

The effectiveness of integrating the Lumbung Hidup and Nutritional Rangers mobile applications in preventing stunting among underprivileged families in Kediri Regency

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Abstract

Stunting remains a significant public health issue in low and middle-income nations, including Indonesia. Globally, approximately 151 million children are affected by stunting. This study involved 22 children under five years old from economically disadvantaged families in Kediri Regency. Its aim was to assess the effectiveness of the Lumbung Hidup and Nutritional Rangers mobile applications in reducing stunting. Data analysis included both quantitative paired sample t-tests and qualitative thematic analysis methods. Results revealed significant improvements in children's nutritional status ($p < 0.05$) across all Z-scores (weight-for-age, height-for-age, and weight-for-height), as well as five major qualitative themes. The significant improvements in Z-scores highlight the potential effectiveness of the integrated intervention in enhancing child nutrition. This comprehensive strategy could serve as a sus-

tainable and holistic solution to address malnutrition and stunting, warranting broader implementation in similar settings.

Introduction

Stunting remains a critical public health challenge, particularly in underprivileged communities where access to adequate nutrition and healthcare services is often limited. Stunting is characterized by impaired growth and development in children and can have long-lasting effects on cognitive function, educational performance, and future economic productivity.¹⁻⁴ Addressing stunting requires a multifaceted approach that targets both immediate nutritional needs and long-term health and educational outcomes.⁵

Recent data from Kediri Regency in 2022 highlights the severity of the issue, with a stunting prevalence of 10.23% among 7,752 toddlers. Nutritional deficiencies, including stunting, are among the most significant challenges affecting infants and young children. These conditions can impair a child's well-being, leading to diminished cognitive and motor development and increased susceptibility to various illnesses due to weakened immune systems. Economic constraints are a major contributing factor, as many families often struggle to provide nutritious food. Additionally, suboptimal cross-sectoral collaboration, inadequate monitoring of stunting management, and insufficient educational resources and support systems further exacerbate the problem. This lack of comprehensive education and sustained support for mothers and caregivers leads to gaps in stunting management, often leaving families feeling isolated and stressed, which negatively affects child-rearing practices.^{6,7} In recent years, the rapid expansion of mobile technology has created new opportunities for health interventions. Mobile applications, thanks to their widespread accessibility, have the potential to deliver health information, facilitate screenings, and provide personalized recommendations to diverse populations. An innovative solution to address nutritional challenges is the Nutritional Rangers mobile application (Figure 1). This app is designed to enhance nutritional practices through education and behavior modification, utilizing mobile technology to empower families with knowledge about balanced diets and healthy eating habits.⁸ In addition to this, the Lumbung Hidup intervention focuses on enhancing household food security through sustainable practices, such as self-sufficient food production. This includes the cultivation of nutritious crops and small-scale livestock farming, like raising catfish (lele) in buckets or small containers to meet protein needs. Together, these interventions aim to address both immediate nutritional needs and long-term food security for underprivileged families, thereby contributing to efforts against stunting and improving child health outcomes.⁹

This study aims to explore the integration of these two interventions in a comprehensive strategy to prevent stunting among underprivileged families. By combining the strengths of both approaches,

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the goal is to develop a holistic method that not only identifies at-risk children but also empowers families with the knowledge and resources needed to improve nutritional outcomes. This case study will evaluate the effectiveness of this integrated approach, examining its impact on screening accuracy, nutritional improvements, and overall child health outcomes. The findings from this research will contribute to the growing body of knowledge on mobile health interventions and their potential to address complex public health issues like stunting. Furthermore, the study will provide insights into the practical challenges and opportunities associated with implementing such technology-based solutions in resource-limited settings. By delivering integrated support—ranging from regular screening, monitoring, education, and food assistance to intensive guidance—this intervention aims to accelerate progress in reducing stunting and other nutritional issues, thereby enhancing the success of nutritional therapy for underprivileged families.

Materials and Methods

Study design

This research employs a mixed-methods approach, integrating both quantitative and qualitative data collection methods to assess the effectiveness of the Lumbung Hidup and Nutritional Rangers mobile applications in preventing stunting among underprivileged families in Kediri Regency. The study spans a 3-month period, allowing for comprehensive monitoring and evaluation of the intervention's impact.

Participants

The study includes 22 children under the age of five from underprivileged families in Gempolan Village who are identified as underweight and stunted. All participants received access to both interventions, ensuring a holistic approach to addressing their nutritional needs.

Intervention

The intervention consists of two integrated components: Lumbung Hidup and Nutritional Rangers. The Lumbung Hidup intervention focuses on enhancing household food security through sustainable practices. Families are encouraged to engage in self-sufficient food production, including the cultivation of nutritious crops and small-scale livestock farming. Specifically, they are trained to raise catfish (lele) in buckets or small containers to meet protein needs, thereby enhancing dietary diversity. The Nutritional Rangers mobile application provides nutritional practices by offering educational content, personalized dietary recommendations, daily dietary tracking, and behavior modification strategies. The goal is to empower families with knowledge of balanced diets and promote healthier eating habits for their children. Families in the intervention group received training on effectively using both interventions, along with regular support from community health workers to reinforce them.

Data collection

Data were collected at the end of the 3-month intervention to measure its impact using the following intervention. The following

methods were used: i) anthropometric measurements (quantitative data): standard techniques employed to measure the height and weight of children at Integrated Service Posts (Posyandu). This helps evaluate their growth and nutritional status by specifically analyzing Z-scores for weight-for-age, height-for-age, and weight-for-height; interviews and focus groups (qualitative data): in-depth interviews and focus group discussions with parents and caregivers to explore their experiences using the applications, challenges encountered, and perceived benefits. This qualitative data provides insights into the feasibility and acceptability of the interventions within the community context.

Data analysis

Quantitative analysis utilizes descriptive statistics to summarize the baseline characteristics of the study population. Paired t-tests were employed to compare changes in anthropometric measurements, specifically weight and height, between pre- and post-test assessments. For qualitative analysis, thematic analysis was conducted on interviews and focus group transcripts to identify recurring themes and insights related to the usability, challenges, and impact of the Lumbung Hidup and Nutritional Rangers applications.

Ethical clearance

Ethical approval for this study was obtained from the local institutional review board. Informed consent was acquired from all participating families, who received clear explanations regarding the study's purpose, procedures, and potential benefits. Participants were assured of confidentiality, and all data were anonymized to protect their privacy.

Results and Discussion

The age distribution of the respondents was relatively balanced, with the largest proportion (41%) being children aged 48-60 months old. The majority of the children (68%) were male (Table 1). A significant improvement was observed in both weight and height from the pre-test to the post-test periods, indicating a positive impact of the interventions. The mean weight increased progressively from 11.25 kg at the pre-test to 12.20 kg, 13.50 kg, and 14.48 kg in subsequent post-test phases. Similarly, the mean height improved from 89.29 cm at the pre-test to 89.57 cm, 89.64 cm, and eventually 100.00 cm by the final post-test assessment (Table 2). This progressive improvement demonstrates the positive

Table 1. Characteristics of respondents.

Characteristics	N	%
Age		
24-36 month	6	27%
36-48 month	7	32%
48-60 month	9	41%
Sex		
Male	15	68%
Female	7	32%

Table 2. Comparison of nutritional status on pre- and post-test.

Nutritional state	N	Pre-Test			Post-Test 1			Post-Test 2			Post-Test 3		
		Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Weight	22	11.25	9.00	12.70	12.20	10.02	13.76	13.50	11.18	15.64	14.48	12.13	16.76
Height	22	89.29	79.70	99.00	89.57	80.00	99.50	89.64	80.50	100.0	89.98	81.00	100.5

impact of the Lumbung Hidup intervention and the Nutritional Rangers mobile application in enhancing the nutritional status of children with nutritional problems from underprivileged families.

The paired sample t-test results indicated a significant improvement in the nutritional status of children ($p < 0.05$) across all Z-scores, including weight-for-age, height-for-age, and weight-for-height (Table 3). This demonstrates the positive impact of the nutritional therapy provided through the Lumbung Hidup program and the comprehensive screening, monitoring, and educational support facilitated by the Nutritional Rangers mobile application.

Qualitative results

Interviews and focus groups

The qualitative data collected through in-depth interviews and focus group discussions provided valuable insights into the experiences of families using the Lumbung Hidup and Nutritional Rangers applications. Common themes that emerged from the analysis included: i) Enhanced knowledge and confidence: participants reported a significant increase in their understanding of child nutrition and optimal feeding practices. Many expressed that the information provided by the Nutritional Rangers application was accessible and easy to implement, leading to more balanced and nutritious meal planning for their children. As one parent noted, “I now understand which foods are essential for my child’s growth. The app has simplified the process, boosting my confidence in providing healthier meals.” ii) Positive behavioral changes: the applications encouraged positive changes in the dietary behaviors of parents and caregivers. Many parents began diversifying their children’s diets, incorporating a wider range of vegetables, proteins, and other essential nutrients while paying closer attention to portion sizes and meal schedules. A caregiver shared, “Previously, we would serve whatever was available. Now, we make a conscious effort to include vegetables and proteins in every meal. The app has improved our meal planning”. iii) Challenges with technology: despite the overall positive feedback, some families faced challenges related to the use of mobile technology, such as limited internet access, technical difficulties, and a lack of familiarity with smartphone functions. One participant mentioned, “There were times when the app would not load properly, or we had trouble navigating it”. These challenges highlight the need for ongoing technical support and user training to maximize the intervention’s reach and effectiveness. iv) Community support and engagement: the role of community health workers was crucial in the successful adoption of the applications. Regular follow-ups and personalized support from these workers helped families stay engaged with the interventions. A parent shared, “The health worker visits were very helpful. They showed us how to use the apps and answered all our questions”. This underscores the importance of community engagement in enhancing the adoption of digital health interventions. v) Perceived benefits and impact: many parents observed noticeable improvements in their children’s

health and growth, including increased appetite, energy levels, and overall vitality. These positive changes were attributed to the combined effects of the mobile applications and the continuous support they received. As one caregiver remarked, “My child’s appetite has improved, and they seem more active and healthier”. Such testimonials indicate the perceived effectiveness and tangible benefits of the integrated intervention approach.

The Nutritional Rangers mobile application has proven to be an effective tool for continuous education and self-monitoring of nutritional status for families, as well as for screening and monitoring by healthcare workers. Education is a crucial intervention to enhance the success of nutritional improvements in young children. With proper educational interventions, parents are better equipped to provide adequate nutrition in terms of type, composition, quantity, quality, and preparation methods. This improvement in parental capability significantly influences children’s daily caloric intake, thereby improving their overall nutritional situation for nutrition education presents several advantages.¹⁰⁻¹²

Using a mobile application for nutrition education offers several advantages. It facilitates the rapid dissemination of information and provides an engaging learning experience by actively involving families according to their needs. This more complex learning experience enhances the success of learning objectives, impacting cognitive areas and affective and psychomotor aspects.¹³⁻¹⁵

Additionally, the Nutritional Rangers application includes features for daily nutritional intake screening and periodic weight monitoring. These features are vital for healthcare workers because effective screening and monitoring of nutritional status can significantly improve the success of nutritional improvement programs and help prevent other nutritional issues. Healthcare workers can quickly assess the progress of a child’s nutritional status, enabling

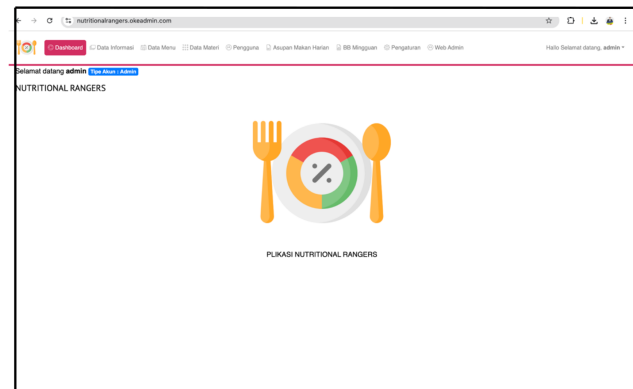


Figure 1. Nutritional Ranger application. Source: <https://nutritionrangers.okeadmin.com/login>

Table 3. Paired sample t-test (Z-score) pre- and post-test.

		N	Mean	SD	SE	p-value
Z-score Weight/Age	Pre-Test	22	-2.36	0.32	0.07	0.006
	Post-Test	22	-0.53	0.43	0.09	
Z score Height/Age	Pre-Test	22	-1.44	0.75	0.16	0.000
	Post-Test	22	1.86	0.85	0.18	
Z score Weight/height	Pre-Test	22	-2.46	0.69	0.15	0.000
	Post-Test	22	-2.44	0.80	0.17	

timely decision-making to enhance child health outcomes. The active collaboration between families and community health workers in using the Nutritional Rangers application improves communication between healthcare providers and families, ensuring the necessary support during the nutritional improvement.^{13,15,16}

On the other hand, the Lumbung Hidup intervention focuses on enhancing household food security, particularly among underprivileged families. This program enables families to become more self-sufficient in meeting their daily nutritional needs, which is crucial for improving child nutrition. Lumbung Hidup provides essential protein sources for children's nutrition improvement through sustainable small-scale livestock farming, such as raising catfish (lele) in buckets. Additionally, cultivating home-grown vegetables increases the intake of vitamins and minerals, enhancing dietary diversity and fulfilling both macro and micronutrient needs.¹⁷

The food self-sufficiency promoted by Lumbung Hidup is expected to sustainably increase the intake of nutritious food within families, with a particular focus on children. Protein sources from catfish farming and nutrient-rich vegetables from home gardens ensure a more diverse and balanced diet. This program addresses protein needs and contributes to overall nutritional improvement, which is vital in reducing stunting and other nutritional problems.^{17,18} Parents reported increased knowledge and confidence in child nutrition and feeding practices, which led to more balanced and nutritious meals for their children. This aligns with the theoretical benefits offered by the Nutritional Rangers application, which provides accessible and engaging nutritional education. Parents also noted positive behavioral changes, such as incorporating a wider variety of foods and being more attentive to portion sizes and meal timing. These qualitative insights support the quantitative improvements observed.^{11,19}

However, technology-related challenges were identified, including limited internet access and technical difficulties, highlighting the need for ongoing technical support and user training. The role of community health workers in facilitating the effective use of the applications was crucial, emphasizing the importance of community engagement in the success of digital health interventions.^{11,19,20}

Parents observed noticeable improvements in their children's health and growth, attributing these positive changes to the combined effects of the applications and the support they received. These observations are consistent with the quantitative data, which demonstrate significant improvements in children's weight and height, thereby confirming the efficacy of the integrated intervention in improving child health outcomes.^{8,11,21}

Conclusions

The study findings, supported by data and statistical analysis, demonstrate that the Lumbung Hidup program effectively enhances the nutritional status of toddlers from economically disadvantaged families. The significant improvements in Z-scores for weight-for-age, height-for-age, and weight-for-height underscore the potential of this intervention in promoting better child health outcomes. Given its comprehensive approach, this program holds substantial promise for broader implementation as a sustainable and holistic strategy to combat malnutrition and stunting. Expanding the reach of these interventions could play a critical role in addressing nutritional deficiencies and fostering long-term improvements in child health and development.

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