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# Effectiveness of Audiovisual Media vs Leaflets in Improving Mothers' Knowledge of Diphtheria in Toddlers in Mojo Health Center, Surabaya

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**ABSTRACT** Diphtheria remains a highly contagious and potentially fatal disease, particularly among children under five, largely due to insufficient maternal awareness and knowledge about its transmission, symptoms, and preventive measures. Enhancing maternal understanding is vital for effective disease prevention; however, the most effective educational approaches are still under investigation. This study aims to evaluate and compare the effectiveness of audiovisual media versus printed leaflets in improving mothers' knowledge of diphtheria in toddlers attending Mojo Health Center, Surabaya. Employing a quasi-experimental design with a two-group pretest-posttest framework, the research involved a sample of 198 mothers with children aged 1-5 years, selected through cluster random sampling from community health post areas. Data collection was conducted using structured questionnaires administered before and after health education interventions, with the impact assessed via Wilcoxon and Mann-Whitney statistical tests. The findings revealed that prior to intervention, 60% of mothers exhibited inadequate knowledge about diphtheria. Post-intervention results demonstrated a significant improvement in maternal knowledge in both groups; however, the group exposed to audiovisual media showed a markedly higher increase in understanding, with 76% reaching a good knowledge level compared to a lesser improvement in the leaflet group. Statistical analysis confirmed the superiority of audiovisual media in enhancing maternal knowledge about diphtheria, suggesting its greater potential as an educational tool. The study concludes that audiovisual media is more effective than traditional leaflet-based education in increasing maternal awareness, thereby emphasizing the need to prioritize multimedia strategies in health education programs targeting disease prevention in community settings.

**INDEX TERMS** Diphtheria, maternal knowledge, audiovisual media, health education, disease prevention

## I. INTRODUCTION

Diphtheria remains a significant public health concern, particularly in developing countries, despite the availability of effective vaccines. According to the World Health Organization (WHO), diphtheria is highly contagious and can cause airway obstruction, myocarditis, neuropathy, and even death if not promptly diagnosed and treated [1]. The disease predominantly affects children under five, attributed to their immature immune systems and increased exposure risks [2]. Furthermore, the persistence of diphtheria outbreaks in certain regions underscores gaps in immunization coverage and inadequate health education among vulnerable populations, especially mothers who serve as primary caregivers [3].

The transmission of diphtheria occurs through respiratory droplets, necessitating stringent prevention strategies, including immunization and health education [4]. Recognizing the pivotal role that maternal knowledge plays in disease prevention, health promotion efforts have increasingly focused on improving maternal awareness and behavior toward disease control measures [5]. Traditional health education interventions have primarily employed

printed materials, such as leaflets and booklets, which are cost-effective and easy to distribute; however, their effectiveness is often constrained by literacy levels and engagement challenges [6], [7]. Recent advances advocate for the integration of multimedia approaches, particularly audiovisual media, which can enhance information retention and understanding through dynamic and interactive content [8].

Current research indicates that audiovisual health education can significantly improve knowledge, attitudes, and practices related to disease prevention [9], [10]. Nonetheless, the comparative effectiveness of audiovisual versus print-based methods remains underexplored in the context of diphtheria prevention among mothers in community settings. While several studies suggest that multimedia interventions outperform traditional methods [11], [12], there is a need for locally tailored research to validate these findings, considering cultural, educational, and socioeconomic factors influencing health literacy.

Despite the recognition of visual and auditory learning modalities, a clear research gap persists regarding the direct comparison between audiovisual media and printed leaflets

in improving maternal knowledge specifically about diphtheria. Most previous studies have either focused solely on one method or have not employed rigorous experimental designs to establish causal relationships [13], [14]. Moreover, understanding the most effective means of delivering health education in resource-limited settings remains critical for optimizing public health strategies.

This study aims to address these gaps by evaluating the effectiveness of audiovisual media against printed leaflets in enhancing mothers' knowledge of diphtheria in a community-based setting in Surabaya. Specifically, the objectives are to determine which educational modality results in a more significant increase in maternal understanding, to provide evidence-based recommendations for health education practices, and to contribute to the scant literature on multimedia health promotion in diphtheria prevention.

The contributions of this paper are threefold: (1) providing empirical evidence on the comparative effectiveness of audiovisual media and printed leaflets in a community context; (2) informing policymakers and health practitioners on the optimal strategy for maternal health education regarding diphtheria; (3) advancing the methodological rigor of health education research through a quasi-experimental design with pretest-posttest assessments.

## II. METHODS

### A. STUDY DESIGN

This research employed a quasi-experimental, two-group pretest-posttest design aimed at evaluating the effectiveness of audiovisual media versus leaflets in enhancing maternal knowledge about diphtheria in toddlers. Quasi-experimental studies are appropriate when randomization of subjects is limited but control over intervention implementation is required to assess causal relationships [21], [22]. This design facilitates direct comparison of the intervention effects within and between groups, providing robust evidence on the impact of different health education modalities.

### B. STUDY SETTING

The study was conducted within the working area of Mojo Community Health Center (Puskesmas Mojo), Surabaya, Indonesia, specifically targeting mothers residing in RW 12 of Mojo Subdistrict, which encompasses eight community health posts (Posyandu). These health posts function as community-based service units involved in maternal and child health activities, making them ideal for assessing health education interventions [23].

### C. POPULATION AND SAMPLE

The target population comprised all mothers with children aged 1 to 5 years residing in RW 12 of Mojo Subdistrict, totaling approximately 391 individuals. The inclusion criteria stipulated mothers who were primarily responsible for childcare and consented to participate voluntarily. Mothers with cognitive impairments or prior participation in similar health education programs within the last six months were excluded to minimize confounding factors. Participants were selected via cluster random sampling, with each Posyandu serving as a cluster, ensuring logistical feasibility

and preserving group integrity for intervention delivery. Within each cluster, mothers were randomly chosen to participate, enhancing the internal validity and representativeness of the study sample [24].

### D. INTERVENTION MATERIALS

Two distinct health education modalities were developed to ensure content standardization: audiovisual media and printed leaflets. Both interventions were based on national diphtheria prevention guidelines issued by the Ministry of Health, Indonesia, and were reviewed by public health experts to ensure accuracy and relevance. The audiovisual media consisted of a 10-minute educational video accompanied by a 5-minute discussion session designed to clarify content and reinforce understanding. The leaflet intervention involved a printed material, which was briefly explained within a 5-minute briefing, followed by a 10-minute interactive discussion. Both materials conveyed identical messages focusing on diphtheria transmission, symptoms, prevention strategies, and the importance of immunization. Pilot testing was performed with 20 mothers similar in demographics to validate the questionnaires' content, ensure clarity, and assess reliability, yielding a Cronbach's alpha of 0.82, indicating good internal consistency [25].

### E. DATA COLLECTION TOOLS

Maternal knowledge was measured via a structured questionnaire, comprising multiple-choice questions aligned with the intervention content. The questionnaire underwent content validation by public health experts and pilot testing to assess validity ( $r > 0.444$ ) and reliability (Cronbach's alpha = 0.82). It was administered twice pre-intervention (pretest) and immediately post-intervention (posttest) to evaluate changes attributable to the educational interventions. The questionnaire addressed key domains: understanding of diphtheria transmission, symptoms, prevention methods, and vaccination importance. Data collection was conducted by trained researchers to minimize bias, with standard procedures for administering questionnaires uniformly across groups.

### F. PROCEDURE

Data collection occurred in selected Posyandu, with participants divided into two groups based on the intervention modality. The audiovisual group watched the educational video in a designated room, followed by a discussion, while the leaflet group received printed materials with explanation and discussion similar in duration to ensure uniformity. Both sessions were conducted within a controlled environment to optimize focus and engagement. Pretest questionnaires were administered immediately before intervention delivery. After the educational session, posttest questionnaires were completed to assess knowledge gains.

### G. DATA ANALYSIS

Data were processed using IBM SPSS Statistics version 25.0. Descriptive statistics described participant demographics and baseline knowledge levels. Normality

testing via the Kolmogorov–Smirnov was conducted to determine the appropriate inferential statistical tests. For hypothesis testing, the Wilcoxon Signed-Rank Test was employed to analyze within-group knowledge improvements, considering the nonparametric nature of the data. The Mann-Whitney U test compared the efficacy between the audiovisual and leaflet groups. A significance level of  $p < 0.05$  was set for all analyses. The statistical approach was designed to ensure robust assessment of intervention effects and facilitate valid conclusions regarding the relative effectiveness of the health education modalities [26].

## H. ETHICAL CONSIDERATIONS

The study protocol received approval from the Medical Faculty Ethics Committee of Poltekkes Kemenkes Surabaya (Reference: [Insert Approval Number]). Ethical adherence included obtaining informed consent from all participants, ensuring confidentiality, and allowing withdrawal at any stage without repercussions. Participants received standard prenatal and postnatal health education services, ensuring no harm or deprivation resulted from participation.

## I. LIMITATIONS

While the quasi-experimental design enhances feasibility and reflects real-world settings, it may introduce selection bias and limit causal inference compared to randomized controlled trials. Nonetheless, careful cluster randomization and statistical adjustments were employed to mitigate confounding factors [27].

## III. RESULT

### A. RESPONDENT CHARACTERISTICS

TABLE 1

Distribution of Characteristics of Mothers with Children Under Five in RW 12 Jojoran, Mojo Subdistrict, Working Area of Mojo Community Health Center, Surabaya

Intervention Group audiovisual (n = 101)			Intervention Group leaflet (n = 97)	
Mother's Age	Frequency	(%)	Frequency	(%)
19-24	10	9,9	0	0
25-35	56	55,4	63	64,9
36-45	35	34,7	34	35,1
Child's Age	Frequency	(%)	Frequency	(%)
0-1	26	25,7	29	29,9
>1-3	33	32,7	39	40,2
>3-5	42	41,6	29	29,9
Education	Frequency	(%)	Frequency	(%)
No Schooling	0	0,0	0	0,0
Elementary School	4	4,0	4	4,1
Junior High School	14	13,9	12	12,4
Senior High School	65	64,4	66	68,0
Bachelor's Degree	18	17,8	15	15,5
Work	Frequency	(%)	Frequency	(%)
Tidak bekerja	74	73,3	71	73,2
PNS	3	3,0	2	2,1
Pegawai swasta	13	12,9	13	13,4
Wirasaha	7	6,9	9	9,3
Buruh	4	4,0	2	2,1

Based on TABLE 1. The age data of mothers with children under five in RW 12 Jojoran, within the audiovisual media intervention group, are aged 25-35 years (55.4%). Meanwhile, in the leaflet media intervention group, the majority of mothers (64.9%) are also aged 25-35 years.

Overall, the 25-35 age group dominates in both the audiovisual and leaflet intervention groups. The audiovisual media intervention group, nearly half (41.6%) of the mothers have children aged >3-5 years. In contrast, in the leaflet media intervention group, nearly half (40.2%) of the mothers have children aged >1-3 years. The audiovisual media intervention group, the majority (64.4%) of mothers have a high school (SMA) education. Similarly, in the leaflet media intervention group, the majority (68.0%) of mothers also have a high school (SMA) education. The audiovisual media intervention group, the majority (73.3%) of mothers do not have a job. The audiovisual media intervention group, the majority (64.4%) of mothers have a high school (SMA) education. Similarly, in the leaflet media intervention group, the majority (68.0%) of mothers also have a high school (SMA) education. The audiovisual media intervention group, the majority (73.3%) of mothers do not have a job. In the leaflet media intervention group, the majority (73.2%) of mothers also do not have a job. In the leaflet media intervention group, the majority (73.2%) of mothers also do not have a job. Overall, the results show that the majority of mothers are not employed in both the audiovisual and leaflet intervention groups. The audiovisual media intervention group, the majority (73.3%) of mothers do not have a job. In the leaflet media intervention group, the majority (73.2%) of mothers also do not have a job. In the leaflet media intervention group, the majority (73.2%) of mothers also do not have a job. Overall, the results show that the majority of mothers are not employed in both the audiovisual and leaflet intervention groups.

### B. THE EFFECT OF AUDIOVISUAL-BASED HEALTH EDUCATION ON MOTHERS' KNOWLEDGE ABOUT DIPHTHERIA

TABLE 2

The Impact of Audiovisual Media Health Education Before and After on Mothers' Knowledge About Diphtheria in Toddlers

Maternal knowledge regarding diphtheria	Audiovisual group			
	Pre-test frequenc y (f)	%	Post-test frequency (f)	%
Poor	61	60	6	6
Sufficient	27	27	18	18
Good	13	13	77	76
Total	101	100	101	100

TABLE 3

Results of the Wilcoxon Signed Rank Test on Mothers' Knowledge About Diphtheria in Toddlers

	N	Mea n	Median	SD	P Value
Pre-Test Audiovisual	101	1.54	1.00	.723	0.000
Post-Test Audiovisual	101	2.69	3.00	.584	

As shown in TABLE 2, the level of maternal knowledge regarding diphtheria significantly increased in the audiovisual intervention group following the educational session. Prior to the intervention, 60% of mothers had poor knowledge, while only 13% were categorized as having good knowledge. Post-intervention, the proportion of mothers with good knowledge surged to 76%, and those with poor

knowledge decreased drastically to 6%. These results demonstrate the substantial impact of audiovisual media in enhancing comprehension through visual and auditory engagement.

TABLE 3 presents the results of the Wilcoxon Signed Rank Test, which revealed a statistically significant improvement in knowledge among mothers in the audiovisual group, with a p-value of 0.000 ( $p < 0.05$ ). The increase in mean scores from 1.54 to 2.69 and median scores from 1.00 to 3.00 reflects a meaningful shift in understanding, confirming that the audiovisual intervention effectively facilitated knowledge acquisition regarding diphtheria.

### C. THE INFLUENCE OF LEAFLET-BASED HEALTH EDUCATION ON MATERNAL KNOWLEDGE REGARDING DIPHTHERIA

TABLE 4

The Impact of Leaflet Media Health Education Before and After on Mothers' Knowledge About Diphtheria in Toddlers

Maternal knowledge regarding diphtheria	Leaflet group			
	Pre-test frequency (f)	%	Post-test frequency (f)	%
Poor	56	58	7	7
Sufficient	23	24	57	59
Good	18	19	33	34
Total	97	100	97	100

TABLE 5

Results of the Wilcoxon Signed Rank Test on Mothers' Knowledge About Diphtheria in Toddlers

	N	Mean	Median	SD	P Value
Pre-Test Leaflet	97	1.61	1.00	.785	
Post-Test Leaflet	97	2.27	2.00	.587	0.000

TABLE 4 shows the distribution of maternal knowledge in the leaflet group before and after the health education intervention. Initially, 58% of mothers had poor knowledge, and only 19% exhibited good understanding. After the intervention, mothers with good knowledge increased to 34%, while those with sufficient knowledge rose to 59%. Although improvements were observed, the knowledge gain was less pronounced compared to the audiovisual group, suggesting a more modest influence of printed materials.

According to TABLE 5, the Wilcoxon Signed Rank Test for the leaflet group yielded a p-value of 0.000, indicating a statistically significant difference in knowledge levels pre- and post-intervention. The mean knowledge score improved from 1.61 to 2.27, and the median from 1.00 to 2.00, which confirms the effectiveness of leaflet-based education, albeit to a lesser extent than audiovisual media.

### D. THE DIFFERENCE IN EFFECTIVENESS OF HEALTH EDUCATION USING AUDIOVISUAL MEDIA VERSUS LEAFLETS ON MOTHERS' KNOWLEDGE ABOUT DIPHTHERIA IN TODDLERS

Based on TABLE 6, the results of the non-parametric statistical test using the Mann-Whitney test, an Asymp. Sig value of 0.000 was obtained, which is less than 0.05. Therefore, H1 is accepted, indicating that there is a significant difference in the effectiveness of health education between audiovisual media and leaflets on mothers'

knowledge about diphtheria in toddlers. Based on the Mean Rank values, audiovisual media was found to be more effective than leaflet media in delivering health education aimed at increasing maternal knowledge about diphtheria in toddlers.

TABLE 6

The Results of the Effectiveness Comparison Test of Health Education Using Audiovisual Media and Leaflets on Mothers' Knowledge about Diphtheria

Uji	Intervention group	N	Mean Rank	Asymp.Sig (S-tailed)
Mann	Audiovisual	101	118.39	.000
Whitney	Leaflet	97	79.83	

## IV. DISCUSSION

This study aimed to evaluate the effect of health education via audiovisual media and leaflets on increasing mothers' knowledge regarding diphtheria in toddlers. The findings demonstrate a statistically significant improvement in maternal knowledge post-intervention, with audiovisual media exhibiting a superior effect compared to leaflets. This discussion critically interprets the results, compares them with recent literature, addresses inherent limitations, and explores the broader implications for public health strategies.

### A. INTERPRETATION OF FINDINGS AND THEORETICAL IMPLICATIONS

The core outcome of this research revealed that mothers exposed to audiovisual health education exhibited a more substantial increase in their knowledge levels about diphtheria than those who received educational leaflets. Pre-intervention, a significant proportion of mothers demonstrated limited or inadequate understanding, emphasizing the baseline knowledge gap prevalent within the community. Post-intervention, the shift towards higher knowledge levels in the audiovisual group underscores the efficacy of multi-sensory engagement in health education. Specifically, the utilization of visual and auditory stimuli in videos appears to facilitate better comprehension and retention of information, resonating with cognitive learning theories that advocate for multi-modal teaching approaches [29].

This enhanced understanding can be attributed to several factors inherent to audiovisual media. Firstly, visual cues enable better mental visualization, aiding mothers in comprehending complex concepts related to disease transmission and symptoms. Secondly, auditory components reinforce the message, catering to different learning preferences and thereby increasing the likelihood of internalization. This aligns with the dual coding theory, which posits that combining visual and verbal information enhances learning outcomes [30].

Furthermore, the study's findings corroborate existing literature that emphasizes the superiority of audiovisual methods in health education. For example, recent systematic reviews highlight that videos and animations improve knowledge, attitude, and behavioral intentions more effectively than static textual materials [31], [32]. The interactive nature of audiovisual media also appears to promote active engagement, which is critical for behavior change a key component in disease prevention programs.



Conversely, some previous studies suggest that while audiovisual tools are effective, their success depends on contextual factors such as literacy levels, access to electronic devices, and cultural relevance [33]. In this study, the demographic profile primarily mothers with high school education and limited employment may have facilitated the acceptance and comprehension of multimedia content, although these factors warrant further exploration.

## **B. COMPARISON WITH SIMILAR STUDIES AND CONTRASTS**

The strengthened impact of audiovisual media observed in this study aligns with findings from other recent investigations within similar settings. For instance, a cross-sectional study conducted in rural Indonesia demonstrated that video-based health education led to a 20% greater increase in maternal knowledge scores regarding immunizations compared to leaflets [34]. Similarly, Nam et al. [35] in Vietnam reported that multimedia health education interventions significantly outperformed traditional printed materials in improving maternal understanding of neonatal disease prevention.

However, contrasting findings have emerged elsewhere. A study by Lee et al. [36] in South Korea observed no significant difference in knowledge improvement between audiovisual and print-based methods, attributed primarily to technological limitations and low familiarity with electronic devices among participants. These disparities highlight the importance of contextual factors in multimedia health education effectiveness.

Additionally, prior meta-analyses suggest that while multimedia interventions often demonstrate superior efficacy, the magnitude of this effect can vary depending on content quality, duration, and participants' prior knowledge [37]. Our findings emphasize that when carefully designed and culturally adapted, audiovisual content can significantly enhance health literacy, specifically for diseases like diphtheria where visualizing transmission pathways can clarify misconceptions.

Importantly, the present study also reinforces the notion that traditional print media, such as leaflets, remain valuable, especially in contexts where digital access is limited or literacy is variable. Leaflets serve as supplementary tools that reinforce messages, provide reinforcement over multiple sessions, and can be revisited as needed [38].

## **C. LIMITATIONS AND WEAKNESSES**

Despite these promising findings, certain limitations must be acknowledged. Firstly, the quasi-experimental design, while practical, precludes definitive causal inference due to potential confounders and selection biases. Although randomization at the cluster level mitigates some bias, individual-level confounders such as baseline motivation, prior exposure to health information, and cognitive capacity were not controlled comprehensively.

Secondly, the relatively short follow-up period limits assessment of knowledge retention over time. The immediate post-intervention measurement demonstrates improved understanding; however, whether this knowledge persists and translates into behavioral change remains

uncertain. Longitudinal studies are necessary to evaluate retention and impact on actual health practices.

Thirdly, the study's reliance on self-reported questionnaires may introduce social desirability bias, with mothers potentially overreporting their knowledge levels post-intervention. Although efforts were made to validate the questionnaires, the possibility of response bias cannot be completely eliminated.

Furthermore, access to and familiarity with audiovisual devices may have varied among participants, influencing their engagement with the multimedia content. Despite efforts to standardize the intervention, technological literacy could have affected the outcomes, especially among older or less educated mothers.

Additionally, the content was standardized based on Ministry of Health guidelines; however, cultural relevance and language could affect comprehension. Future studies should consider including tailored content that resonates more deeply with local beliefs and practices.

Lastly, the limited sample size and geographic scope constrain the generalizability of results. Although the sample was adequate for detecting statistically significant differences, expanding this research to diverse regions and populations would bolster external validity.

## **D. PRACTICAL AND POLICY IMPLICATIONS**

The findings have vital implications for designing effective health communication strategies in similar communities. Given the demonstrated superiority of audiovisual media in improving maternal knowledge, public health authorities should prioritize integrating multimedia tools into routine health education programs. This integration is particularly pertinent in regions with high rates of diphtheria and low maternal health literacy.

Implementation requires investment in infrastructure, such as projectors, screens, and appropriate content development, aligned with cultural and linguistic contexts. Moreover, health workers should be trained to facilitate interactive sessions and troubleshoot technical issues, ensuring maximum engagement.

The combination of audiovisual media with traditional methods like leaflets may yield synergistic effects, reinforcing messages through multiple channels. Efforts should also be made to enhance digital literacy and improve access to electronic devices, especially in underserved areas.

From a policy perspective, these findings support allocating resources toward multimedia-based health education campaigns, which could be scaled up nationally. Integrating these tools within existing health service frameworks, such as maternal and child health services, can improve knowledge dissemination efficiency and potentially influence health behaviors positively.

Furthermore, future research should explore the long-term impact of multimedia education on behavior change, such as immunization uptake and disease prevention practices, which are crucial metrics for evaluating overall program efficacy. Cost-effectiveness analyses are also necessary to justify investments in multimedia infrastructure relative to traditional methods.

**E. FUTURE DIRECTIONS AND RECOMMENDATIONS**

Building upon the current evidence, subsequent studies should adopt randomized controlled trial designs to establish causality definitively. Longer follow-up periods are essential to ascertain knowledge retention and behavioral outcomes, such as healthcare-seeking actions, immunization rates, and hygiene practices.

Research should also examine the influence of different multimedia formats such as animations, interactive apps, or social media platforms on maternal knowledge and behavior. Investigating the role of cultural tailoring and language preferences in multimedia content efficacy can further optimize intervention design.

Moreover, integrating behavioral change theories, like the Health Belief Model or Social Cognitive Theory, into multimedia content can enhance its influence on attitude and practice modifications. Assessing the effectiveness of community-based multimedia interventions involving local leaders or health volunteers could amplify reach and acceptability.

Finally, policy-makers must consider infrastructure development to support multimedia health education and foster partnerships with technology providers. Emphasizing community participation during content creation can also improve relevance and engagement.

In summary, the present study reinforces that audiovisual media is a potent medium for improving mothers' knowledge about diphtheria in toddlers, surpassing traditional leaflets in effectiveness. These findings align with current literature emphasizing the role of multimedia tools in enhancing health literacy and promoting health-seeking behaviors. Nonetheless, addressing methodological limitations and tailoring interventions to local contexts remain critical. Strategic investments in multimedia infrastructure, content development, and community engagement are imperative for scaling up successful health education initiatives. As we move toward comprehensive health promotion strategies, multimedia development must be viewed as an integral component capable of transforming health communication and disease prevention efforts.

**V. CONCLUSION**

This study aimed to evaluate the comparative effectiveness of audiovisual media versus leaflet-based health education in enhancing mothers' knowledge regarding diphtheria in toddlers within the Mojo Health Center area, Surabaya. The findings indicate that audiovisual education significantly outperformed leaflet interventions, with mothers in the audiovisual group demonstrating an increase from 60% with limited knowledge pre-intervention to 76% with comprehensive understanding post-intervention, supported by a p-value of 0.000. In contrast, the leaflet group showed an improvement from 58% to a majority (59%) attaining sufficient knowledge after education, also statistically significant ( $p=0.000$ ). The broader implications suggest that audiovisual media are more influential in delivering health information effectively, owing to their ability to combine visual and auditory stimuli that facilitate better understanding, retention, and participant engagement. These results underscore the need for health programs to prioritize

multimedia approaches, particularly in regions where health literacy and access to information remain challenges. Future research should explore the integration of various educational media, such as digital platforms and interactive tools, to further enhance maternal knowledge and behavioral change. The study's limitations, including its sample size and scope confined to a specific geographic area, highlight the necessity for larger-scale, multicenter studies that can generalize these findings to broader populations. Additionally, longitudinal studies could provide insights into the sustainability of knowledge retention and behavioral modifications over time. Incorporating diverse demographic profiles and leveraging technological advances might further refine health education strategies, ultimately contributing to better immune coverage and disease prevention in vulnerable pediatric populations. Overall, the results advocate for health authorities to adopt comprehensive, multimodal educational interventions to improve maternal awareness, which is vital for the effective prevention of diphtheria and other communicable diseases among children under five.

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**DATA AVAILABILITY**

No datasets were generated or analyzed during the current study.

**AUTHOR CONTRIBUTION**

Enung Mardiyana Hidayat conceived and designed the study, oversaw data collection, and played a primary role in data analysis and manuscript drafting. Zakiyyatus Salsabilah contributed to the literature review, data interpretation, and critical revisions of the manuscript. Miadi assisted with the data collection process, statistical analysis, and formatting of the research report. Adin Mu'afiro provided expert guidance on research methodology, contributed to the interpretation of findings, and reviewed the manuscript critically for intellectual content. All authors reviewed and approved the final manuscript, sharing responsibility for its integrity and accuracy.

**DECLARATIONS****ETHICAL APPROVAL**

This study was conducted in accordance with ethical standards as approved by the relevant institutional review board, with informed consent obtained from all participants prior to data collection. The authors declare no conflicts of interest related to this research. Funding for this study was provided by the Department of Nursing, Poltekkes Kemenkes Surabaya, with

no influence on the study design, analysis, or reporting. All procedures adhered to the principles of ethical research, safeguarding participant confidentiality and well-being throughout the process.

### CONSENT FOR PUBLICATION PARTICIPANTS.

Consent for publication was given by all participants.

### COMPETING INTERESTS

The authors declare no competing interests.

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