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Integration of Health Education Technology to Improve Mothers' Understanding of Toddler Nutrition in the Ciputat Timur Community Health Center Area, South Tangerang

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ABSTRACT

Purpose of the study: This study aimed to analyze the effectiveness of integrating health education media in improving maternal knowledge regarding toddler nutrition in the working area of the Ciputat Timur Community Health Center, South Tangerang.

Methodology: A quantitative study with a quasi-experimental design using a non-equivalent control group approach was conducted. The study involved 36 mothers of toddlers, consisting of 9 mothers of underweight toddlers (intervention group) and 27 mothers of well-nourished toddlers (control group). Data were collected using a structured questionnaire measuring maternal knowledge before and after the educational intervention. The intervention included health education using flipchart media and video-based educational materials, while the control group received education using flipchart media only. Data were analyzed using Wilcoxon Signed Rank Test with a significance level of $\alpha = 0.05$.

Main Findings: The results showed a significant improvement in maternal knowledge after the educational intervention. In the underweight toddler group, the median knowledge score increased from 65.00 to 80.00 ($p = 0.007$). In the well-nourished toddler group, the median knowledge score increased from 70.00 to 80.00 ($p < 0.001$). Furthermore, the proportion of mothers with knowledge scores above 70 increased from 0% to 66.7% in the underweight group and from 48.1% to 85.2% in the well-nourished group.

Novelty/Originality of this study: The novelty of this study lies in the integration of multiple health education media, including flipcharts and video-based learning, within a community-based nutrition education intervention at the primary health care level, providing a more interactive and effective approach to improving maternal nutrition literacy.

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1. INTRODUCTION

Nutritional problems in toddlers remain a major challenge in public health development, particularly in developing countries. Malnutrition during infancy can have serious impacts on a child's growth and development, both in the short and long term [1], [2], [3]. Malnourished toddlers are at risk of impaired physical growth, reduced immunity, and delayed cognitive and motor development [4], [5], [6]. One of the most obvious

consequences of chronic malnutrition is stunting, which impacts the quality of human resources in the future [7], [8], [9]. Furthermore, deficiencies in certain nutrients, such as vitamin A and folic acid, can also lead to other health problems such as blindness and developmental disorders.

Nutritional problems in toddlers are not only influenced by economic constraints or the lack of nutritious food availability, but are also closely related to knowledge and parenting behaviors within the family, particularly among mothers as the primary caregivers. The United Nations Children's Fund states that low levels of knowledge about nutrition, feeding patterns, and monitoring child growth are important determinants of a toddler's nutritional status [10], [11], [12]. This lack of understanding can lead to feeding practices that do not meet a child's nutritional needs, potentially increasing the risk of malnutrition in toddlers (UNICEF) [13], [14]. Therefore, improving nutritional literacy among mothers is a crucial strategy in preventing and addressing child malnutrition.

The Indonesian government has undertaken various efforts to address toddler nutrition issues through nutrition education and health promotion programs at the primary health care level [15]. These programs include nutrition counseling at Integrated Health Posts (*Posyandu*), supplementary feeding (PMT) for toddlers with malnutrition, and the provision of various communication, information, and education (KIE) media related to nutrition [16], [17], [18]. In South Tangerang City, a program to improve toddler nutrition has been implemented at all Community Health Centers (*Puskesmas*), including through counseling by health workers and Posyandu cadres to mothers of toddlers (Directorate of Nutrition Development, 2013). Furthermore, the Health Office has provided various educational media such as leaflets, posters, and flipcharts aimed at increasing public knowledge about child nutrition [19].

Despite the availability of various educational media, the effectiveness of delivering nutrition information through conventional media still faces several limitations. Printed media such as leaflets are often underutilized by the public due to limited information, low reading interest, and a lack of interactivity in delivering health messages. According to information from cadres in the Ciputat Timur Community Health Center (*Puskesmas*) working area, leaflets distributed to mothers of toddlers are often not read thoroughly and are often used for other purposes, resulting in the educational message not being fully absorbed. This situation indicates that the current health education approach still requires innovation to deliver nutrition information more effectively, engagingly, and easily understood by the public.

Several previous studies have shown that the use of educational media can increase public knowledge about nutrition. Research by Wulandari et al. [15] showed that nutrition education using the Family Awareness of Nutrition (*Kadarzi*) leaflet resulted in a significant increase in knowledge compared to counseling without media. Another study also found that the use of audiovisual media was more effective in increasing knowledge than modules or conventional methods [20], [21]. However, most of this research has focused on the use of conventional educational media such as leaflets, modules, and audiovisuals, and has not explored the use of digital technology as a more interactive and accessible health education medium [22], [23].

Along with the development of information technology, the use of digital technology in the health sector is growing and opening up new opportunities in delivering health education to the public. The integration of application-based health education technology or digital media has the potential to increase the effectiveness of information delivery because it can present material visually, interactively, and easily accessible at any time. However, research specifically examining the integration of health education technology to improve mothers' understanding of toddler nutrition at the primary health care level, particularly in the Ciputat Timur Community Health Center in South Tangerang City, is still limited.

Based on these conditions, this study presents a novel approach in developing and integrating health education technology as a nutrition learning medium for mothers of toddlers. It not only presents information in an informative manner but is also designed to be more interactive and easy to understand. This approach is expected to overcome the limitations of conventional educational media while increasing the effectiveness of nutrition education in..

This research is urgently needed, considering that improving mothers' understanding of toddler nutrition is a strategic step in preventing nutritional problems from an early age. By utilizing the integration of health education technology, it is hoped that the process of delivering nutrition information can be more effective, engaging, and sustainable, thereby increasing mothers' knowledge and awareness of maintaining their children's nutritional status. Therefore, this study aims to analyze the integration.

2. RESEARCH METHOD

2.1 Research Design

This study employed a quantitative research approach using a quasi-experimental design with a non-equivalent control group [24], [25], [26]. The design was selected to evaluate the effectiveness of integrating health education technology in improving mothers' understanding of toddler nutrition within a real-world

primary health care setting. In this design, two groups of participants were observed: an intervention group and a control group. Both groups underwent measurements before and after the educational intervention through pre-test and post-test assessments. The intervention group consisted of mothers with toddlers experiencing undernutrition, while the control group consisted of mothers with toddlers with normal nutritional status. The intervention involved structured health education using integrated educational media, while the control group received conventional educational exposure [27].

This approach allowed the researchers to assess changes in maternal knowledge after the intervention while comparing the outcomes between the intervention and control groups.

To clarify the study design, the structure of the quasi-experimental model used in this research is presented in table 1.

Table 1. Research Design of the Quasi-Experimental Study

Group	Pre-test	Intervention	Post-test
Intervention Group (Mothers of undernourished toddlers)	O1	Integrated health education media (flipchart + video)	O2
Control Group (Mothers of well-nourished toddlers)	O3	Conventional education media (flipchart)	O4

Table 1 illustrates the experimental structure used in this study. Both groups were assessed before and after the intervention to measure changes in knowledge regarding toddler nutrition. The intervention group received enhanced educational exposure using integrated digital and visual media, while the control group received standard educational materials.

The research was conducted at Puskesmas Ciputat Timur, a primary health care center located in South Tangerang, Indonesia. This health center provides maternal and child health services, including nutrition monitoring programs for toddlers through community-based integrated health posts (Posyandu).

Data collection was carried out over a two-month period, from November to December, during routine maternal and child health service activities coordinated by the health center and local Posyandu cadres.

2.2 Population and Sampling

The target population consisted of all mothers who had toddlers with undernutrition status identified within the working area of the Ciputat Timur Health Center. Nutritional status was determined using the weight-for-height indicator ≤ –2 standard deviations (SD) based on anthropometric measurements recorded by Posyandu cadres. Based on the latest data from community health posts in the study area, nine mothers with undernourished toddlers were identified and included as the intervention group. Sampling technique applied in this research differed between the intervention and control groups [28], [29].

The intervention group employed a total sampling technique, meaning that all mothers of toddlers with undernutrition within the study area were included as respondents. Consequently, the intervention group consisted of nine participants. For the control group, participants were selected using purposive random sampling from mothers whose toddlers had a normal nutritional status. Normal nutritional status was defined based on growth monitoring results recorded in the Kartu Menuju Sehat (KMS), where the weight measurement indicator was located in the green zone of the growth chart. The sample size for the control group followed a 1:3 ratio, resulting in 27 mothers with well-nourished toddlers. Table 2 summarizes the characteristics of the research sample.

Table 2. Distribution of Research Participants

Group	Nutritional Status of Toddler	Sampling Technique	Number of Participants
Intervention	Undernutrition (≤ –2 SD weight-for-height)	Total sampling	9
Control	Normal nutritional status	Purposive random sampling	27
Total			36

Table 2 presents the distribution of respondents participating in the study. A larger control group was included to increase statistical comparability and strengthen the analytical power when evaluating differences in maternal knowledge outcomes.

2.3 Data Collection Procedures

Data collection was conducted in several stages to ensure systematic and reliable measurement of maternal knowledge. First, respondents were asked to complete a baseline questionnaire containing demographic information. This questionnaire included data such as age, educational background, and occupation. Second, a pre-test questionnaire was administered to assess participants' initial knowledge regarding toddler nutrition and nutritional disorders. Third, the intervention was conducted through direct health education sessions facilitated by the researcher with assistance from the nutrition officer of the health center. Educational sessions were delivered using integrated educational media. Finally, after the educational intervention, respondents completed the post-test questionnaire, which contained the same knowledge assessment items as the pre-test. The difference between pre-test and post-test scores was used to evaluate the effectiveness of the educational intervention.

2.4 Research Instruments

The main research instrument used in this study was a structured questionnaire assessing maternal knowledge regarding toddler nutritional status. The instrument consisted of three components:

1. Respondent identity form
2. Pre-test questionnaire
3. Post-test questionnaire

The questionnaire items were adapted from previously validated studies to ensure reliability and validity. The sources of questionnaire items and their psychometric properties are summarized in Table 3.

Table 3. Sources and Psychometric Properties of Questionnaire Items

Item Numbers	Source Study	Validity	Reliability (Cronbach's Alpha)
1–6	Munawaroh (2006)	$p < 0.05$	0.737
7–9	Palupi (2014)	$p < 0.05$	0.669
10	Purwanti (2010)	$p < 0.05$	0.963

Questionnaire demonstrated acceptable reliability values across all sources, indicating that the instrument was sufficiently consistent for measuring maternal knowledge regarding toddler nutrition.

In addition to the questionnaire, educational media were used as intervention tools. The intervention media consisted of:

- Flipchart educational media containing structured information on nutritional disorders
- Short educational video explaining the causes and prevention of severe malnutrition

The flipchart material covered seven key topics: definition of malnutrition, risk factors, signs and symptoms, prevention strategies, treatment approaches, impacts of malnutrition, and the importance of balanced nutrition for children.

2.5 Research Procedure

The research procedure consisted of several sequential stages, beginning with the preparation of educational media and ending with data analysis and reporting. The stages included media development, pilot testing, implementation of educational intervention, and evaluation of knowledge outcomes.

The overall research process is illustrated in Figure 1.

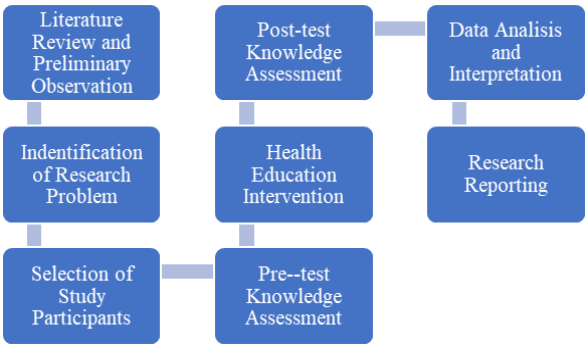

Figure 1. Research Flow Diagram

The pilot testing stage ensured that the educational materials were understandable, visually appropriate, and culturally relevant before being implemented in the main study. Data management was conducted systematically to ensure accuracy and consistency. The process consisted of several steps. First, data editing was performed to verify the completeness of questionnaire responses. Second, data coding was carried out by assigning numerical codes to each response category to facilitate statistical analysis. Third, a data structure and

database file were created using statistical software. Next, data entry was conducted using the Statistical Package for Social Sciences (SPSS). Finally, data cleaning was performed to identify and correct possible errors or inconsistencies during data entry.

2.6 Data Analysis

In addition to statistical analysis, qualitative descriptive analysis was conducted to evaluate the design and structure of the educational media used in the intervention. This analysis examined aspects such as layout, typography, color selection, clarity of illustrations, language simplicity, and sequence of educational messages. The evaluation aimed to ensure that the educational content was presented in a manner that was accessible and understandable to mothers participating in the study.

Data analysis consisted of univariate and bivariate statistical analysis. Univariate analysis was conducted to describe the distribution of respondents' characteristics and knowledge scores using frequency distributions and median values. Bivariate analysis was performed to determine differences in maternal knowledge before and after the educational intervention. Because the normality test indicated that the data were not normally distributed, a non-parametric statistical test (Wilcoxon Signed-Rank Test) was applied. The statistical significance level was set at 95% confidence interval ($\alpha = 0.05$). A p-value less than 0.05 indicated a statistically significant difference between pre-test and post-test scores.

3. RESULTS AND DISCUSSION

The study was conducted in the working area of the Ciputat Timur Community Health Center, South Tangerang City, which covers several urban villages including Cempaka Putih and Rempoa. Demographic data from the local health office indicate that the majority of mothers residing in this area are within the reproductive age range. Approximately 4,700 mothers aged between 23–42 years live in Cempaka Putih Village, while around 6,900 mothers aged between 19–43 years reside in Rempoa Village. In terms of educational background, most mothers in this area have completed junior or senior secondary education. In Cempaka Putih Village, approximately 2,700 mothers have completed senior high school or its equivalent, while nearly 8,000 mothers in Rempoa Village have attained the same level of education. Meanwhile, around 1,500 mothers in Cempaka Putih and approximately 1,300 mothers in Rempoa have completed education up to junior high school level.

Regarding employment status, many mothers in Cempaka Putih work in the private sector, followed by domestic workers and civil servants. However, detailed occupational distribution for mothers in Rempoa Village is not fully documented. The characteristics of respondents included in this study consisted of maternal age, educational level, and employment status. Understanding these characteristics is important to describe the demographic background of the study participants and to ensure comparability between the intervention and control groups.

The distribution of maternal characteristics among mothers of undernourished toddlers and mothers of well-nourished toddlers is presented in Table 4.

Table 4. Characteristics of Mothers of Underweight and Well-Nourished Toddlers

Characteristics	Underweight Toddler (n=9)	Well-Nourished Toddler (n=27)
Maternal Age		
< 30 years	2	13
≥ 30 years	7	14
Education Level		
Did not complete junior high school	1	1
Completed junior high school or higher	8	26
Employment Status		
Not working	9	22
Working	0	5

Based on Table 4, most mothers of underweight toddlers were aged 30 years or older (7 respondents), while two respondents were younger than 30 years. In contrast, among mothers with well-nourished toddlers, 13 were under 30 years of age and 14 were aged 30 years or above. Regarding educational background, the majority of respondents in both groups had completed at least junior high school education. Eight mothers in the underweight toddler group and twenty-six mothers in the well-nourished group had completed junior high school or higher. Only one respondent in each group had not completed junior high school. In terms of employment status, all mothers in the underweight toddler group were not formally employed. Among mothers with well-nourished toddlers, twenty-two were not working while five respondents had formal employment.

The age distribution of toddlers in both nutritional status groups was analyzed to describe the demographic characteristics of the children whose mothers participated in the study. The age categories were

divided based on the median age of the toddlers. The distribution of toddler age in both groups is presented in Table 5.

Table 5. Age Distribution of Underweight and Well-Nourished Toddlers

Age of Toddler	Underweight (n=9)	Well-Nourished (n=27)
< 2 years	3	8
≥ 2 years	6	19

As shown in Table 5, among toddlers classified as underweight, three were younger than two years old, while six were aged two years or older. In the well-nourished group, eight toddlers were younger than two years and nineteen were aged two years or above. The categorization of toddler age was determined based on the median value within each group.

To evaluate the effectiveness of the educational intervention, maternal knowledge scores were measured before and after the implementation of the health education program using educational media. Knowledge scores were categorized into two groups: scores ≤ 70 indicating lower knowledge levels and scores > 70 indicating higher knowledge levels. The distribution of knowledge scores before and after the intervention is presented in Table 6.

Table 6. Distribution of Maternal Knowledge Scores Before and After Educational Intervention

Knowledge Score	Underweight Group		Well-Nourished Group	
	Pre-test n (%)	Post-test n (%)	Pre-test n (%)	Post-test n (%)
≤ 70	9 (100)	3 (33.3)	14 (51.9)	4 (14.8)
> 70	0 (0)	6 (66.7)	13 (48.1)	23 (85.2)
Total	9 (100)	9 (100)	27 (100)	27 (100)

As shown in Table 3, all mothers in the underweight toddler group initially had knowledge scores of ≤70 before the educational intervention. After the health education program, six respondents (66.7%) achieved scores above 70, indicating improved knowledge levels, while three respondents remained below or equal to the threshold score. In the well-nourished toddler group, fourteen respondents (51.9%) had knowledge scores ≤70 before the intervention, whereas thirteen respondents (48.1%) already had scores above 70. After the educational program, the number of mothers with scores above 70 increased to twenty-three respondents (85.2%), demonstrating a substantial improvement in knowledge levels. The effectiveness of the educational intervention was also reflected in the change in knowledge score proportions (Δ). Among mothers of underweight toddlers, the increase in the proportion of scores above 70 was 66.7%, while among mothers of well-nourished toddlers the increase was 37.1%.

Further analysis was conducted to examine changes in correct responses for each knowledge question before and after the intervention. This analysis helps identify specific aspects of nutrition knowledge that improved following the educational program. The distribution of correct responses is presented in Table 4.

Table 4. Correct Responses to Knowledge Questions Before and After Intervention

No	Knowledge Topic	Underweight Group Pre (%)	Underweight Post (%)	Well-Nourished Pre (%)	Well-Nourished Post (%)
1	Definition of malnutrition	0	77.8	11.1	66.7
2	Signs and symptoms of malnutrition	22.2	55.6	14.8	74.1
3	Risk factors of malnutrition	44.4	77.8	59.2	85.1
4	Diseases associated with malnutrition	22.2	77.8	48.1	88.9
5	Prevention of malnutrition	55.6	77.8	62.9	85.1
6	Management of malnutrition	44.4	88.9	74.1	96.3
7	Effect on child growth	100	100	81.4	100
8	Impact on child development	55.6	77.8	66.7	92.5
9	Benefits of nutritious food	100	100	85.1	100
10	Food diversity for toddlers	100	100	100	100

Based on Table 4, the largest improvement among mothers of underweight toddlers occurred in the question related to the definition of malnutrition, with an increase of 77.8% in correct responses after the intervention. Meanwhile, no change was observed in questions related to child growth impact, benefits of nutritious foods, and dietary diversity because all respondents had already answered these questions correctly at baseline. Among mothers of well-nourished toddlers, the most notable increases were observed in questions

related to the definition of malnutrition and clinical signs of malnutrition, with improvements of 55.6% and 59.3%, respectively. Similar to the underweight group, responses to the question regarding dietary diversity remained unchanged due to a perfect baseline score.

To determine whether the observed changes in maternal knowledge were statistically significant, a Wilcoxon Signed Rank Test was conducted. This non-parametric test was used because the data did not meet the assumption of normal distribution. The results of the statistical analysis are presented in Table 5.

Table 5. Comparison of Maternal Knowledge Scores Before and After Intervention

Group	Median Before	Median After	SD	p-value
Underweight Toddler Group	65.00	80.00	14.67	0.007
Well-Nourished Toddler Group	70.00	80.00	9.34	0.000

As shown in Table 5, there was a statistically significant increase in maternal knowledge among mothers of underweight toddlers after receiving the educational intervention ($p = 0.007$). The median knowledge score increased from 65 to 80, indicating a substantial improvement following the health education program.
Similarly, mothers of well-nourished toddlers also showed a significant improvement in knowledge levels ($p < 0.001$). The median knowledge score increased from 70 before the intervention to 80 after the intervention.
These findings indicate that the integration of educational media in health education activities effectively improved maternal knowledge regarding toddler nutrition.

The present study examined the effectiveness of integrating health education media in improving maternal knowledge regarding toddler nutrition in the working area of the Ciputat Timur Community Health Center. The findings demonstrate that educational interventions using structured media, including flipchart materials and video-based information, significantly improved mothers' knowledge related to malnutrition, its causes, prevention, and management. These results highlight the important role of educational media in strengthening maternal understanding of child nutrition and suggest that innovative communication approaches can support nutrition promotion efforts at the primary health care level.

Demographic characteristics of respondents indicate that most mothers participating in the study were aged 30 years or older and had completed at least junior high school education. These characteristics are consistent with the demographic profile of mothers in the study area, where the majority of women of reproductive age have achieved basic formal education. Education level is widely recognized as an important determinant of health literacy and the ability to understand health-related information. Mothers with higher educational attainment tend to have greater access to information, improved cognitive capacity to process health messages, and a stronger ability to apply nutritional knowledge in daily child-care practices. However, despite the relatively adequate educational background of most respondents, the baseline results of this study revealed that knowledge regarding malnutrition was still limited, particularly among mothers of underweight toddlers. This finding indicates that formal education alone may not be sufficient to ensure adequate maternal knowledge regarding child nutrition, emphasizing the importance of targeted health education interventions within community health services.

The results of the knowledge assessment revealed a substantial improvement in maternal knowledge following the educational intervention. Prior to the intervention, all mothers in the underweight toddler group had knowledge scores below the threshold value of 70. After the intervention, two-thirds of these mothers achieved scores above 70, indicating a marked increase in understanding of nutrition-related concepts. Similarly, mothers of well-nourished toddlers also experienced an improvement in knowledge scores, with the proportion of respondents scoring above 70 increasing from 48.1% to 85.2%. These findings suggest that the educational program successfully enhanced maternal knowledge regardless of the child's nutritional status, although the magnitude of improvement was more pronounced among mothers of underweight toddlers.

Improvement in knowledge was further confirmed by the analysis of correct responses to individual questionnaire items [30]. The most notable improvement occurred in questions related to the definition of malnutrition and the identification of its causes and associated diseases [31]. This result suggests that the educational media effectively conveyed essential information that had previously been poorly understood by respondents. In contrast, several questions showed minimal or no change because the majority of respondents had already answered them correctly at baseline, particularly those related to the benefits of nutritious foods and dietary diversity. This pattern indicates that mothers already possessed some general knowledge regarding healthy foods for children, but lacked a deeper understanding of the mechanisms, causes, and consequences of malnutrition.

Statistical analysis using the Wilcoxon Signed Rank Test confirmed that the increase in maternal knowledge after the intervention was statistically significant in both groups. The median knowledge score increased from 65 to 80 among mothers of underweight toddlers and from 70 to 80 among mothers of well-nourished toddlers. These findings support the conclusion that the health education intervention had a meaningful impact on maternal knowledge regarding toddler nutrition. From a public health perspective,

improving maternal knowledge is a crucial step toward promoting better feeding practices, early detection of growth problems, and improved child health outcomes.

The findings of this study are consistent with several previous studies that have highlighted the effectiveness of educational media in improving nutrition knowledge among mothers. Earlier research has shown that health education using printed materials, such as leaflets and flipcharts, can significantly increase awareness and understanding of child nutrition issues. Studies conducted in various community settings have also demonstrated that audiovisual media can enhance knowledge retention because visual and auditory stimulation facilitates better comprehension and recall of health information [32]. For example, previous research reported that nutrition education delivered through audiovisual media produced greater improvements in knowledge compared with conventional text-based materials alone [23], [33]. Similarly, community-based interventions using structured educational materials have been shown to improve maternal knowledge and practices related to child feeding and nutritional care.

Despite these similarities, the present study contributes additional insights by demonstrating the potential benefits of integrating multiple forms of educational media within a community health education program. Many previous studies focused primarily on single educational tools such as leaflets, modules, or lectures. In contrast, this study utilized a combination of visual flipchart materials and video-based educational content, which allowed information to be delivered through complementary communication channels. This integrated approach may have enhanced participant engagement and improved comprehension of complex nutrition concepts. Therefore, the novelty of this study lies in the integration of multiple educational media formats within a structured health education intervention at the primary health care level, particularly in the context of community-based nutrition education for mothers of toddlers.

Another important contribution of this study is its focus on comparing mothers of underweight toddlers with those of well-nourished toddlers. This comparative approach provides a more comprehensive understanding of how educational interventions may influence different population groups. The findings show that although mothers of well-nourished toddlers had slightly higher baseline knowledge levels, both groups benefited significantly from the educational intervention. This result suggests that nutrition education should not only target high-risk families but should also be implemented broadly among mothers with young children to strengthen preventive knowledge and promote healthy feeding practices.

This study also have several practical implications for public health programs. First, they highlight the importance of strengthening nutrition education strategies at the community health center level. Health education activities conducted during routine maternal and child health services, such as Posyandu sessions, represent valuable opportunities to disseminate nutrition information to mothers. Second, the results suggest that integrating innovative educational media into these activities can enhance the effectiveness of information delivery. Educational materials that combine visual images, structured explanations, and multimedia elements may help mothers better understand complex nutrition concepts and retain key health messages [34], [35], [36]. Third, improved maternal knowledge may ultimately contribute to better caregiving practices, including appropriate feeding, monitoring of child growth, and early recognition of nutrition-related health problems.

Nevertheless, several limitations should be considered when interpreting the findings of this study. One important limitation is the relatively small sample size, particularly in the group of mothers with underweight toddlers. Because the number of respondents was limited to the available population in the study area, the generalizability of the results to other populations may be restricted. In addition, the quasi-experimental design used in this study did not involve full randomization of participants, which may introduce potential selection bias between the intervention and control groups. Another limitation is that the study primarily measured changes in knowledge rather than long-term behavioral changes in child feeding practices. While increased knowledge is an important prerequisite for behavioral improvement, it does not necessarily guarantee changes in daily practices without continuous reinforcement and supportive environmental factors.

Despite these limitations, the study provides valuable evidence regarding the role of integrated educational media in improving maternal knowledge about toddler nutrition. The findings suggest that strengthening health education strategies using innovative communication approaches may support broader efforts to prevent malnutrition and improve child health outcomes in community settings. Future research should consider involving larger sample sizes, incorporating digital or mobile-based educational technologies, and examining the long-term impact of educational interventions on maternal behavior and child nutritional status.

4. CONCLUSION

This study aimed to analyze the effectiveness of integrating health education media in improving maternal knowledge regarding toddler nutrition in the working area of the Ciputat Timur Community Health Center, South Tangerang. The results showed that health education using integrated educational media significantly improved maternal knowledge in both study groups. Among mothers of underweight toddlers, the median knowledge score increased from 65.00 before the intervention to 80.00 after the intervention, with a

statistically significant difference (p = 0.007). Similarly, among mothers of well-nourished toddlers, the median knowledge score increased from 70.00 to 80.00, with a significant statistical result (p < 0.001). In addition, the proportion of respondents with knowledge scores above 70 increased from 0% to 66.7% in the underweight toddler group and from 48.1% to 85.2% in the well-nourished toddler group. These findings indicate that the integration of educational media, including flipchart materials and video-based learning, is effective in enhancing maternal understanding of malnutrition, its causes, prevention, and management. Overall, the study demonstrates that innovative educational strategies implemented at the primary health care level can contribute to improving maternal nutrition literacy and strengthening preventive efforts against child malnutrition. It is recommended that community health centers integrate multimedia-based educational approaches into routine maternal and child health programs to improve the effectiveness of nutrition education. Future studies should involve larger populations and explore digital or mobile-based educational platforms to further strengthen community-based nutrition promotion strategies.

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USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

The authors confirm that no artificial intelligence (AI)-assisted technologies were utilized in thepreparation, analysis, or writing of this manuscript. All stages of the research process, including data collection, data interpretation, and the development of the manuscript, were conducted solely by the authors without any support from AI-based tools.

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