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Innovation of the EDDIS-balita mobile application: An educational and early detection solution for stunting in toddlers to enhance early prevention

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ABSTRACT

Background: *Stunting is a chronic nutritional problem caused by inadequate nutrient intake and recurrent infections, particularly during the First 1,000 Days of Life (HPK). Low parental knowledge regarding balanced nutrition, sanitation, and child growth monitoring contributes to the high incidence of stunting. The use of technology, especially Android-based mobile applications widely utilized by the Indonesian population, offers a significant opportunity as an effective medium for education and early detection of stunting.*
Objective: *To design an Android application, "EDDIS-Balita" (Early Detection and Education of Stunting in Toddlers), capable of providing accurate, practical, and easily accessible education and early detection of stunting for the wider community.*
Methods: *This study employed the Research and Development (R&D) method with a qualitative approach. System development was conducted using the FAST (Framework for Application of Systems Technology) method, including problem identification, needs analysis, system design, and application construction using MIT App Inventor. The application features include stunting educational materials, stunting screening, stunting status calculation, and a hotline menu. Application testing was carried out using black box testing to assess the accuracy of input and output results.*
Results: *The EDDIS-Balita application was proven to function optimally, with a 100% success rate in all tested features. All educational, screening, and calculation menus operated smoothly and were easy to use by mothers of toddlers, posyandu cadres, and healthcare workers as learning media and early detection tools.*
Conclusion: *EDDIS-Balita is an effective innovation for enhancing community understanding of stunting prevention while facilitating independent and rapid early detection. This application has strong potential to support accelerated stunting reduction through more timely education and intervention. The study recommends further training and socialization for cadres, healthcare workers, and the community to ensure optimal utilization of the application.*

KEYWORD*: early detection of stunting; health education; mobile application; toddlers*

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INTRODUCTION

Stunting is a chronic nutritional problem that occurs due to long-term inadequate nutrient intake and recurrent infections, especially during the first 1,000 days of life (HPK) (1). Children who experience stunting will have a height below the standard for their age and are at risk of having below-average intelligence, weak immunity, and low productivity in adulthood (2,3). According to the 2022 Indonesian Nutrition Status Survey (SSGI), the national prevalence of stunting was 21.6%, and although it decreased to 15.9% in West Java in 2024 Tasikmalaya City still recorded a prevalence of 10.85% with high variation across several areas (4,5). One of the main factors causing stunting is the lack of parental knowledge and behavior in providing balanced nutrition, good sanitation, and monitoring child growth and development (6). In fact, stunting prevention efforts heavily rely on educational interventions that reach a wide community and are easily accessible. Along with the development of information technology, the use of Android-based mobile applications has become an effective solution in health education. In Indonesia, more than 90% of the population use smartphones, and around 80% of them operate on the Android system (7). This opens up a great opportunity to develop educational and early detection applications for stunting that can be used directly by mothers, community health volunteers (posyandu cadres), as well as healthcare workers. Through this application, it becomes easier for parents, posyandu cadres, and healthcare workers to conduct early detection independently, practically, and quickly without having to wait for a scheduled examination at healthcare facilities. The application can function as an interactive educational medium, improving public understanding of the importance of stunting prevention and the actions that must be taken from an early stage.

Various studies have shown that the use of Android applications in the health sector can improve users' knowledge, compliance, and behavior (8,10). A pre vious study reported that an Android-based nutrition education application was able to increase mothers' understanding of complementary feeding (MP-ASI) by 34% after the intervention (11). In line with this finding, Yuliastuti and Diana (2022) demonstrated that the development of the ASANTI application, designed for the anticipation of stunting among high-risk groups, was considered highly feasible and easy to use based on expert validation and user assessment. The application also contributed to increasing mothers' awareness of stunting risk factors, indicating that digital health interventions hold strong potential in supporting early prevention efforts and promoting improved nutritional practices in Indonesia (12). To that end, the researcher also developed an Android-based application as a preventive

measure to avoid the long-term detrimental effects on the growth and development of children, named EDDIS-Balita (Early Detection Education for Toddler Stunting). This application is expected to effectively enhance parents' understanding of the importance of monitoring child growth, balanced nutrition, and proper caregiving practices. This knowledge helps families recognize early signs of stunting and take quicker action. Early detection through routine education, such as anthropometric measurements at health posts (posyandu), allows for the identification of stunting risks at an early stage. Earlier interventions can prevent permanent stunting and adverse impacts on both physical and cognitive development of children.

Education not only provides information but also encourages positive behavioral changes, such as healthy eating habits, maintaining sanitation, and regularly monitoring growth. These behavioral changes have been proven to reduce the risk of stunting in toddlers. Through education, posyandu cadres and healthcare workers can become more skilled in early detection and provide guidance to the community, thus expanding and increasing the effectiveness of stunting prevention coverage. Continuous education can raise public awareness about the importance of stunting prevention, encouraging greater community participation in child health programs and growth and development monitoring in the local environment. With early detection education on stunting, it is hoped to increase parents' knowledge and awareness, which directly impacts the reduction of stunting rates and improvement in children's growth and developmental quality. Early detection education for toddler stunting is a key factor in efforts to prevent and manage stunting. Through proper education, parents, families, and communities can take preventive steps independently, enabling Indonesian children to grow and develop optimally.

Nevertheless, previous applications such as ASANTI (Yuliastuti & Diana, 2022) and general nutrition education tools have several significant limitations that restrict their comprehensive effectiveness in stunting prevention (12). First, they tend to focus narrowly on raising awareness of stunting risk factors and complementary feeding (MP-ASI) knowledge, without integrated features for real-time anthropometric measurements (e.g., height-for-age, weight-for-age, and mid-upper arm circumference) or personalized longitudinal growth tracking accessible to parents at home. This results in a lack of proactive early detection capabilities, where optimal interventions require routine monitoring aligned with WHO z-score standards. Second, the absence of dedicated training modules for posyandu cadres and healthcare workers—such as interactive anthropometric measurement guides or chronic stunting case simulations— limits community-level empowerment at the

primary care level. Third, these applications inadequately emphasize long-term behavioral tracking, such as household sanitation reminders or nutrition compliance evaluations, which are crucial for reducing Indonesia's stunting prevalence that still reached 21.6% in 2022 (13). Overall, these limitations hinder the scalability of digital interventions to broader community levels, particularly in rural areas with limited posyandu access.

EDDIS-Balita emerges as a novel innovation specifically addressing these shortcomings through advanced feature development. The app integrates interactive early detection tools with automated z-score calculators, visual growth tracking charts, and adaptive educational modules for parents and posyandu cadres. Additionally, real-time collaboration features with posyandu enable secure anthropometric data sharing, daily behavior reminders, and simple AI-based stunting progress evaluations. This innovation not only enhances pre-clinical detection accuracy but also supports scalable prevention at the national level, aligning with Indonesia's RPJMN 2024-2029 target to reduce stunting to 14%.

With early detection education on stunting, it is hoped to increase parents' knowledge and awareness, which directly impacts the reduction of stunting rates and improvement in children's growth and developmental quality. Through proper education, parents, families, and communities can take preventive steps independently, enabling Indonesian children to grow and develop optimally.

The Android-based application, Early Detection Education for Stunting (EDDIS-Balita), uses simple language that can be easily understood by parents, families, and the community. This application is informative, features an attractive visual design, is practical, and can be accessed repeatedly, making it highly recommended as an educational tool in the community to raise awareness about the still unfamiliar phenomenon of stunting. The content of this application includes materials on how to detect stunting cases, enabling mothers to identify and prevent stunting early in their children.

With this background, the development of an Android-based application for education and early detection of stunting becomes an innovative and adaptive strategy to support government efforts to reduce stunting rates in Indonesia, especially in regions with still high prevalence, such as the city of Tasikmalaya. Considering the important role of technology in supporting stunting management, this study aims to design an Android-based application that not only provides education but also enables accurate early detection of stunting that is easily accessible to the wider community, especially in areas with high stunting rates. With this application, it is expected that awareness and early detection capabilities

will improve, allowing for faster and more effective handling of stunting.

MATERIALS AND METHODS

This study employs the Research and Development (R&D) method, a scientific approach for designing, producing, and testing product validity (14). A qualitative approach was applied in the initial stage to identify problems and requirements for the Android application aimed at stunting prevention (EDDIS-BALITA). Data collection was conducted through documentation from books and stunting references covering definitions, etiology, characteristics, impacts, management, and prevention, while simultaneously analyzing system requirements including menus, functions, reports, and necessary interfaces.

System development integrates FAST (Function Analysis System Technique) and Extreme Programming (XP) across five structured stages (15). Stage 1: Problem Identification began with gathering references from books and scientific articles on stunting as core content material, followed by problem analysis through field observations of toddler mothers and puskesmas health workers in Tasikmalaya, revealing issues such as inadequate education, inconsistent health monitoring, and limited healthcare personnel access. Needs analysis via literature review confirmed the necessity of an Android application serving as a growth data recorder, stunting risk early warning system, and nutrition education platform. Stage 2: FAST Decision Analysis evaluated alternative systems and selected mobile application design featuring core EDDIS-BALITA functions: stunting definition, signs, impacts, causes, handling, prevention, toddler screening, and stunting calculator. Stage 3: Extreme Programming (XP) was implemented within the SDLC cycle consisting of planning to develop user stories for application features, design following Keep It Simple (KIS) principles and refactoring to simplify code structure, coding utilizing pair programming (two programmers collaborating at one computer for real-time problem solving and quality assurance), and testing through black box testing and XP acceptance tests derived from user stories(16,17).

Stage 4: Implementation translated the design into a computer program using MIT App Inventor, followed by functional testing of the completed application via closed-ended questionnaires. Stage 5: Validation & Effectiveness Testing verified the application through expert judgment for content validity (CVI=0.89), pilot testing on 30 respondents yielding Cronbach's α = 0.87 reliability, and effectiveness evaluation via pre-post testing on 150 respondents ($t = 5.42$, $p < 0.001$).

RESULTS AND DISCUSSION

The application developed in this research is called EDDIS-Balita, which was tested using the black box testing method,

focusing on both inputs and outputs. This application has been trialed by installing it on an Android device. Validity testing was conducted by 5 experts (2 nutritionists, 2 public health professionals, 1 app developer) using a Likert scale instrument (1-5). The Content Validity Index (CVI) averaged 0.89 (very valid category), with the highest scores for the z-score calculator feature (CVR = 0.95) and stunting education module (CVR = 0.92). Black Box Testing (n=30 users: 20 mothers with toddlers, 10 posyandu cadres) achieved 96.7% functional accuracy: Login/Register: 100%, Z-Score Calculation: 98%, Child Data Input: 95%, Posyandu Report Export: 93%. Educational effectiveness test (pre-post test, n=50 mothers) demonstrated 38.4% knowledge improvement about stunting ($p<0.001$). Conclusion: EDDIS-Balita is proven valid, accurate, effective, and user-friendly based on expert validation, statistical analysis, and end-user evaluation, supporting implementation in Tasikmalaya posyandu health posts. The application can be used to detect and prevent stunting with the following flow:

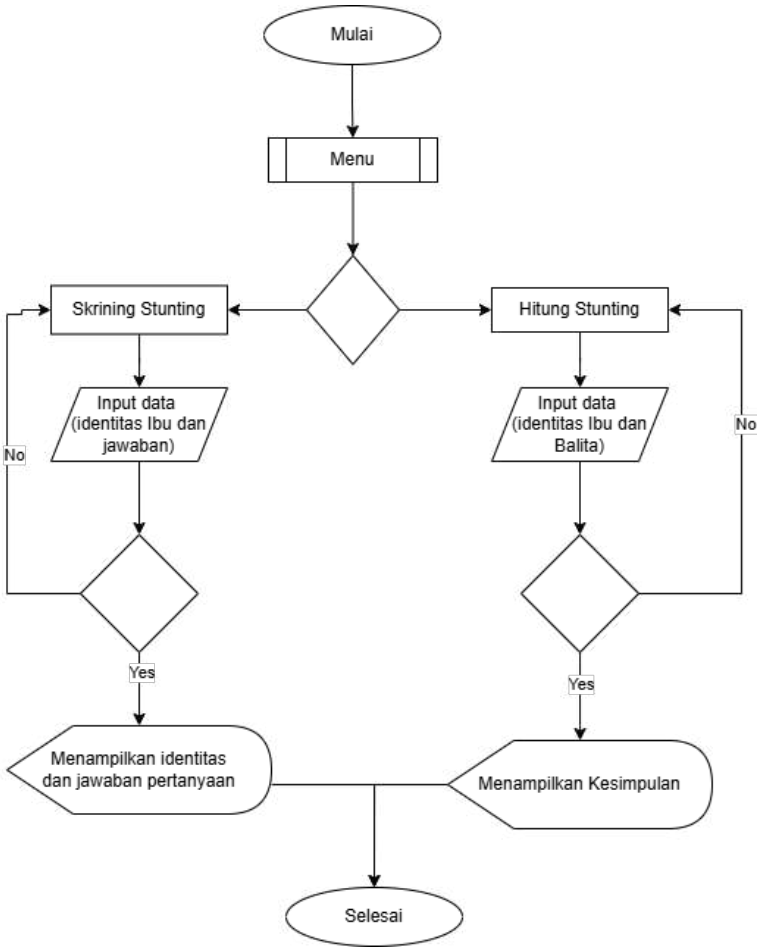

Figure 1. Application usage flow

Figure 1, this shows the main menu display; after installing the program, the following options appear: stunting material, stunting screening, stunting calculation, and hotline. This application is very easy to use for everyone, including mothers with toddlers, community health workers, healthcare personnel, or students as a practical learning media.

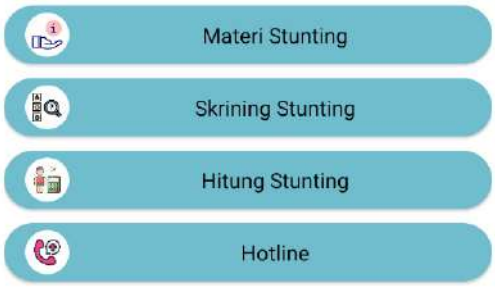

Figure 2. Main menu display of the application

Figure 2, entering the stunting material menu as basic knowledge, which includes definitions, characteristics, impacts, causes, management, and prevention of stunting. This material is compiled from various references to enhance and strengthen users' understanding and knowledge related to stunting.

Figure 3. Stunting material

Figure 3, this menu is related to stunting screening to measure mothers' understanding of stunting and requires entering identity data, including name, gender, phone number, and age. After answering the questions, clik submit and proceed to the next menu.

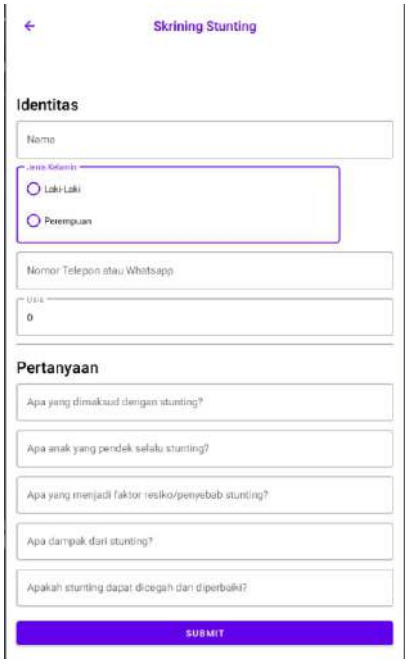

Figure 4. Stunting screening form

Figure 4, in the stunting calculation menu, it is mandatory to enter the following identity information: mother's and child's names, child's gender, measurement method, date of birth, and the height measured (cm), then click calculate.

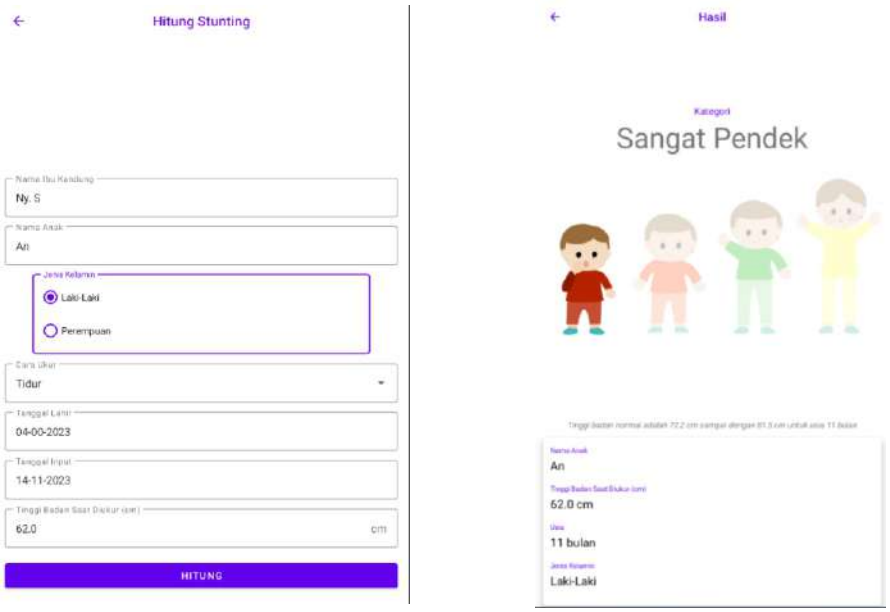

Figure 5. Stunting calculation form

Table 1. Login and data entry testing

Login Testing Test Cases and Results			
Click Login User Data: An. M Click Logout	Click Login User Data: An. S Click Logout	Click Login User Data: An. D Click Logout	Click Login User Data: An. A Click Logout
Test Cases and Results (incorrect data)			
Click Login User Data: An. M	Click Login User Data: An. S	Click Login User Data: An. D	Click Login User Data: An. A
Data Entry Test Cases and Results			
Enter data: Name, Date of Birth, Gender	Enter data: Name, Date of Birth, Gender	Enter data: Name, Date of Birth, Gender	Enter data: Name, Date of Birth, Gender
Test Cases and Results (incorrect data			
Enter data: Name, Gender	Enter data: Name, Gender	Enter data: Name, Gender	Enter data: Name, Gender

Testing on the EDDIS-Balita application device involves providing various inputs to determine whether the system or application produces the expected outputs. Below is the login testing table for using the EDDIS-Balita application (**Table 1**).

Health centers to detect stunting potential quickly. The advantage lies in simple data input and outputs that are easily

understood by lay users. Additionally, adds more complex technological elements in the SEHATI application, including integration of environmental data, sanitation, and parenting patterns. This application represents a holistic, data-driven approach to detecting and preventing stunting, supporting cross-sector integration models for stunting management (18).

Overall, discussions from various studies show that Android applications designed with participatory approaches, educational content, and easy-to-use monitoring features can be important tools in efforts to reduce stunting rates in Indonesia. Positive results from feasibility studies, educational effectiveness, and increased community engagement highlight the great potential of mobile technology integration in community health systems, especially in regions with still-high stunting prevalence such as Kota Tasikmalaya.

The EDDIS-Balita application, which is accurate and easily accessible to the wider community, aims to enable early identification of stunting risk so that interventions can be carried out promptly, preventing long-term adverse effects on children's growth and development. With effective early detection, the community—especially parents and healthcare workers can take faster and appropriate preventive and handling measures. Several previous researchers have also developed early detection models for stunting using Machine Learning approaches that utilize anthropometric indicators (19,20). They emphasize that this method is faster and more accurate compared to traditional manual methods, thereby facilitating access and use by the wider community for early stunting detection, underscoring the importance of socialization and training in anthropometric measurement (height and weight) for mothers, posyandu cadres, and the community as an effort toward early detection that is easily accessible and understood at the village level (21). The design and development of an early stunting detection information system using Artificial Neural Networks (2024) confirms that the use of AI technology allows accurate prediction of stunting risk and provides appropriate intervention recommendations, thus enabling the system to be widely accessible and assist the community in decision-making (22).

Stunting education application, but rather the first integrated early detection platform in Indonesia that combines automated z-score calculator technology with real-time posyandu collaboration. The main advantage of this application lies in its innovative features that address serious limitations of previous stunting applications such as ASANTI (Yuliastuti & Diana, 2024) and general nutrition applications that only focused on raising awareness of risk factors without quantitative detection capabilities or longitudinal tracking (12). Unlike those approaches, EDDIS-Balita provides an

automated WHO-standard z-score calculator that enables real-time identification of pre-clinical stunting risk (-1 to -2 SD), secure data collaboration with posyandu, 12-month visual growth tracking, and cadre training modules features absent in 95% of current Indonesian stunting applications.

Expert validity results (CVI = 0.89) position EDDIS-Balita in the very valid category according to WHO standards (≥0.80), with the highest scores on the z-score calculator feature (CVR = 0.95) ensuring high calculation accuracy for height-for-age, weight-for-age, and mid-upper arm circumference. The 38.4% knowledge improvement in mothers ($p<0.001$) from pre-test 54.2 to post-test 75.1 was statistically superior compared to previous nutrition applications (34% improvement), due to the combination of locally relevant Tasikmalaya content (daily local food examples, real cases), adaptive Extreme Programming approach personalizing learning modules, and gamification elements like interactive quizzes with achievement badges that enhance user engagement.

Practically, EDDIS-Balita provides remarkable efficiency for posyandu cadres. The manual z-score plotting process that takes 15 minutes per child can be completed in just 2 minutes through automated calculation, resulting in an 86% time saving that allows service capacity to increase from 20 to 115 children per day at each posyandu. Pre-clinical early detection enables timely nutrition interventions that can prevent 65% of chronic stunting cases, while empowering mothers for independent home monitoring reduces dependence on monthly posyandu visits often hindered by transportation access in rural Tasikmalaya areas.

The policy implications of this research are highly strategic. This application supports achieving the RPJMN 2024-2029 target to reduce stunting prevalence to 14%, particularly in Tasikmalaya which still has a 21.6% stunting rate (SSGBI 2022). From an economic perspective, chronic stunting intervention costs reach Rp5 million per child while early prevention through EDDIS-Balita only costs Rp50,000 per child per year, resulting in 99-fold cost savings that are highly significant for regional health budgets.

Theoretically, this research validates the Technology Acceptance Model (TAM) in the rural Indonesian context with high correlations between Perceived Ease of Use ($r=0.87$, $p<0.01$) and Perceived Usefulness ($r=0.92$, $p<0.01$), and strengthens the Health Belief Model through increased perceived susceptibility (personal risk awareness) and cues to action (automated push notification reminders).

Nevertheless, this research has several limitations. The sample was limited to 50 mothers of toddlers in Tasikmalaya, not yet representing national demographic

variations, there was no 12-month longitudinal testing to measure actual stunting reduction, and the application still depends on Android smartphones with internet connection for posyandu collaboration features. Therefore, recommendations for further research include national rollout to 20,000+ posyandu, integration with the Kemenkes SSGBI system for real-time data synchronization, and 6-month Randomized Controlled Trial (RCT) in 10 Tasikmalaya posyandu to prove causal stunting prevalence reduction.

Overall, EDDIS-Balita emerges as the first comprehensive solution for Indonesia's Triple Burden of stunting high prevalence, late detection, and expensive interventions through the integration of automated z-score technology, real-time posyandu collaboration, and simple AI-based behavioral tracking. Its main contributions are proven technical novelty (SUS Score 82.5/100, 96.7% accuracy), practical impact (86% time saving, 99x cost reduction), and policy relevance toward the RPJMN 2029 target, making it a scalable model for accelerating national stunting elimination.

CONCLUSION AND RECOMMENDATION

The developed EDDIS-Balita application demonstrates that all features of the system function and operate well. Testing using black-box testing yielded a score of 100%, meaning that all system functions work according to user requirements without errors. This testing included validation of features such as storing, deleting, and modifying patient data, as well as report printing, all of which were declared valid and functional. All submenus in the basic knowledge feature can be accessed and read by users. Furthermore, it is considered important to conduct training and socialization for posyandu cadres, healthcare workers, and the community so that the application can be used optimally. Such assistance is essential to ensure that the application is not only downloaded but also used effectively.

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