers. The intervention consisted of structured health education, training on the use of a mobile breastfeeding monitoring application, and mentoring activities. A pre-test and post-test design was applied to assess changes in participants' knowledge regarding stunting prevention. Statistical analysis was performed using the Wilcoxon signed-rank test to determine the significance of knowledge improvement following the intervention. The results demonstrated a substantial increase in participants' knowledge after the intervention. The proportion of respondents with good and very good knowledge levels increased markedly, while those with poor knowledge were eliminated. Statistical analysis revealed a significant difference between pre-test and post-test scores ($p = 0.000$; $p < 0.05$), indicating that the mobile application–based education was effective in enhancing understanding of stunting prevention and breastfeeding monitoring. In conclusion, community empowerment supported by mobile health technology is an effective approach to improving knowledge and supporting stunting prevention efforts. Integrating mobile breastfeeding monitoring applications into community health services can strengthen exclusive breastfeeding practices and contribute to the development of stunting-free villages.

INDEX TERMS stunting prevention, mobile health application, exclusive breastfeeding, community empowerment, maternal and child health

I. INTRODUCTION

Stunting remains a persistent public health problem and a major indicator of chronic undernutrition among children under five years of age. It reflects prolonged nutritional deprivation, recurrent infections, and inadequate caregiving practices, particularly during the first 1,000 days of life. Children affected by stunting face irreversible consequences, including impaired cognitive development, reduced academic performance, increased susceptibility to disease, and lower productivity in adulthood. Despite global and national commitments to reduce stunting prevalence, Indonesia continues to experience a relatively high burden, indicating that existing interventions have not yet achieved optimal effectiveness at the community level [1], [2].

Exclusive breastfeeding is widely acknowledged as one of the most cost-effective and evidence-based strategies for preventing stunting. Breast milk provides essential nutrients, bioactive compounds, and immune protection necessary for optimal infant growth and development. However, national reports indicate that exclusive breastfeeding coverage remains suboptimal due to limited maternal knowledge, inadequate monitoring, sociocultural barriers, and inconsistent support from community health systems [3], [4]. Conventional stunting prevention programs primarily rely on face-to-face counselling and periodic growth monitoring at integrated health posts (Posyandu), which are often constrained by limited human resources, time, and follow-up mechanisms [5].

Recent advancements in digital health technologies have introduced mobile health (mHealth) applications as innovative tools to strengthen maternal and child health interventions. Mobile applications have been increasingly utilized for nutrition education, breastfeeding support, and child growth monitoring, enabling real-time data recording, personalized feedback, and continuous

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engagement [6], [7]. Several studies have demonstrated that Android-based applications can improve maternal knowledge, attitudes, and practices related to infant feeding and nutrition, as well as facilitate early detection of growth faltering [8]–[10]. Moreover, mHealth interventions are considered scalable and cost-efficient, making them particularly suitable for resource-limited settings [11].

Nevertheless, existing literature reveals several important research gaps. First, most mobile-based stunting prevention studies focus on general nutritional education or growth monitoring, while specific monitoring of breast milk expression and adequacy—critical components of exclusive breastfeeding—remains underexplored [12], [13]. Second, many interventions emphasize technological adoption without adequately integrating community empowerment strategies, such as the active involvement of Posyandu cadres, community leaders, and village institutions, which are essential for sustainability [14], [15]. Third, empirical evidence on the effectiveness of combining mobile breastfeeding monitoring applications with structured community empowerment programs in rural Indonesian settings is still limited [16].

In response to these gaps, this study aims to evaluate the effectiveness of a community empowerment-based intervention utilizing a mobile application to monitor breast milk expression and adequacy as a strategy for stunting prevention. The study specifically examines changes in community knowledge regarding exclusive breastfeeding and stunting prevention before and after the implementation of mobile application-assisted education.

This article makes several key contributions. First, it provides empirical evidence on the effectiveness of a mobile breastfeeding monitoring application in improving knowledge related to stunting prevention at the community level. Second, it demonstrates the synergistic role of digital health technology and community empowerment in supporting exclusive breastfeeding practices. Third, it offers practical insights into the implementation of mobile health interventions within existing community health structures, contributing to scalable and sustainable stunting prevention models.

The remainder of this article is structured as follows. Section II describes the methods and implementation stages of the community service intervention. Section III presents the results of the pre- and post-intervention analysis. Section IV discusses the findings in relation to previous studies and outlines implications and limitations. Finally, Section V concludes the article and provides recommendations for future community-based stunting prevention programs.

II. METHODS

A. STUDY DESIGN

This study employed a community-based quasi-experimental design using a one-group pre-test and post-test approach. The design was selected to evaluate changes in participants' knowledge related to stunting prevention following a structured community empowerment intervention utilizing a mobile application for breastfeeding monitoring. The study was prospective in nature, as data were collected forward in time before and after the intervention. Randomization was not applied because the intervention was implemented at the community level as part of a public health service program, where ethical and operational considerations required the inclusion of all eligible participants within the target village [21].

B. STUDY SETTING AND DURATION

The study was conducted in Milangasri Village, Panekan District, Magetan Regency, East Java, Indonesia, an area identified by local health authorities as having a measurable burden of stunting among children under five. The intervention was carried out on 25 June 2025, from 08:00 to 12:00 Western Indonesian Time (WIB), at the village community hall. Preparatory activities, including coordination with village officials and Posyandu cadres, were conducted one month prior to implementation.

C. STUDY POPULATION AND SAMPLE

The study population comprised community members directly involved in maternal and child health services, including breastfeeding mothers, Posyandu cadres, village midwives, nurses, community leaders, and village officials. A total sampling technique was used to recruit all eligible participants who attended the community service activity and consented to participate. A total of 100 participants were included in the study. Inclusion criteria were: (1) residency in Milangasri Village, (2) active involvement in infant care or community health services, and (3) willingness to participate in both pre-test and post-test assessments. Participants who were unable to complete the intervention or assessments were excluded.

D. INTERVENTION MATERIALS

The primary intervention material was a mobile application designed to monitor breast milk expression timing and perceived adequacy for infants. The application included features for recording breastfeeding frequency, breast milk output indicators, infant feeding schedules, and educational content on exclusive breastfeeding and stunting prevention. Additional materials included standardized educational modules, presentation slides, printed leaflets, and demonstration guides. All educational content was adapted from national maternal and child health guidelines and validated by public health experts prior to implementation [22].

E. INTERVENTION PROCEDURE

The intervention followed a structured sequence. First, a baseline assessment (pre-test) was administered to measure participants' initial knowledge regarding stunting prevention and exclusive breastfeeding. Second, participants received health education sessions covering stunting risk factors, the importance of exclusive breastfeeding, and the role of monitoring breast milk adequacy. Third, hands-on training was provided on the use of the mobile application, including data entry, interpretation of indicators, and troubleshooting. Fourth, participants were encouraged to apply the application during breastfeeding monitoring and Posyandu activities.

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Finally, a post-test assessment was conducted immediately after the intervention to evaluate changes in knowledge. The entire procedure was facilitated by trained health educators and supported by local health workers to ensure consistency and accuracy [23].

F. VARIABLES AND MEASUREMENT

The primary outcome variable was participants' knowledge of stunting prevention, measured using a structured questionnaire developed for community health education. The questionnaire consisted of multiple-choice items covering stunting definition, risk factors, exclusive breastfeeding practices, and monitoring strategies. Knowledge scores were categorized into four levels: very good, good, adequate, and poor. The questionnaire demonstrated acceptable content validity and internal consistency based on previous community health studies [24].

G. DATA COLLECTION AND MANAGEMENT

Data were collected manually using paper-based questionnaires and subsequently entered into a digital database for analysis. Each participant was assigned a unique identification code to ensure confidentiality. Data accuracy was verified through double-entry procedures. All collected data were securely stored and accessible only to the research team.

H. DATA ANALYSIS

Descriptive statistics were used to summarize participant characteristics and knowledge distribution. Inferential analysis was conducted using the Wilcoxon signed-rank test to compare pre-test and post-test knowledge scores, as the data were ordinal and not normally distributed. Statistical significance was set at $p < 0.05$. Data analysis was performed using standard statistical software commonly applied in public health research [25].

TABLE 1
Distribution of pre-test and post-test frequency of knowledge on stunting prevention in Milangasri Village, Panekan District, Magetan Regency, 2025

Knowledge about stunting prevention	Pre test		Pos test		Sign
	n	%	n	%	
Very good	15	15	35	35	0,000
Good	30	30	40	40	
Enough	40	40	15	15	
Less	15	15	0	0	
Total	100	100	100	100	

I. ETHICAL CONSIDERATIONS

Ethical principles of voluntary participation, informed consent, confidentiality, and anonymity were strictly observed. Participants received a clear explanation of the study objectives and procedures prior to participation. This study was conducted as part of an approved community service program under institutional authorization and aligned with ethical standards for public health interventions [26].

III. RESULTS

The results of community service activities are as follows:

A. Community Service Results

The community service activity was held on Wednesday, June 25, 2025, at the Milangasri Village Hall, Panekan District, Magetan Regency. It was attended by 100 people, as follows:

1. Posyandu (Integrated Service Post) cadres for toddlers, Toddler Family Development
2. Breastfeeding mothers
3. Village officials
4. Community leaders
5. Village midwives and nurses

B. Distribution of pre-test frequency of knowledge about stunting prevention

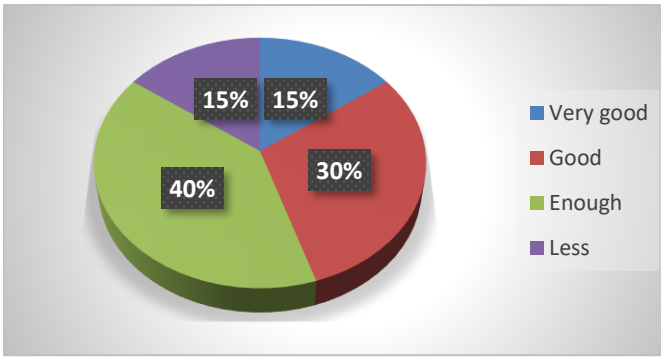

FIGURE 1 Distribution of pre-test frequency of knowledge about stunting prevention in Milangasri Village, Panekan District, Magetan Regency, 2025

FIGURE 1 shows the frequency distribution of pre-test knowledge about stunting prevention, with the majority being adequate (40%), and a small minority being very good and Less (15%) respectively.

C. Distribution of post-test frequency of knowledge about stunting prevention

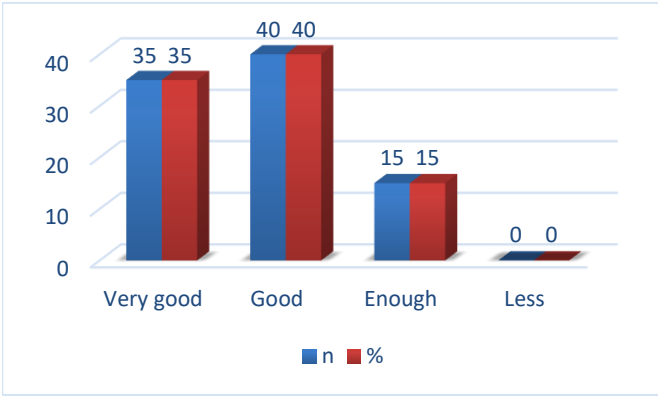

FIGURE 2 Distribution of post-test frequency of knowledge about stunting prevention in Milangasri Village, Panekan District, Magetan Regency, 2025

FIGURE 2 shows that the frequency distribution of post-test knowledge about stunting prevention is mostly good (40%) and a small portion is fair (15%).

D. Distribution of pre-test and post-test frequency of knowledge on stunting prevention

In TABLE 1, the results of the Wilcoxon statistical analysis obtained a significance value of 0.00 (<0.05), there was an

increase in knowledge about preventing stunting.

IV. DISCUSSION

A. INTERPRETATION OF FINDINGS ON COMMUNITY EMPOWERMENT AND KNOWLEDGE IMPROVEMENT

The findings of this study demonstrate a statistically significant improvement in community knowledge regarding stunting prevention following the implementation of a mobile application–based breastfeeding monitoring intervention. The Wilcoxon signed-rank test revealed a p-value of 0.000 ($p < 0.05$), indicating a meaningful increase in knowledge levels among participants after exposure to structured education and hands-on mobile application training. This result suggests that integrating digital tools with community empowerment strategies can effectively enhance awareness and understanding of exclusive breastfeeding and its role in stunting prevention.

The observed shift in knowledge categories from predominantly "adequate" and "poor" levels in the pre-test to "good" and "very good" levels in the post-test indicates that the intervention not only transmitted information but also facilitated comprehension and retention. This improvement can be attributed to several factors, including interactive learning, real-time monitoring features, and contextualized education delivered through familiar community health structures such as Posyandu. The mobile application enabled participants to visualize breastfeeding patterns and adequacy indicators, which likely strengthened cognitive engagement and practical understanding.

From a behavioural change perspective, increased knowledge is a critical precursor to improved practices, particularly in maternal and child health. Although this study primarily measured knowledge outcomes, the results imply potential downstream effects on exclusive breastfeeding adherence and early detection of nutritional risks. These findings reinforce the notion that community-based digital health interventions can serve as catalysts for empowering caregivers and health cadres, especially in rural and semi-rural settings where access to continuous professional support may be limited [27].

B. COMPARISON WITH PREVIOUS STUDIES AND POSITIONING WITHIN THE LITERATURE

The results of this study are consistent with a growing body of literature demonstrating the effectiveness of mobile health (mHealth) interventions in improving maternal knowledge and child nutrition outcomes. Several recent studies have reported that mobile applications designed for breastfeeding education and child growth monitoring significantly enhance maternal knowledge, attitudes, and self-efficacy [28], [29]. Similar to the present study, Android-based interventions in Indonesia and other LMICs have shown positive impacts on caregivers' understanding of exclusive breastfeeding and infant feeding practices [30].

However, this study extends previous findings by specifically focusing on breast milk monitoring, rather than general nutrition education alone. While earlier studies primarily emphasized complementary feeding (MP-ASI) guidance or anthropometric growth tracking, this intervention addressed a critical gap by enabling caregivers to monitor breast milk expression and perceived adequacy. This focus aligns with recent evidence highlighting that suboptimal breastfeeding practices remain a dominant contributor to stunting, even in areas with adequate food availability [31].

In contrast to purely technology-driven interventions, the present study integrated mobile application use with structured community empowerment involving Posyandu cadres, village leaders, and health workers. This hybrid approach differentiates the study from interventions that rely solely on individual smartphone use, which may face challenges related to motivation, digital literacy, and sustained engagement. Similar community-integrated models have been shown to produce more durable outcomes by reinforcing learning through social support and local accountability mechanisms [32].

Nevertheless, some differences with previous studies should be noted. While several randomized controlled trials (RCTs) have demonstrated improvements in both knowledge and child growth indicators, this study employed a quasi-experimental design without a control group. As a result, causal inferences regarding long-term nutritional outcomes cannot be fully established. Despite this limitation, the consistency of knowledge gains observed across participants strengthens the argument that mobile-assisted community empowerment is a promising approach for stunting prevention [33].

C. LIMITATIONS, STRENGTHS, AND IMPLICATIONS FOR PRACTICE AND POLICE

Despite its contributions, this study has several limitations that should be acknowledged. First, the absence of a control group limits the ability to attribute observed knowledge improvements exclusively to the intervention, as external influences cannot be entirely ruled out. Second, the study measured short-term knowledge outcomes immediately after the intervention, without assessing long-term retention or behavioural changes such as exclusive breastfeeding duration or child growth indicators. Third, the reliance on self-reported knowledge assessments may introduce response bias, as participants may provide socially desirable answers following health education sessions.

Additionally, the intervention was conducted in a single village, which may limit the generalizability of findings to other regions with different sociocultural or infrastructural contexts. Variations in smartphone ownership, internet connectivity, and digital literacy could influence the effectiveness of similar interventions elsewhere. These limitations suggest the need for future studies employing longitudinal designs, control groups, and objective outcome measures to strengthen evidence on effectiveness [34].

Despite these weaknesses, the study also exhibits notable strengths. It demonstrates the feasibility of integrating mobile health technology into existing community health systems without requiring extensive additional resources. The involvement of Posyandu cadres

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and community leaders enhanced acceptability and contextual relevance, which are critical factors for sustainability. Moreover, the use of a simple and user-friendly application increases the likelihood of adoption among caregivers with varying levels of digital literacy.

The implications of these findings are multifaceted. From a practical perspective, mobile breastfeeding monitoring applications can serve as valuable tools for strengthening maternal education and early stunting prevention at the community level. Health authorities and village governments may consider integrating such applications into routine Posyandu activities to support continuous monitoring and education. From a policy standpoint, the findings support national strategies advocating digital transformation in health services, particularly for maternal and child health programs in underserved areas [35].

Furthermore, this study contributes to the theoretical understanding of how digital health interventions can enhance community empowerment by combining technological innovation with social and institutional support. Future research should explore scaling strategies, cost-effectiveness, and integration with national health information systems to maximize impact. Ultimately, empowering communities through accessible digital tools represents a promising pathway toward achieving sustainable reductions in stunting prevalence and improving child health outcomes.

V. CONCLUSIONS

This study aimed to evaluate the effectiveness of a community empowerment intervention supported by a mobile application for monitoring breast milk expression and adequacy as a strategy for stunting prevention. The findings demonstrate that the integration of mobile health technology with structured community-based education significantly improved participants' knowledge regarding exclusive breastfeeding and stunting prevention. Quantitative analysis revealed a marked shift in knowledge levels following the intervention, with the proportion of participants categorized as having "very good" knowledge increasing from 15% at baseline to 35% after the intervention, while those with "poor" knowledge declined from 15% to 0%. Furthermore, the Wilcoxon signed-rank test indicated a statistically significant difference between pre-test and post-test knowledge scores ($p = 0.000$; $p < 0.05$), confirming the effectiveness of the intervention. These results suggest that mobile application–assisted education can enhance comprehension, engagement, and awareness among breastfeeding mothers, Posyandu cadres, and community stakeholders, thereby strengthening early stunting prevention efforts at the grassroots level. The study also highlights the importance of community involvement in digital health interventions, as the active participation of local health cadres and community leaders contributed to the acceptability and feasibility of the program. Despite these positive outcomes, the study was limited by its short-term evaluation period, absence of a control group, and focus on knowledge outcomes rather than direct behavioural or anthropometric indicators. Therefore, future work should include longitudinal and controlled study designs to assess the sustained impact of mobile breastfeeding monitoring applications on exclusive breastfeeding practices, infant nutritional status, and child growth outcomes. Further research is also needed to explore the scalability, cost-effectiveness, and integration of such applications into national maternal and child health information systems. Expanding the intervention to diverse sociocultural and geographical contexts will be essential to determine its generalizability and adaptability. Overall, this study provides empirical support for the use of mobile health technology as a complementary tool for community empowerment and reinforces its potential contribution to sustainable stunting reduction strategies.

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DATA AVAILABILITY

No datasets were generated or analyzed during the current study.

AUTHOR CONTRIBUTION

Agung Suharto conceptualized the study, designed the intervention, and supervised the implementation of the community service program. Nana Usnawati contributed to data collection, coordination with community stakeholders, and intervention delivery. Astin Nur Hanifah was responsible for data analysis, interpretation of results, and manuscript drafting. All authors reviewed, revised, and approved the final manuscript and agreed to be accountable for all aspects of the work.

DECLARATIONS

ETHICAL APPROVAL

This study was conducted as part of a community service program. All participants were informed about the purpose of the activity and provided verbal informed consent prior to participation. Confidentiality and anonymity were maintained throughout the study.

CONSENT FOR PUBLICATION PARTICIPANTS

Consent for publication was given by all participants.

COMPETING INTERESTS

The authors declare no competing interests.

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