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Development of a Smartphone Application "Family Care Stunting" to Increase the Independence of Families with Stunting Toddlers and Comorbid Diseases

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Abstract

Stunting is a complex public health problem in Indonesia. The incidence of stunting in Kudus City was 3,601 toddlers (5.85%), with the highest prevalence in Dawe District (13.32%), Undaan District (11.13%), Gebog District (10.66%), and 238 children under five, accompanied by comorbidities such as acute respiratory tract infections (ARI), diarrhea, tuberculosis (TB), and worms. One of the determining factors for success in combating stunting is family independence in managing the health of toddlers. However, family independence is constrained by limited access to information, lack of balanced nutrition education, sanitation, personal hygiene, symptoms of comorbidities, monitoring and development of toddlers not routinely, non-compliance with immunization and treatment. Smartphone applications can be used to overcome these obstacles. This study aims to develop and evaluate the effectiveness of the "Family Care Stunting" smartphone application in improving the health independence of families of stunted toddlers with comorbidities. This study used a research and development design, with 201 respondents from families of stunted toddlers who had comorbidities. Effectiveness was analyzed using the Wilcoxon nonparametric differential test to compare the level of family health independence before and after the intervention. There was a significant increase in the level of family health independence after the intervention of the "Family Care Stunting" smartphone application (p-value = 0.000). This application has the potential to be an innovative tool that supports families to play an active role in child health management, thereby contributing to more comprehensive stunting prevention and handling efforts

Introduction

Stunting is a condition of children where body length or height is less than the normal size, caused by insufficient nutritional intake for a long period of time due to feeding not in accordance with nutritional needs (Ministry of Health of the Republic of Indonesia, 2018). Stunting is one of the major problems in the world, especially in large countries and developing countries, because it can result in growth failure, which causes cognitive and motor problems in children, the risk of infectious diseases, non-communicable diseases, suboptimal learning achievement, and decreased productivity during adolescence and adulthood (Alfonso Mayén *et al*., 2022). Stunting or body too short based on age is height that is below minus two standard deviations (<-2SD) of the WHO Child Growth Standard nutritional status table (WHO, 2018). Stunting reduces work productivity, which has a negative impact on the future of the nation's children directly, namely, weak cognition, late psychomotor, below-average intellectual independence, more susceptible to degenerative diseases, and low-quality human resources (Listyarini *et al*., 2024). Malnutrition starts from a lack of appetite, especially in children, so that if the

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child lacks caloric protein, it can cause growth and development disorders. Meanwhile, weight gain is influenced by food consumption and appetite. The age of children most at risk of stunting is 6 to 24 months, and the diagnosis of stunting is enforced in children aged 25 to 59 months. This age is the mass of the growth and development process, which is an important period of human growth and development, so balanced nutritional intake is needed. If there is a mistake in fulfilling the nutritional needs of toddlers, it will have a bad impact on adulthood (Amusa *et al*., 2022).

Data on the incidence of stunting under five in Central Java in the last three months of 2022 were 1489 cases in June, 1292 cases in July, and 1465 cases in August 2022. The government's target for stunting prevalence in Indonesia is to drop to below 14% by 2024. The target is to reduce stunting prevalence every year from 3.8% to 2.7%. A factor that affects the high incidence of stunting is the presence of impaired growth and development in the womb by pregnant women, which can cause newborns with low birth weight, who are at risk of complications and even stunting. Other factors that affect stunting include the nutritional status of toddlers and the poor nutritional status of pregnant women. The health condition of the mother is also influenced by the health of the mother during adolescence, the fulfillment of adolescent nutrition and the avoidance of anemia greatly affect health during the preparation period of reproductive maturity, the period of pregnancy and childbirth in the first 1000 days and several other factors such as the lack of ANC (Antenatal Care) in pregnant women, short maternal height, and clean and healthy living behavior of pregnant women are the causes of stunting in toddlers (Helmizar *et al*., 2024; Symbolon *et al*., 2021).

Based on the results of previous research by Astuti (2025), several factors that cause stunting in Kudus Regency include a history of pregnancy complications of eclampsia and pre-eclampsia 1.8%, pregnancy anemia 26%, low birth weight (BBLR) 22%, history of chronic diseases 14%, tuberculosis in children 13%, history of diarrhea 47%, growth and development disorders of toddlers 26% and worms 33%. Children who are stunted are very prone to several infectious diseases, such as acute respiratory tract infections (ARI), diarrhea, tuberculosis (TB) in children, and worms, so this can result in the emergence of health problems in stunted toddlers (Nurlaily, 2025). Stunting toddlers will experience problems such as decreased immunity due to insufficient nutritional intake, so they are prone to complications. Children who experience malnutrition have low immunity to the disease, so they are susceptible to infectious diseases. Similarly, children affected by infectious diseases can easily experience malnutrition, so stunted toddlers often have comorbidities. Comorbid diseases are conditions in which a person has other diseases that occur in addition to their main disease at the same time. If screening is not carried out on stunted toddlers who have comorbidities, it will worsen both prognoses.

The stunting problem that has been raised by Rinanda (2023) becomes even more complex when stunted toddlers also experience comorbidities. Comorbidities in stunting, such as childhood Tuberculosis (TB), Pneumonia, Acute Respiratory Tract Infection (ARI), and Diarrhea (Wulandary & Sudiarti, 2024; Kasmita et. al., 2023; Diyah & Faradilah, 2020). These diseases not only worsen the nutritional condition of stunted toddlers but also hinder the recovery process and often lead to a continuous cycle of malnutrition-infection. Data from Puskesmas in various regions. Kudus Regency consists of 9 sub-districts, namely Kaliwungu District, Kota District, Jati District, Undaan District, Menjobo District, Jekulo District, Bae District, Gebog District, and Dawe District. The number of stunting in Kudus City was 3601 with a prevalence of 5.85%. There were 3 regions that had the highest stunting prevalence, namely Dawe District at 13.32%, Undaan District at 11.13%, and Gebog District at 10.66%. Based on data reports from the Kudus Health Department in 2022, the highest rate of stunting in Dawe District, and from data reports at 19 Pukesmas in Kudus Regency, there are 238 stunted toddlers with comorbidities, including diarrhea, acute respiratory tract infections (ARI), Pneumonia, and Pulmonary Tuberculosis (TB) (Kudus Health Department, 2022). Based on the results of previous research

by Indriana (2019), several factors that cause stunting in Kudus Regency include a history of pregnancy complications of eclampsia and pre-eclampsia 1.8%, Pregnancy Anemia 26%, Low Birth Weight (BBLR) 22%, History of Chronic Diseases 14%, Tuberculosis in Children 13%, History of Diarrhea 47%, Growth and Development Disorders of Toddlers 26% and worms 33%. The health center in Kudus shows that there are significant cases of stunting accompanied by comorbidities such as ARI and diarrhea, indicating that the management of cases of stunting toddlers with comorbidities requires extra attention and comprehensive intervention from various parties, especially families.

Families, especially parents and caregivers, play a central role in efforts to prevent and handle stunting. Family independence in understanding, preventing, and managing stunted toddler health conditions, especially those accompanied by comorbidities, is the key to the success of interventions. However, often families face limited access to accurate and timely information, a lack of education about balanced nutrition, sanitation, personal hygiene, and signs and symptoms of comorbidities. In addition, regular monitoring of the growth and development of toddlers, as well as adherence to immunization and treatment schedules, is often not optimal. This condition is exacerbated by the limited time of health workers conducting intensive home visits and providing continuous education (Diyah & Faradilah, 2020).

Based on the above problems, researchers try to innovate comprehensively to improve the health and nutritional status of stunting toddlers with comorbidities through the Family Centered Care model approach. This Family Centered Care model is care based on a partnership between families and health workers in providing care to sick children. Treatment interventions using a family-centered approach to care emphasize that decision-making, care program planning, health facility planning, and daily interactions between sick children and health care workers should be known and involve families (Frakking *et al*., 2020) . Families are given the authority to be involved in the care of stunted children, which means families with family backgrounds, expertise, and competence in providing positive benefits in caring for children with health problems. This Family Centered Care gives authority and understanding to families to know the strength and ability of the family to care for sick children (Kokorelias *et al*., 2019). Physiologically, the involvement of parents and children in their own upbringing is essential. Cooperation or partnership between health workers, sick children, and parents is a form of success in implementing care measures in the family.

Family Centered Care has two important concepts, namely the concept of enabling and empowering. Enabling is creating an atmosphere that allows the potential of the community to develop. Meanwhile, empowering is part of efforts to actualize the potential that is already possessed by the community (Kokorelias *et al*., 2019). This Family Centered Care is a combination of both applied in the smallest social group, namely the family. A concept that allows the view that the family has a role in the care provided. Health workers must involve families in providing care to meet the needs of children and families in general. In the concept of empowerment, health workers can involve families in making decisions about actions to be taken.

The application of this Family Care Stunting model is a service provided directly to families of stunted toddlers with comorbidities, for this reason, an effective and efficient method of service delivery by health center nurses to families of stunted toddlers is needed, so that the researcher intends to develop *a* Family Care Stunting model through appropriate technology combined with the application of a based application Android smartphone. This model is designed to make it easier for health center nurses to carry out Family Care Stunting when documenting the results of assessments and family visits (Franck & O'Brien, 2019). The use of information technology, especially smartphone applications, offers innovative solutions to overcome these challenges. Smartphone apps have great potential as a platform to provide easily accessible health information, interactive education, self-monitoring features, reminders of important schedules (such as immunizations

or controls to health facilities), as well as a forum for communication between families and health workers. With the application, it is hoped that families can improve their knowledge, attitudes, and practices (KAP) related to nutrition, hygiene, and early treatment of comorbidities, so that they can take a more active and independent role in increasing the health independence of stunted toddlers (Ibrahim *et al*., 2023).

Previous research has shown the effectiveness of the Primaku android smartphone-based application in improving health knowledge about growth and developmental assessment and nutrition in early childhood. However, the development of applications specifically designed for families of stunted toddlers with comorbidities, which integrate aspects of nutrition education, early disease detection, growth monitoring, and psychosocial support, is still limited, especially in Indonesia. Therefore, this study aims to develop a smartphone application called "Family Care Stunting" which is specifically designed to meet the needs of families of stunted toddlers with comorbidities, with the hope of increasing family health independence and ultimately contributing to reducing stunting rates and improving the quality of life of toddlers in Indonesia (Nurjanah *et al*., 2024).

Method

This Family Care Stunting application was developed using research and development (R&D) methods by adapting the Sugiyono model (2022). The Sugiyono model proposes 10 main steps in R&D research, but it can be simplified and adjusted to research needs, especially for the development of information technology-based products such as smartphone applications. The steps of research and development of this methodology are described

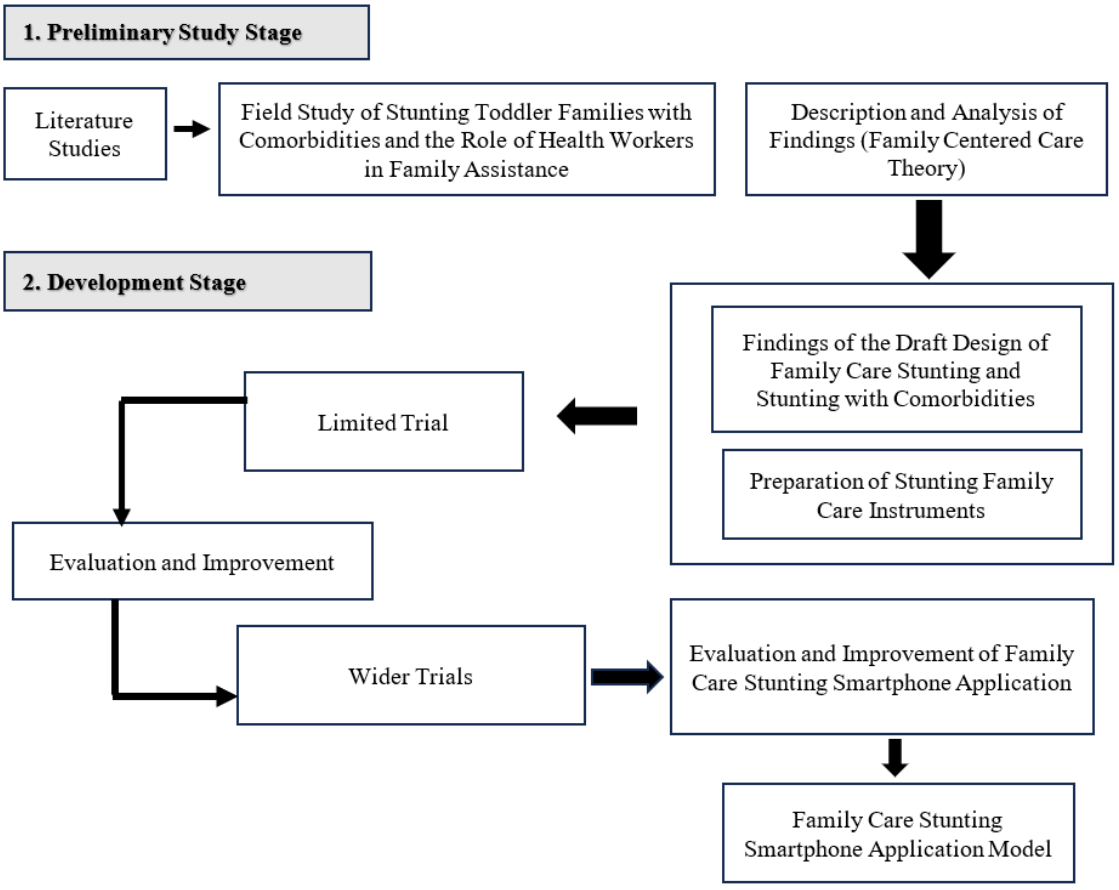

Figure 1. Family Centered Care Stunting methodology model
(Gimbel, 2020; Petra *et al*., 2024)

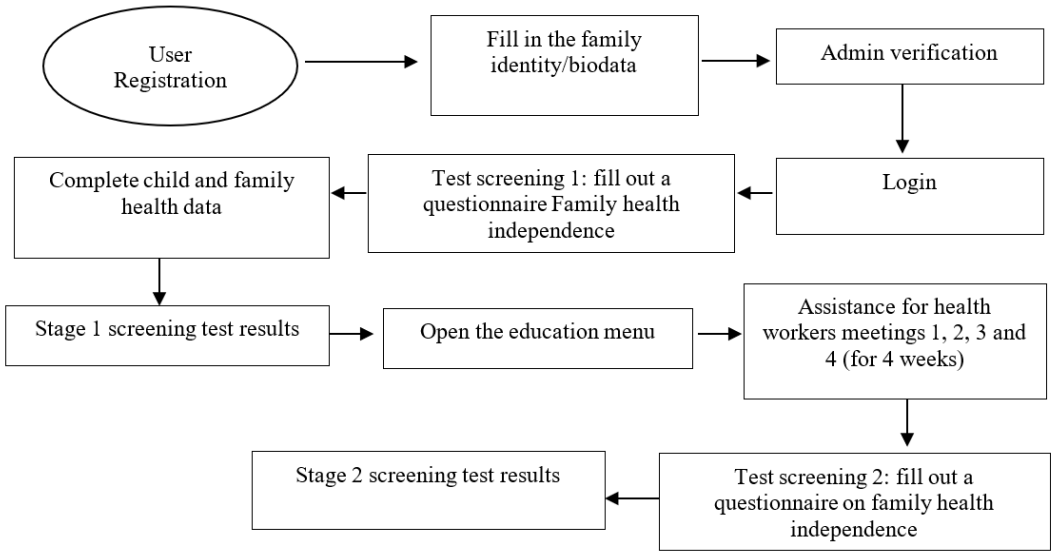

Figure 2. Intervention Measures or Assistance for the Care of Toddlers Stunting with Comorbidities at Home.

in a series of two stages and nine steps in Figure 1.

After the creation of the application, according to the waterfall flow in prototyping (Mishra & Alzoubi, 2024), the "Family Care Stunting" smartphone application was tested in three stages, namely internal play store testing, expert validation, and SUS testing (the system, after evaluation, is deployed to the user environment and registered to the domain for public access). After that, the application launch and socialization or short training are carried out at Posyandu, Puskesmas, or communities to introduce the application to target users (Yau et. al, 2023). The intervention steps are presented in Figure 2.

A limited or small-scale trial was carried out by determining the population and sample of respondents in this study of 30 respondents from families of stunted toddlers who have complications or comorbidities. Respondent sampling was conducted in the Demak district, Central Java Province. Application testing utilizes the SUS test and pre-post application use to determine family health independence in caring for sick family members. The SUS instrument is a well-validated smartphone application usability measurement tool, presented as a questionnaire that is easy to understand. The SUS used in this user trial has been translated into Indonesian (Islam *et al.*, 2020). A large-scale trial was conducted on 201 stunted toddlers with comorbidities, divided into an intervention or experimental group of 104 toddlers and a control group of 97 toddlers in the Kudus Regency area. This research has been approved by the Health Research Ethics Commission of the Faculty of Medicine, Universitas Negeri Semarang (No. 857/KEPK/FK/KLE/2025). All respondents gave their consent based on the information.

Results and Discussion

User testing involved 30 respondents from families of stunted comorbidities in toddlers. The characteristics of stunted toddlers with comorbidities are presented in Table 1. Meanwhile, the results of user tests with SUS instruments are presented in Table 2.

Based on the user test of the Family Care Stunting application using the SUS instrument, the score obtained from 30 respondents was 77.42. This result can be interpreted as the application is at grade B above the average score (Figure 3). The results show that respondents consider that the Family Care Stunting application is very good and suitable for use (adjective) and acceptable.

A large-scale trial was conducted on 201 stunted toddlers with comorbidities. Toddlers

Table 1. Characteristics of Stunted Toddlers with Comorbidities (n=30)

Variable	N	%
Age (months)		
1-12	3	10
13-23	2	6.6
24-36	12	40
37-48	7	23.4
49-60	6	20
Height/Age		
Very short (< 3 SD)	1	3.4
Short (-3 SD < -2 SD)	29	96.6
Gender		
Male	11	36.7
Female	19	63.3
Stunting with Communicable Diseases		
Pediatric TB	6	20
Pneumonia	2	6.7
ARI	7	23.3
Diarrhea	15	15

Source: Primary Data, 2025

Table 2. Usability Test Results Using SUS (System Usability Scale) (n=30)

Yes	Question	Score Min-Max	Average score
1.	I think that I will use this app more often	1-4	3
2.	I find that this app doesn't have to be complicated	3-4	3.3
3.	I think the app is easy to use	2-4	3.1
4.	I thought that I would need help from a technical person to be able to use this app	3-4	3.3
5.	I found the various functions in this application to be well integrated	2-4	3.2
6.	I think there are too many inconsistencies in this app	0-4	2.9
7.	I imagine that most people would find it easy to learn this app very quickly	1-4	3.1
8.	I find this app very complicated to use	3-4	3.1
9.	I feel very confident in using this app	2-4	3.1
10.	I need to learn a lot of things before I can start using the app	2-4	2.9
Score (multiplied by 2.5): 2322.5 Total score range: 62.5 – 87.8 SUS Score: 77.42			

Source: Primary Data, 2025

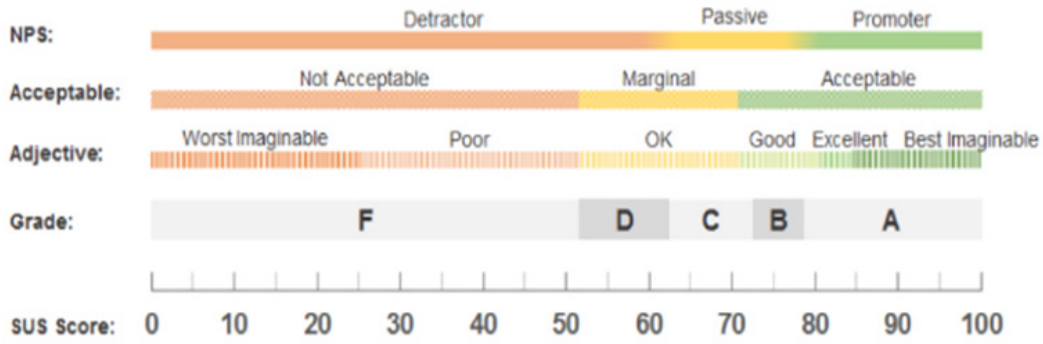

Figure 3. Interpretation of the SUS score of the "Family Care Stunting" Application

Table 3. Characteristics of Families of Stunted Toddlers with Comorbidities

Variable	Group			
	Intervention		Control	
Age (months)	**N**	**%**	**N**	**%**
1-12	22	10.8	24	11.8
13-23	19	9.3	19	9.3
24-36	22	10.8	20	9.8
37-48	25	12.3	27	13.2
49-60	16	7.8	7	3.4
Height/Age (Z-Score)				
Very short (< 3 SD)	18	8.8	24	24.7
Short (-3 SD < -2 SD)	86	42.2	73	75.3
Gender				
Male	55	27	52	25.5
Female	49	24	45	22.1
Mother's Work				
Work	75	36.8	82	40.2
Not Working	29	14.2	15	7.4
Mother's Education				
Elementary School	0	0	2	2.1
Junior High School	4	2	3	3.1
High School	92	45.1	84	86.6
Bachelor	8	3.9	8	8.2
Stunting with Communicable Diseases				
Pediatric TB	9	4.4	7	3.4
Pneumonia	4	2.0	0	0
ARI	14	6.9	20	9.8
Diarrhea	77	37.7	70	34.3
Family Health Independence Level (Pre Intervention Control)				
Level I	42	20.6	42	20.6
Level II	62	30.4	55	27
Level III	-	-	-	-
Level IV	-	-	-	-
Family Health Independence Level (Post-Group Control)				

Level I	-	-	39	19.1
Level II	26	12.7	50	24.5
Level III	70	34.3	6	2.9
Level IV	8	3.9	2	1

Source: Primary Data, 2025

Table 4. The Effectiveness of the "Family Care Stunting" Smartphone Application on the Level of Family Health Independence

Variable	N	P-value
Independence level (Pre Intervention _Post Intervention Group)	201	0.000

Source: Primary Data, 2025

were divided into two groups, namely the intervention group and the control group. The characteristics of stunted toddler families with comorbidities are presented in Table 3.

The effectiveness of the "Family Care Stunting" smartphone application in increasing family health independence was analyzed by different tests conducted by the Wilcoxon test. The results of the analysis test are presented in Table 4.

Based on the results of the Wilcoxon test, it was found that there was a significant difference in the level of family health independence before and after the intervention of the application of the "Family Care Stunting" smartphone application (P value = 0.000). The results of this study are in line with various studies and literature that support the role of digital technology, especially smart mobile applications or Android smartphones, in public health interventions. The significant increase in the level of health independence of families of stunted toddlers with comorbidities indicates that this application not only provides information but also actively empowers families. Several similar studies have confirmed the potential of mobile health (mHealth) applications in improving health knowledge, attitudes, and practices. Research by Anjani *et al*. (2022) shows that health education through digital media is effective in increasing maternal knowledge about stunting prevention and child growth and development monitoring. Applications such as "ASANTI" (Anticipation of Stunting in High-Risk Groups) have also been developed as a viable and effective educational medium for pregnant women related to stunting. Research by White *et al*. (2019) about Android-based applications in the implementation of the husband's role in exclusive breastfeeding is also able to provide *a* support system for exclusive breastfeeding for toddlers.

Handling stunting with a family care approach emphasizes families who have a central and active role as the front line in caring for sick children at home. It is not just about providing basic needs, but rather the holistic and ongoing involvement of each family member in monitoring, responding to, and managing the child's health condition (Nasution & Sansuwito, 2024). When a toddler with a history of stunting or at risk of stunting is sick, whether it is fever, diarrhea, cough and cold, ARI, or other infections that can worsen their nutritional condition, the concept of implementing family care using the "Family Care Stunting" application encourages families to not be passive and can take care of family members who are sick at home.

Families proactively identify early signs of illness, ensure that children's nutritional intake remains optimal even when appetite decreases, and provide appropriate first aid according to the guidelines they have obtained, for example, through the "Family Care Stunting" application. This includes ensuring adequate nutrient intake, providing nutrient-rich soft foods, and managing mild illness symptoms at home. In addition, families also

play an important role in making decisions about when to seek professional medical help, such as taking children to health centers or hospitals, based on their understanding of the danger signs and complications that may arise. All family members, from parents, grandparents, to older siblings, can be involved in this collective effort, creating a supportive and responsive environment to children's health needs. Thus, the "Family Care Stunting" application empowers families to become their children's health care providers in the home environment.

The role of digitalization in stunting prevention was also explained by Erika *et al*. (2024), who found that digital-based applications can improve the efficiency of nutrition monitoring and expand the reach of health education for stunting management in Indonesia. This supports the finding that the "Family Care Stunting" application can be an effective tool in facilitating increased independence, as access to health information and guidance becomes more accessible to families (Rochmayani *et al*., 2024). Although the research focused more on improving knowledge and attitudes, these findings implicitly supported increased independence. Family health independence is often rooted in adequate knowledge, a proactive attitude, and the ability to make the right decisions regarding health. Smartphone apps facilitate this by providing relevant information, personalization, and ongoing support, as shown by studies on e-health education apps that improve knowledge, self-care, and family readiness to care for chronic patients at home. The results of this study strengthen the evidence that smartphone application-based interventions are a promising and effective strategy in efforts to improve family health independence, especially in the context of the treatment and handling of stunting with complications and accompanying health conditions. These findings also underscore the importance of technological innovation in supporting public health programs to achieve broader and sustainable impact.

Conclusion

This study successfully developed and tested the "Family Care Stunting" smartphone application, which has been proven to be effective in increasing the health independence of families of stunted toddlers with comorbidities. The development of a smartphone-based application "Family Care Stunting" is an important innovation in supporting families to play a more active and independent role in caring for children at home. This application is a potential tool for better education, monitoring, and decision-making, especially for families facing the challenges of stunting and comorbidities in children. Overall, this study shows that the "Family Care Stunting" smartphone application can be an effective and feasible intervention to increase the capacity of families to manage the health of their children affected by stunting and can prevent complications.

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