



# Innovation of Prototype of Stunting Health Information System and 3D Pageflip E-Module on Stunting Preventive Knowledge and Attitude in South Tangerang

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Track Record Article	Abstract
<p>Revised: 20 December 2025 Accepted: 15 February 2026 Published: 31 March 2026</p> <p><b>How to cite :</b> Pratiwi, R. D., Andriati, R., &amp; Indah, F. P. S. (2026). Innovation of Prototype of Stunting Health Information System and 3D Pageflip E-Module on Stunting Preventive Knowledge and Attitude in South Tangerang. <i>Contagion: Scientific Periodical of Public Health and Coastal Health</i>, 8(1), 47–63.</p>	<p><i>According to an analysis conducted by the World Bank Group, WHO, and UNICEF, around 144 million children who are under the age of five (21.3%) were affected by stunting worldwide in 2019. By 2022, this figure had risen to an estimated 148.1 million children (22.3%). This study aims to evaluate the health promotion interventions utilizing a prototype of a stunting health information system and a 3D pageflip e-module in enhancing attitudes and knowledge for the prevention of stunting in South Tangerang. This study applied a quantitative approach combined with a quasi-experimental design, utilizing a two-group design with a pretest and post-test measurements framework. A total of 106 individuals surveyed were included, divided equally into two groups: one group received the prototype stunting health information system intervention, and the other was provided with the 3D Pageflip e-module, comprising 53 participants for every group. The Wilcoxon test showed the prototype of the stunting health information system group showed a significant difference for knowledge (<math>p = 0.046</math>) and attitude (<math>p = 0.025</math>), and the 3D pageflip e-module group showed a significant difference in knowledge and attitude (<math>p = 0.000</math>). The Mann-Whitney test showed that there was a significant difference for knowledge (<math>p = 0.000</math>) and for attitude (<math>p = 0.042</math>). The effect size test for knowledge is 1.06 and for attitude 0.27. It can be concluded that the prototype of the stunting health information system and the 3D pageflip e-module effectively increase mothers' knowledge and attitudes regarding stunting prevention.</i></p> <p><b>Keywords:</b> <i>Prototype, Stunting Health Information System, 3D Pageflip E Module, Knowledge, Preventive, Attitude.</i></p>

## INTRODUCTION

Health problems are serious issues in Indonesia, among them stunting. Stunting has been the government's main focus since 2017. Stunting refers to a height that is not appropriate for age or is too short. Stunting is a health issue that may occur because of long-term or chronic malnutrition and repeated infections, which can be characterized by height that is less than or below -2 standard deviations (-2 SD) of child growth according to WHO (UNICEF & WHO, 2020; Windasari et al., 2020).

Drawing on analyses published in 2019 by the WHO, the World Bank Group, and UNICEF, approximately 144 million children under 5 were stunted. Further analysis in 2022 found a rise from 21.3% in 2019 to 22.3% of affected children worldwide. The incidence of

children suffering from stunting mostly occurs in Asia (52%) and Africa (43%) (UNICEF & WHO, 2020; World Health Organization, 2023).

The stunting rate among toddlers in Indonesia, as reported in the Indonesian Toddler Nutrition Status Survey (SSGI), was 27.67% in 2019 and 24.4% in 2021. According to the Riskesdas (Basic Health Study) conducted by Litbangkes, the stunting rate in Indonesia was 21.6% in 2022. Although the frequency of stunting cases in Indonesia has decreased, this figure is still quite high. The World Health Organization (WHO) set the standard at less than 20% (Kemenkes RI, 2023).

The government has set a target of reducing stunting prevalence to 14% by 2024. Banten Province is among the top five regions with the highest stunting rates in Indonesia and is also one of the 12 priority regions, as reported in the 2021 Indonesian Toddler Nutrition Status Survey (SSGI). Based on the SSGI's research, the stunting rate in Banten fell by 4.5% in 2022 (from 24.5% in 2021 to 20%). The Riskesdas (Basic Health Study) research in 2023 found that the prevalence of stunting among children in South Tangerang increased by 0.2% (9.0% in 2022 to 9.2% in 2023). Although there was a slight increase of only 0.2 percent, the phenomenon should not be ignored and must be a serious concern for all parties.

Growth failure or stunting is a condition that occurs due to poor nutrition during pregnancy (womb) or childhood. A child who experiences stunting is likely to grow less than a child of the same age, and cognitive development may not unfold optimally and can last a lifetime, which also impacts the next generation. Stunting is a threat to economic growth and national welfare, continuing to undermine the development and health of millions of children worldwide (UNICEF & WHO, 2020).

A mother's knowledge is one of the factors that significantly influence stunting. Mothers with low education and knowledge who do not understand proper nutrition and parenting are at risk of having children who are stunted. Good knowledge of the importance of balanced nutrition, exclusive breastfeeding, and other preventive measures can foster positive attitudes and behaviors that support stunting prevention. Stunting knowledge is obtained from formal education or from the media (non-formal), such as the internet, TV, radio, newspapers, magazines, etc. The involvement of mothers is essential to reducing stunting rates (Girma et al., 2023; Wanimbo & Wartiningsih, 2020).

Health promotion and community empowerment are ways to prevent stunting. Various parties make various efforts and interventions to promote positive behaviors based on the information pregnant women possess regarding nutritional needs during pregnancy, childbirth, and child growth before the age of 2 years (Fitriani & Darmawi, 2022).

In health promotion, media selection is also very important to consider. Given that smartphones have become a primary daily need in the digital era, their use has spread across age groups, from children to adults to the elderly. The influence or impact on media users can enable them to receive and share information quickly, communicate anytime and anywhere, and facilitate daily life in education, business, social interactions, communication, and politics. Several educational applications have been developed to help mothers prevent and manage stunting. Research by Fitriami & Galaresa (2022) found that stunting education using an Android application increased mothers' knowledge and attitudes at the Tenayan Raya Public Health Centre in Pekanbaru. Additionally, Utamingtyas et al. (2023) found that pregnant women's knowledge and attitudes regarding stunting prevention were significantly influenced by health education delivered via an e-booklet in Kadirejo Village.

The design of an information system is one effort to prevent stunting problems from worsening. The prototype of the stunting health information system and the 3D pageflip e-module are innovations that contain supportive, educational, and motivational elements in the form of psychoeducation related to stunting health information and child growth and development, nutrition, anthropometry, and motivation through posters and rhymes, as well as motivational videos that can be accessed via mobile phones. This can be utilized by healthcare facilities and serve as additional input in formulating health policies for stunting prevention. The novelty of the study lies in the fact that no one has conducted a study on the effectiveness of the prototype of the stunting health information system and a 3D pageflip e-module on knowledge and preventive attitudes in reducing the incidence of stunting in South Tangerang. The aim of the study was to evaluate the effectiveness of interventions using a prototype stunting health information system and a 3D pageflip e-module in enhancing attitudes and knowledge to prevent stunting in South Tangerang.

## **METHODS**

A quantitative research methodology is applied in the study. It uses a quasi-experimental research design with a two-group pretest-posttest to evaluate the effectiveness of health promotion interventions using a prototype stunting health information system and a 3D pageflip e-module in enhancing knowledge and attitudes for the prevention of stunting in South Tangerang. Sampling was conducted using random sampling techniques, with a total of 106 respondents divided equally into two groups: a prototype of a stunting health information system and a 3D pageflip e-module, each comprising 53 respondents. The sample of this study consists of mothers in the South Tangerang area who meet the inclusion and exclusion criteria.

The inclusion criteria were pregnant mothers and mothers of toddlers who were cooperative, willing to be respondents, owned an Android phone, and were able to hear, read, and write. The exclusion criteria were dropping out during the data collection process, patients experiencing intellectual disability, and having difficulties in interaction and communication.

The interventions in this study were the prototype of the stunting health information system and the 3D pageflip e-module, serving as a digital educational model to increase knowledge and attitudes regarding the prevention of stunting. The research began with a qualitative study through FGDs with health service facilities and cadres. The outcome of the activities was the development of a smartphone-based information system accessible to the public. Through the prototype of the stunting health information system and the 3D pageflip e-module, respondents receive educational materials on child growth and development (KPSP, DDST, and child anthropometry as well as Body Mass Index (BMI)), information about stunting, its characteristics, causes, prevention, foods and drinks/diet for children with stunting or for normal children, and the impact of stunting on growth and development. In addition, the application includes motivation for mothers to help their children achieve optimal growth and development. Specifically, through the prototype, parents can measure BMI using the anthropometry feature. The application not only contains text but also includes posters, animated videos, and playful rhymes as motivational content.

Data collection used a pretest-posttest questionnaire. The questionnaire has been tested for validity and reliability using Pearson's correlation and Cronbach's alpha. The results show that both instruments have all question items valid ( $r > 0.3$ ) and reliable ( $p > 0.6$ ). The study was conducted by distributing pre-test questionnaires that had been explained by the researcher and approved by the respondents. This was followed by providing interventions to the experiment group (the prototype of the stunting health information system) and the control group (the 3D pageflip e-module). After the intervention, respondents were given the questionnaire again to complete the post-test and measure their knowledge and attitudes before and after the treatment and to assess the effectiveness of the intervention. The knowledge variable was categorized as good (score  $> 75\%$ ), sufficient (75-56%), and less ( $< 56\%$ ). The attitude variable was assessed as positive (score  $> 61\%$ ) or negative (score  $\leq 61\%$ ).

Data analysis was conducted using univariate and bivariate methods. The normality test in this study used the Kolmogorov-Smirnov test, which showed that the knowledge and attitude variable in stunting prevention was not normally distributed (Sig. value  $< 0.05$ ). Therefore, bivariate analysis used the Wilcoxon test for within-group comparisons and the Mann-Whitney U test for between-group comparisons, and effectiveness was indicated by p-values  $< 0.05$ . The

effect size test was used to determine the magnitude of the effect after treatment, with Cohen's guidelines stating that a large effect is 0.5, a medium effect is 0.3, and a small effect is 0.1. The number of contributing samples was collected under ethical approval granted by the Institutional Ethical Committee of WDH Institution, with Reference Number 667/K-1KP/WDH/II/2024.

## RESULT

### Univariate Analysis

As shown in Table 1, the characteristics of respondents based on age from 106 respondents show that in the Stunting Health Information System Prototype group, most respondents are aged 52-61 years, as many as 22 respondents (41.5%), and in the 3D Pageflip E-Module group, most respondents are aged 32-41 years, as many as 27 respondents (50.9%). Among 106 respondents, the characteristics by education show that in the Stunting Health Information System Prototype group, 38 respondents (71.7%) have received a high school education. Meanwhile, the 3D Pageflip E-Module group includes 24 respondents with a high school education, representing 45.3% of the group.

**Table 1. Characteristics of Respondents**

Variable	Prototype of Health Information System for Monitoring Stunting		3D Pageflip E-Module	
	n	%	n	%
<b>Age</b>				
21-31 years	-	-	26	49.1
32-41 years	4	7.5	27	50.9
42-51 years	21	39.6	-	-
52-61 years	22	41.5	-	-
62-71 years	6	11.3	-	-
<b>Education</b>				
Elementary School	-	-	8	15.1
Junior High School	5	9.4	15	28.3
Senior High School/Vocational High School	38	71.7	24	45.3
D3	7	13.2	4	7.5
Bachelor's Degree	2	3.8	2	3.8
Master's Degree	1	1.9	-	-
<b>Total</b>	<b>53</b>	<b>100</b>	<b>53</b>	<b>100</b>

As shown in Table 2, the distribution frequency of respondents based on mothers' knowledge about stunting before (pre) health promotion from 106 respondents shows that in the health information system prototype group, more than half of the respondents had good knowledge about stunting, with 49 respondents (92.5%). After (post) health promotion using the health information system prototype, all respondents had good knowledge regarding

stunting, with 53 respondents (100%). Meanwhile, in the 3D pageflip e-module group before (pre) health promotion, almost half of the respondents had inadequate knowledge about stunting, with 25 respondents (47.2%). After (post) health promotion using the 3D pageflip e-module, over 50% of respondents possessed sufficient awareness of stunting, with 34 respondents (64.2%).

The distribution frequency in Table 2 illustrates that in the prototype group before health promotion, more than half of total respondents had a favorable attitude about stunting, with 48 respondents (90.6%). After health promotion, all 106 respondents had a positive attitude about stunting, with 53 respondents (100%). In the 3D pageflip e-module group before health promotion, 32 respondents had a negative attitude about stunting, amounting to 60.4% of total respondents. After health promotion with the 3D pageflip e-module, the majority of the respondents had a favorable attitude about stunting, with 49 respondents (92.5%).

**Table 2. Distribution Frequency of Respondents Based on Mothers' Knowledge and Attitudes About Stunting Before (Pre) and After (Post) Health Promotion Using the 3D Pageflip E-Module and the Health Information System Prototype for Monitoring Stunting**

Variable	Prototype of Health Information System for Monitoring Stunting				3D Pageflip E-Module			
	Pre-Test		Post-Test		Pre-Test		Post-Test	
	N	%	n	%	n	%	n	%
<b>Knowledge</b>								
Less	-	-	-	-	25	47.2	5	9.4
Sufficient	4	7.5	-	-	23	43.4	34	64.2
Good	49	92.5	53	100	5	9.4	14	26.4
<b>Attitude</b>								
Negative	5	9.4	-	-	32	60.4	4	7.5
Positive	48	90.6	53	100	21	39.6	49	92.5

### Bivariate Analysis

As shown in Table 3, the findings of the calculation using the Wilcoxon Test of maternal knowledge about stunting pre (before) and post (after) health promotion using the prototype of the stunting health information system show that the p-value (Asymp. Sig. (2-tailed)) was 0.046 (p-value < 0.05). This result indicates a significant difference between pre-test and post-test values for the prototype of the stunting health information system method. This is evident from the increase in the average pre-test value from 2.92 to the average post-test value of 3.00. The mother's outlook about stunting before (pre) and after (post) health promotion using the prototype of the stunting health information system, the p-value (Asymp. Sig. (2-tailed)) was 0.025 (p-value < 0.05), highlighting that a meaningful difference exists between the pre-test and post-test values with the prototype of the stunting health information

system method. This is shown in the increase of the average pretest value from 1.91 to the average post-test value of 3.00.

**Table 3. Wilcoxon Test Results of the Stunting Health Information System Prototype**

Variable	Prototype of Stunting Health Information System		
	N	Mean	Asymp. Sig. (2-tailed)
<b>Knowledge</b>			
<i>Pre-Test</i>	53	2.92	0.046
<i>Post-Test</i>	53	3.00	
<b>Attitude</b>			
<i>Pre-Test</i>	53	1.91	0.025
<i>Post-Test</i>	53	2.00	

The data in Table 4 show the results of the Wilcoxon test for maternal knowledge about stunting before and after health promotion using the 3D pageflip e-module. The p-value (Asymp. Sig. (2-tailed)) is 0.000 (p-value < 0.05), highlighting meaningful difference values. This is shown by the rise in the average pretest value from 1.62 to the average post-test value of 2.17 for maternal knowledge. Similarly, for the mother's attitude about stunting before (pre) and after (post) health promotion with the 3D pageflip e-module, the p-value (Asymp. Sig. (2-tailed)) is 0.000 (p-value < 0.05), suggesting a meaningful correlation between the pre-test and post-test values with the 3D pageflip e-module method. This is supported by the rise in the average pretest value from 1.40 to the average post-test value of 1.92.

**Table 4. Wilcoxon 3D Pageflip E-Module Test Results**

Variable	3D Pageflip E-Module		
	N	Mean	Asymp. Sig. (2-tailed)
<b>Knowledge</b>			
<i>Pre-Test</i>	53	1.62	0.000
<i>Post-Test</i>	53	2.17	
<b>Attitude</b>			
<i>Pre-Test</i>	53	1.40	0.000
<i>Post-Test</i>	53	1.92	

As shown in Table 5, the Mann-Whitney test indicated a significant difference between the group receiving education using the prototype of the stunting health information system and the group using the 3D pageflip e-module (v-values of 0 and 0.042, respectively; p-value < 0.05). Therefore, based on the interpretation of  $H_a$ , it can be concluded that health promotion using the prototype of the stunting health information system and the 3D pageflip e-module improves mothers' knowledge and attitudes regarding preventive efforts against stunting. The increase in knowledge and attitudes among participants in the group that received education through the prototype of the stunting health information system was greater than that among participants in the group that received education through the 3D pageflip e-module. Health promotion using the prototype of the stunting health information system is more effective in improving mothers' knowledge and attitudes regarding stunting prevention. Furthermore, based

on the results of the effect size test, the knowledge variable yielded a value of  $r = 1.06$ , indicating that the influence of health promotion using the prototype of the stunting health information system and the 3D pageflip e-module on increasing preventive stunting knowledge is large. The effect size test for the attitude variable yielded  $r = 0.27$ , indicating that the influence of health promotion through the prototype of the stunting health information system and the 3D pageflip e-module on improving preventive stunting attitudes is small.

**Table 5. Mann-Whitney Test Results of Mothers' Knowledge and Attitudes About Stunting Using the 3D Pageflip E-Module and the Health Information System Prototype for Monitoring Stunting Changes (Post-test - Pre-test)**

	Group	Changes (Post-test - Pre-test)				Effect Size (r)
		n	Mean Rank	P-Value	Z	
<b>Knowledge</b>	Prototype of Stunting Health Information System	53	73.00	0.000	-7.726	1.061
	3D Pageflip E-Module	53	34.00			
<b>Attitude</b>	Prototype of Stunting Health Information System	53	55.50	0.042	-2.029	0.278
	3D Pageflip E-Module	53	51.50			

## DISCUSSION

### Age

Drawing from the study's result in Table 1, characteristics of respondents by age from 106 respondents show that in the prototype of the stunting health information system group, most respondents were aged 52-61 years, with 22 respondents (41.5%), and in the 3D pageflip e-module group, most respondents were aged 32-41 years, with 27 respondents (50.9%).

Previous research conducted by Saadah et al. (2024) entitled "Prevention and Intervention of Stunting Through Mother's Empowerment" found that the 240 mothers involved were mainly aged 20-35 years old, by 219 (94.4%) mothers, and there was a significant effect of maternal age during pregnancy on the incidence of stunting. Mature age for a mother who has received sufficient knowledge of caring for children so that the child's development goes well.

Mothers who are very young (<20 years old) or older (>35 years old) are at higher risk of having stunted children. A study in Ethiopia found that children who had mothers who were above 20 years old at giving birth had less risk of experiencing stunting than children with adolescent mothers. Adolescents usually have higher nutritional demands for their growth. Pregnancies during this age group result in competition for nutrients between the mother and the developing fetus. This often leads to impaired child growth, including stunting (Muche & Dewau, 2021). In addition, young mothers are often less physically and psychologically prepared to undergo pregnancy, which increases the likelihood of health problems. Children

born to mothers at an early age are often exposed to poor parenting and malnutrition (Adelbertha et al., 2022; Kurniawati & Saputro, 2022; Octaviani et al., 2025; Pusmaika et al., 2022).

Pregnancy after age 35 carries a risk of decreased nutrient absorption. This can result in an unbalanced diet and may lead to malabsorption, affecting the baby's nutritional intake. Pregnancy and childbirth in mothers aged 35 carry several risks, including the possibility of giving birth to a baby with stunting. At this age, women are more vulnerable to various illnesses, which can affect both the mother's and the baby's health throughout pregnancy and childbirth (Pusmaika et al., 2022; Wanimbo & Wartiningsih, 2020). Reflecting on the description, the researcher is of the opinion that an individual's cognitive abilities can develop with age: the older they are, the more knowledge they gain, which can be applied to everyday life and used to prevent stunting.

### **Education**

In light of the findings in Table 2 regarding the education of 106 respondents, the prototype stunting health information system group shows that 38 respondents (71.7%) had enrolled in high school, more than half of the group. In contrast, 24 participants in the 3D pageflip e-module group had a high school education, representing the majority (45.3%).

Education is a process to obtain knowledge, skills, values, and attitudes through various types of learning, both through formal and non-formal institutions, in order to support individuals to develop so that they can contribute to everything for the progress of themselves or society (Doharey et al., 2023). Previous research conducted by Saadah et al. (2024) entitled "Prevention and Intervention of Stunting Through Mother's Empowerment" showed that most of the mothers have a high school education, 97 (41.8%). A study by Bukari et al. (2020) in Tamale City, Ghana, found that stunting and wasting were significantly associated with maternal education. Additionally, a study in Nepal found that a baby born to an uneducated mother has a higher risk than a baby born to an educated mother (Budhathoki et al., 2020). Low maternal education will have an impact on child health care, child diet, child hygiene, and the amount of nutritional intake that must be met by children (Chowdhury *et al.*, 2022). Mothers with higher levels of education tend to have a better understanding of child nutrition and health. This knowledge includes awareness of the importance of balanced nutritional intake, exclusive breastfeeding, and regular monitoring of child growth. When mothers understand the significance of good nutrition, they are more likely to provide appropriate food for their children, which can help prevent both stunting and wasting (Bukari et al., 2020).

As outlined above, the researcher holds the view that the role of education for parents is particularly important for personal growth, development, and decision-making, especially in relation to children's health problems. With adequate information, parents can do everything possible to meet children's nutritional needs, thereby preventing stunting.

### **Knowledge**

The frequency distribution table shows that, before the health promotion, more than half of the 106 respondents in the prototype group of the stunting health information system had good knowledge about stunting, with 49 respondents (92.5%). The result was that all 53 respondents had good knowledge of stunting (100%) after receiving health promotion through the stunting health information system prototype. The Wilcoxon test results for maternal knowledge about stunting before (pre) and after (post) health promotion, using the Stunting Health Information System Prototype, showed an Asymp. Sig. (2-tailed) of 0.046 (p-value <0.05), which signifies a notable difference in values using the Stunting Health Information System Prototype method. This can be seen from the rise in the average pretest value from 2.92 to the average post-test value of 3.00.

The study's findings regarding the frequency distribution of individuals surveyed on maternal knowledge about stunting in the 3D Pageflip E-Module group before (pre) health promotion indicated that nearly half of the respondents lacked adequate knowledge about stunting (25 respondents, 47.2%). After (post) health promotion using the 3D Pageflip E-Module, more than half of the respondents had adequate knowledge about stunting, with 34 respondents (64.2%). The Wilcoxon test is used to assess maternal knowledge about stunting before (pre) and after (post) health promotion using the 3D Pageflip E-Module, with the result as follows: a p-value (Asymp. Sig. (2-tailed)) of 0.000 (p-value < 0.05) was obtained, thus suggesting the 3D Pageflip E-Module method is prominently effective in increasing values as evidenced from the rise in the average pre-test value from 1.62 to the average post-test value of 2.17.

This study aligns with Simamora et al. (2023), entitled "Increasing Mothers' Knowledge, Attitudes, and Actions through Stunting-Based Prevention Education AECAS App," which showed that before being given education on the use of Android, the knowledge level was in the poor category for as many as 28 people (59.6%); after being given the education regarding stunting based on the Android application media given again, the mothers' knowledge level increased, namely to good for 35 people (74.5%). Based on the analysis, p-value = 0.000 < 0.05, it can be concluded that there is a significant difference in the knowledge

variable between before and after the intervention in the experimental group that received education via an Android application (Simamora et al., 2023).

Knowledge is closely linked to education, as it is generally assumed that individuals with higher levels of education possess greater knowledge and a deeper understanding. The mother's knowledge proficiency is essential for household management; this will influence the mother's approach to selecting food ingredients for the family's consumption. Highly educated mothers have better knowledge of their child's nutritional health, are more aware of their child's health, and provide better parenting. It can be concluded that the higher the mother's education, the greater her knowledge of her child's health status, and the lower the incidence of stunting in children (Fitriani & Darmawi, 2022; Yunitasari et al., 2021).

Based on Lailiyah et al. (2021), a mother with limited nutritional knowledge and poor attitudes can significantly impact her toddler's nutritional status and struggle to select nutritious foods and menus for her child and family. Good, balanced nutrition means that nutrient intake must be in accordance with the body's needs. Malnutrition in toddlers affects brain growth and intelligence. This is due to a lack of protein production and a lack of energy obtained from food. Mothers' knowledge and attitudes regarding adequate nutrition are very important for ensuring that toddlers receive adequate nutrition and avoid malnutrition, especially to prevent stunting (Lailiyah et al., 2021).

### **Attitude**

Based on the frequency distribution table of respondents' mothers' attitudes about stunting before (pre) health promotion among 106 respondents, it shows that in the prototype group of the stunting health information system. The majority of respondents expressed a favorable attitude toward stunting (48 respondents, 90.6%). After (post) promoting health through the use of the prototype of a health information system for addressing stunting, all respondents had a positive attitude about stunting, with 53 respondents (100%). The Wilcoxon test results for mothers' attitudes about stunting before (pre) and after (post). Health promotion through the use of the Stunting Health Information System prototype. The system obtained a p-value (Asymp. Sig. (2-tailed)) of 0.025 (p-value < 0.05). This indicates a notable difference between the post-test and pre-test results. values with the prototype of the Stunting Health Information System method. This is evident from the rise in the average pre-test value from 1.91 to the average post-test value of 2.00.

The findings of the study on the frequency distribution of individuals surveyed based on mothers' attitudes about stunting in the 3D Pageflip E Module group showed that more than 50% of the individuals surveyed had negative attitudes about stunting before health promotion

(32 respondents, 60.4%), and after health promotion, more than half had positive attitudes (49 respondents, 92.5%). The Wilcoxon test results on mothers' attitudes showed a significant difference between pre- and post-health promotion using the 3D Pageflip E-Module method, with a p-value of 0.000 ( $p\text{-value} < 0.05$ ). This is evident from the increase in the average pretest value from 1.40 to the average post-test value of 1.92.

The findings of this study are consistent with Nugroho & Anggraeni's (2024) study, which showed that of 53 parents, the average mother's attitude was "fair" before (29, or 54.7%) and "good" after (25, or 47.2%). The average attitude toward stunting after receiving health education through the Ceting e-booklet media has improved. The p-value is  $0.000 < 0.05$ , so it can be concluded that attitudes changed after the intervention. So it can also be concluded that providing health education using a ceting (prevent stunting) e-booklet has an influence on attitudes towards stunting prevention among toddlers in the posyandu in Gunung Wetan Village.

Attitude refers to an individual's personal reaction or response to a specific stimulus or object, encompassing opinion and emotion (e.g., happy–unhappy, agree–disagree, good–bad), and is insightful. The manifestations of attitudes cannot be observed instantly; instead, they can only be inferred from behaviors that are apparent in advance. Attitudes essentially reflect the underlying reactions to stimuli in daily life (Anggraeni et al., 2022).

Good knowledge will create a good attitude. Attitude is an inclination of an individual to respond to a specific stimulus or object in a certain way. Attitude is not an activity or action, but rather a tendency to exhibit behavior, action, or assume a role. Attitudes related to overcoming stunting prevention include mothers' efforts to improve the nutrition of pregnant women by consuming good food, taking iron tablets, and maintaining their health during pregnancy to protect them from diseases (Kristiyanti et al., 2021).

### **Differences in the Effectiveness of Health Awareness Promotion Utilizing the 3D Pageflip E-Module and Health Information System Prototype for Monitoring Stunting on Mothers' Knowledge and Attitudes Towards Stunting**

According to the Mann-Whitney test, there was a significant difference between the group given education using the prototype of the stunting health information system and the group using the 3D pageflip e-module, with p-values of 0.000 and 0.042, respectively ( $p\text{-value} < 0.05$ ). Therefore, based on the interpretation of  $H_a$ , it can be concluded that health promotion using the prototype of a stunting health information system and the 3D pageflip e-module improves mothers' knowledge and attitudes regarding preventive efforts against stunting. The increase in knowledge and attitudes among participants in the group that received education

through the prototype of the stunting health information system was greater than that among participants in the group that received education through the 3D pageflip e-module. Health promotion using the prototype of the stunting health information system is more effective in improving mothers' knowledge and attitudes regarding stunting prevention. Furthermore, based on the results of the effect size test, the knowledge variable yielded a value of  $r = 1.06$ , indicating that the influence of health promotion using the prototype of the stunting health information system and the 3D pageflip e-module on increasing preventive stunting knowledge is large. The effect size test for the attitude variable yielded  $r = 0.27$ , indicating that the influence of health promotion using the prototype of a stunting health information system and the 3D pageflip e-module on improving preventive stunting attitudes is small.

Health education is oriented towards changing healthy behavior in a more positive direction. Health education aims to increase participants' or targets' knowledge of health (Abdussamad et al., 2021). Health education media refers to all channels or methods used to deliver information or messages that the communicator aims to share, whether through electronic, digital, print, or outdoor media. These media are intended to enhance the target audience's knowledge, ultimately leading to a positive change in their health-related behavior (Gejir et al., 2021). The principle of using digital media is that, by using interesting media to convey health information, the audience or community can enjoy quality, valuable information that is even more varied than direct experience. Thus, the effectiveness and efficiency of learning can be improved (Hulu et al., 2020; Marlinawati et al., 2023).

This study aligns with Gustina et al. (2025) in the Kampung Melayu Subdistrict, Bengkulu City, showing that the SESAMA Android-based educational application is effective in improving maternal knowledge, attitudes, and behaviors related to stunting prevention ( $p$ -value  $< 0.05$ ). Additionally, the study by Patel et al. (2024) designed the 'Mobile Solutions Aiding Knowledge for Health Improvement' or 'M-SAKHI' intervention, which was provided to pregnant mothers, enrolled before 20 weeks of gestation, through their delivery till their infant was 12 months old, with the goal to reduce infant stunting and improve infant development measured at 18 months of age in rural India. The program impact pathway was developed, and it identified the following pathways for the final impact: (1) improving maternal and infant nutrition, (2) early recognition of maternal and infant danger signs, (3) improving access and utilization to healthcare services, (4) improving hygiene, sanitation, and immunization practices, and (5) improving implementation and service delivery of community health workers through their training, monitoring, and supervision in real time.

It can be observed that most mothers have a high level of education, which makes it easier for them to receive information. A person's level of education affects their willingness to accept new ideas, concepts, and technologies. Increased knowledge and attitudes are effects of the results of knowing, caused by the respondent's learning process after sensing certain objects and becoming aware of the evaluation. Health promotion and community empowerment are ways to prevent stunting, as parents' knowledge and attitudes will, in turn, influence their behavior, health-care utilization, and access to nutrition information (Adam et al., 2022; Fitriani & Darmawi, 2022; Pratiwi et al., 2025).

The outcomes of this study are a digital health education program and a smartphone-based information system that can be accessed by the public. Through the prototype of the stunting health information system, respondents receive educational materials about stunting. In addition, the application includes motivation for mothers to help their children achieve optimal growth and development. Specifically, through the prototype, parents can measure BMI using the anthropometry feature. The application not only contains text but also includes posters, animated videos, and playful rhymes as motivational content.

Implementing digital health interventions relies heavily on digital literacy, which affects the performance of health-based apps by influencing users' capacity to comprehend and interact with the app's content (Arias López et al., 2023). The impact of educational background on contextual knowledge aligns with the findings of Côté et al. (2020) and Korkmaz & Toraman (2021), underscoring formal education's role in theoretical understanding. Adaptive learning pathways that accommodate these demographic differences can enhance the accessibility and effectiveness of learners (Côté et al., 2020; Korkmaz & Toraman, 2021).

## CONCLUSION

The prototype of the stunting health information system and the 3D pageflip e-module effectively increase mothers' knowledge and attitudes regarding stunting prevention. Compared to 3D pageflip e-module methods, health promotion using the prototype of the stunting health information system is more effective in improving mothers' knowledge and attitudes regarding stunting prevention. The effect size test shows that the influence of health promotion using the prototype of the stunting health information system and the 3D pageflip e-module on increasing preventive stunting for knowledge is large (1.06) and for attitude small (0.27). It is expected to be used by stakeholders to reduce stunting incidence. This study has several limitations, including a lack of randomization, a small sample size, short-term follow-up, potential for

social desirability bias, and the use of non-validated measurement tools. Strengths of the study include the use of digital tools in a real-world setting.

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