Jurnal Kesehatan
Volume 17, Number 1, April 2026
ISSN 2086-7751 (*Print*), ISSN 2548-5695 (*Online*)
http://ejurnal.poltekkes-tjk.ac.id/index.php/JK

Educational Media and Maternal Behavioral Change in Fetal Brain Health Stimulation

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ARTICLE INFO

Article history

Submitted:
28 January 2026

Revised:
30 March 2026

Accepted:
10 April 2026

Keywords:

Attitudes;
Behaviors;
Educational video;
Knowledge;
Stimulation.

ABSTRACT

Health behaviors of pregnant women, such as stimulating fetal brain development, are efforts to improve long-term child development. This study aims to analyze the effectiveness of Education and Communication educational media (educational videos and leaflets) on the knowledge, attitudes, and behavior of pregnant women in conducting stimulation to improve fetal brain health. This study is a quasi-experimental pretest–posttest design conducted at the Kalianda Community Health Center, South Lampung Regency, from October to December 2025. The study included 30 pregnant women in the second and third trimesters, selected purposively and divided into two groups: the educational video intervention group (n = 15) and the brochure intervention group (n = 15). Data were collected using a validated and reliable questionnaire. Data analysis used descriptive statistics, the Shapiro-Wilk normality test, and the paired t-test. The results showed a significant increase in knowledge, attitudes, and behavior of pregnant women in both groups after the intervention ($p < 0.05$). The educational video group showed a greater increase in all variables than the leaflet group, with p-values of 0.000 for knowledge, 0.001 for attitude, and 0.000 for behavior. Conclusion: Educational videos are more effective than leaflets in improving pregnant women's knowledge, attitudes, and behavior regarding fetal brain stimulation.

INTRODUCTION

A global health issue that requires attention is the persistently high infant mortality rate. The infant mortality rate is 27.4 per 1,000 live births, with the main causes being premature birth and low birth weight. Maternal health is crucial to determining a country's health status (World Health Organization, 2019.. Maternal and infant health is a key focus of the Sustainable Development Goals (SDGs), particularly the third goal, which is to ensure a healthy life and improve well-being. The SDGs target emphasizes reducing the infant mortality rate to less than 20 per 1,000 live births (Department of Economic and Social Affairs, 2020). In Indonesia, the infant mortality rate is 19.5 per 1,000 live births, with the 2020–2024 National Medium-Term Development Plan targeting 16 per 1,000 live births (Ministry of Health Republic Indonesia, 2020a; 2020b).

Government efforts to achieve this target include providing prenatal care (at least 4 visits), delivery and postpartum care, improving the referral system, and implementing maternal education programs (Ministry of Health Republic Indonesia, 2019). To date, these efforts have not achieved the desired results, so strategies are needed to improve services from the prenatal stage onward. Adaptation to pregnancy is fundamental for mothers to build a relationship with their fetus during pregnancy (Anjarwati & Koni Suryaningsih, 2021). Studies of pregnant women in Africa show that a strong maternal-fetal bond is associated with good health practices and reduced adverse neonatal outcomes, with an odds ratio of 0.91 (Purwati & Sari, 2024). The stronger the bond, the better the mother maintains her own and her fetus's health (Maddahi et al., 2016). The bond between mother and fetus plays a crucial role in maternal and fetal health,

influencing the mother's decision to adopt healthy behaviors during pregnancy. A loving mother-fetus relationship contributes to the protection the mother provides to the fetus, as reflected in caring behavior, love, affection, caresses, communication, and the mother's responses to her fetus, including brain-stimulation actions (Purwati & Sari, 2024). Fetal brain development begins early in pregnancy. This brain development process is heavily influenced by internal factors such as maternal nutrition, hormones, and genetics, as well as external factors such as stimulation, the environment, and emotional stressors (Yulita & Yanti, 2021). Interventions provided during pregnancy, particularly in the form of sensory stimulation such as sound, touch, or emotion (Apriani et al., 2023).

According to World Health Organization data, more than 43% of toddlers in developing countries experience suboptimal development, partly due to inadequate fetal stimulation in the womb (World Health Organization, 2020). The Lancet Early Childhood Development Series report also emphasizes the importance of interventions during the First 1,000 Days of Life (HPK), from conception to age 2, to prevent brain development disorders and increase children's intelligence (The Lancet, 2024). In Indonesia, the issue of children with developmental problems is still a major public health concern. Riskesdas 2018 data reported that as many as 33.1% of children suffer from developmental delays, with insufficient early stimulation and responsive prenatal care. Moreover, stunting and SAM still occur in 21.6% of Indonesian toddlers in the 2022 Indonesia Nutritional Status Study (SSGI), which may be related to suboptimal brain development during pregnancy (Apriani et al., 2023). Lampung Province, like other areas with a higher number of pregnant women, also faces a similar problem. The Lampung Provincial Health Office reported in 2023 that, among 140,000 pregnancies in the province during a year, only around 45-50% of pregnant women received comprehensive education on fetal stimulation and prenatal care. This finding suggests low literacy among pregnant women regarding their role in ensuring fetal stimulation, particularly in supporting brain development (Lampung Provincial Health Office, 2024).

One effort to increase awareness and behavior among pregnant women is through the Information, Education, and Communication (IEC) approach. IEC aims to change public knowledge and behavior by delivering accurate, easy-to-understand information, such as videos and leaflets. Research by Fannia et al. (2023) showed significant changes before and after fetal stimulation education using video media, affecting the emotional bond between mother and fetus. Previous research has shown that audio-visual aids facilitate faster comprehension by participants. The material is delivered digitally in spoken form, through illustrations, photographs, animations, or videos (Sudarmi, 2021). Audio-visual aids are preferred because they include realistic-looking images or photographs, making them easier for respondents to understand (Kristiani et al., 2020). Similar research in Indonesia, particularly in Lampung Province, is still limited. Not many IEC media-based interventions have been implemented to support fetal stimulation programs. Therefore, research is needed to assess the effectiveness of video media on changing the knowledge, attitudes, and behavior of pregnant women regarding fetal brain stimulation.

METHOD

This study used a quasi-experimental design with a pretest–posttest approach. This design aimed to assess changes in knowledge, attitudes, and behavior. Knowledge was assessed using 10 true/false statements. Correct answers were scored 1 and incorrect answers 0, and then summed (scores 0–10). Higher scores indicated better knowledge. Attitudes were assessed using 10 statements on a Likert scale (strongly agree–strongly disagree, 4–1). Scores were summed (range 10–40), with higher scores indicating more positive attitudes. Behavior was assessed using a 10-item questionnaire on maternal stimulation practices, scored on a Likert scale (always–never, 4–1). Total scores were summed, with higher scores indicating better behavior. Measurements were conducted twice (pretest and posttest) to identify changes in pregnant women's stimulation practices after the IEC educational media intervention (educational video and leaflet).

The questionnaire was a self-developed instrument based on relevant theories, recent literature, and WHO guidelines, adapted from previous studies and tested for validity and reliability before use. The novelty of this study lies in its focus on fetal brain health stimulation, which remains under-researched in the literature; its comprehensive assessment of knowledge,

attitudes, and behaviors; and its comparison of audio-visual (educational video) and printed (leaflet) media within a quasi-experimental design. Additionally, this study provides community-based evidence from primary healthcare settings. The study subjects were divided into two treatment groups: the educational video intervention group and the leaflet intervention group.

This research was conducted in the work area of the Kalianda Community Health Center, South Lampung Regency, from October to December 2025. The stages of this research are the preparation phase, data collection, and data analysis. The dependent variable in this study is the knowledge, attitudes, and behavior of pregnant women regarding stimulation to improve fetal brain health. Fetal brain health is indirectly assessed through several examinations, such as ultrasound to view brain structure, Doppler to assess cerebral blood flow, and CTG (cardiotocography) to evaluate fetal heart rate, which reflects nervous system function. Furthermore, fetal movement is an important indicator, as active movement indicates good neurological development. In this study, the assessment focused primarily on maternal stimulation behaviors to support fetal brain health. The independent variable is educational media, which consists of educational videos (audio-visual) and leaflets. The video and leaflet used in this study are researcher-developed educational media focused specifically on fetal brain stimulation. They present simple, practical, and easy-to-understand information for pregnant women. Unlike general materials, they emphasize both knowledge and practical behavior, and are designed with audio-visual elements (video) and clear visuals (leaflet) to improve understanding and effectiveness.

The population in this study consisted of all pregnant women in the second and third trimesters who visited Kalianda Community Health Center during the research period. The sampling technique used was purposive sampling, with predetermined inclusion and exclusion criteria. The study included 30 pregnant women (15 in the educational video media intervention group and 15 in the leaflet media intervention group).

Data were collected using a questionnaire, whose validity and reliability have been tested, with a calculated r of 0.42-0.81 and a Cronbach's alpha of 0.85, as the primary data collection instrument. The questionnaire was used to measure pregnant women's knowledge, attitudes, and behaviors regarding fetal brain stimulation. A continuous scale was used in the questionnaire. Data collection was conducted twice: before the intervention (pretest) and after the intervention (posttest).

Data analysis used descriptive statistics to calculate average scores for knowledge, attitude, and behavior variables before and after the intervention in each group. Data normality was assessed using the Shapiro-Wilk test. After the data normality test, the results indicated normality, so inferential statistical analysis was conducted using a paired t-test to examine differences in scores before and after the intervention within each group. This research has passed the ethical feasibility test with number 479/KEPK-TJK/X/2025.

RESULTS

Table 1. Socio-demographic characteristics of pregnant women

Variable	Educational video intervention group		Leaflet intervention group	
	Frequency	%	Frequency	%
Age				
<20 years	1	6.7	2	13.3
20-35 years	12	80.0	12	80.0
>35 years	2	13.3	1	6.7
Pregnancy status				
Primigravida	6	40.0	5	33.3
Multigravida	9	60.0	10	66.7
Employment status				
Employed	4	26.7	5	33.3
Not employed	11	73.3	10	66.7
Education				
Primary	4	26.7	3	20.0
Secondary	9	60.0	11	73.3
Higher	2	13.3	1	6.7

The development of IEC educational media, namely educational videos and leaflets, was carried out through a literature review, video scripting, and video production, based on a storyboard that included images, animations, and instrumental music to encourage relaxation among pregnant women. The video's voiceover used a soft, engaging tone. The video lasted 3 minutes and 40 seconds. The leaflet used attractive images and colors. The leaflet consisted of two A4 pages.

The following are the results of the socio-demographic analysis of the study respondents. Of the 15 respondents in the educational video intervention group and the 15 in the leaflet intervention group, the majority were between 20 and 35 years old, with 12 (80%) in each group. The majority of respondents were multigravida; the video group consisted of 9 multigravida (60%), and the leaflet group consisted of 10 multigravida (66.7%). The employment status of the video and leaflet intervention groups was mostly unemployed, 11 (73.3%) and 10 (66.7%), respectively. Most respondents had a history of secondary education; in the video intervention group, 9 (60%) had a history of secondary education, and in the leaflet intervention group, 11 (73.3%).

Table 2. Results of paired T-test analysis before and after the test in the intervention and control groups on the knowledge variable

Pretest/Posttest Intervention Group	Paired Differences					t	df	Sig (3-tailed)
	Mean	St. Dev.	St. Error Mean	95% CI Lower	Upper			
Educational videos	0.428	0.812	0.144	0.733	0.123	2.901	28	0.000
Leaflet	0.262	0.445	0.078	0.43	0.094	3.242	28	0.012

Changes in knowledge were observed in both groups before and after the intervention. However, the educational video group showed a greater increase in knowledge scores than the leaflet group. Statistical analysis using the paired t-test revealed a p-value of 0.000 (significant) in the educational video group and 0.012 (significant) in the leaflet group. Based on these results, educational videos were found to be more effective at improving knowledge.

Table 2. Results of paired T-test analysis before and after the test in the intervention and control groups on the attitude variable

Pretest/Posttest Intervention Group	Paired Differences					t	df	Sig (3-tailed)
	Mean	St. Dev.	St. Error Mean	95% CI Lower	Upper			
Educational videos	0.512	0.764	0.136	0.233	0.791	3.765	28	0.001
Leaflet	0.301	0.498	0.091	0.115	0.487	3.308	28	0.028

Attitude changes were observed in both groups before and after the intervention. However, the educational video group showed greater improvement in attitude scores than the leaflet group. Statistical analysis using the paired t-test indicated a p-value of 0.001 (significant) in the video group and a p-value of 0.028 (significant) in the leaflet group.

Table 3. Results of paired T-test analysis before and after the test in the intervention and control groups on the attitude variable

Pretest/Posttest Intervention Group	Paired Differences					t	df	Sig (3-tailed)
	Mean	St. Dev.	St. Error Mean	95% CI Lower	Upper			
Educational videos	0.463	0.689	0.123	0.211	0.715	3.764	28	0.000
Leaflet	0.287	0.532	0.097	0.089	0.485	2.958	28	0.015

An improvement in stimulation-related behaviors among pregnant women was observed following the educational intervention. Observations in this study were conducted during the

intervention period, from pretest to posttest within the research period (October–December 2025). Measurements were taken twice, before and after the intervention. The observation and data collection processes were conducted by researchers, with the assistance of enumerators. The educational video group showed the largest increase in behavior scores, particularly in frequency of sensory stimulation, communication, and interaction with the fetus. Statistical analysis revealed that educational video media had a more significant impact on behavioral change (p-value = 0.000) compared to leaflet media (p-value = 0.015).

DISCUSSION

Audio-visual media (video) and leaflets are two media used in maternal health education to improve knowledge, attitudes, and behaviors related to fetal brain stimulation. Various studies have shown that audio-visual media are more effective than leaflets in improving pregnant women's understanding. The advantage of audio-visual media lies in its ability to present information that is engaging and easy to understand. However, using both media simultaneously can provide a more holistic approach to maternal health education (Rahayuningsih & Kristinawati, 2023). Maintaining intelligence during the fetal period is closely related to efforts to prepare a quality future generation, as competition for human resource development is currently a global challenge for all countries. Having strong intelligence potential to become high-quality human resources is directly related to the intelligence function. A child's intelligence (IQ) is not entirely influenced by heredity (nature), but also by stimulation (nurture). The influence of nurture will be far greater if implemented appropriately. Preparing superior-quality Human Resources (HR) can begin at an early age, even in the womb (Haka et al., 2022).

Dr. David Chamberlain, an obstetrician-gynecologist at Boston University in the United States, presented research showing that children who begin learning in the womb have multiple intelligences by school age. This finding echoes Dr. William Lilley of the University of Auckland, New Zealand, who stated that children who receive extensive stimulation in the womb develop more quickly than those who receive little or no stimulation. The earlier stimulation is initiated, the greater the benefits to a child's development (Suri, 2019).

Effectiveness of educational media on pregnant women's knowledge of stimulation to enhance fetal brain health

Based on the research results, educational media, both videos and leaflets, proved effective in increasing pregnant women's knowledge about stimulation to improve fetal brain health. This was demonstrated by a statistically significant increase in knowledge scores in both groups after the intervention. Data analysis revealed a p-value of 0.000 in the educational video group and a p-value of 0.012 in the brochure group ($p < 0.05$). The mean knowledge score in the educational video group (0.428) was higher than in the leaflet group (0.262). These results indicate that educational videos are more effective than leaflets in increasing pregnant women's knowledge about stimulation for fetal brain health.

There was a significant increase in knowledge in both groups after the intervention. This indicates that educational videos and leaflets are equally effective in conveying information to participants and can increase respondents' knowledge about pregnancy. This aligns with findings that audio-visual media tends to be more engaging and easier to understand, thereby having a greater impact on knowledge acquisition (Dai & Wang, 2023). Several possible explanations exist for why audio-visual media showed a slightly higher increase in pregnancy knowledge than leaflets (Smith et al., 2020).

Audio-visual media is a multisensory learning tool that involves sight and hearing, the two primary senses involved in the learning process. Audio-visual media allows respondents to process information through two sensory pathways, thereby improving memory and comprehension (Seijdel et al., 2024). Audio-visual media can present information more engagingly than leaflets. The use of images, videos, and audio can capture respondents' attention and help them focus more on the educational material. Audio-visual media can also present complex information more understandably. Visualizations and animations can help respondents

understand abstract concepts and complex processes (Strømme & Mork, 2021). Audio-visual media can realistically present situations or events, providing a clearer context for respondents in understanding information. This can increase the relevance and usefulness of the information for them. Audio-visual media can encourage more active learning than leaflets. Interaction with multimedia elements, such as answering questions or completing assignments, can increase respondent participation and engagement (Abdulrahaman et al., 2020). Some respondents may have visual or auditory learning styles that are more suited to audio-visual media, allowing them to process information more effectively and efficiently. Audio-visual media can also increase respondents' motivation and enthusiasm for learning. The use of engaging and interactive multimedia elements can make the learning process more enjoyable and meaningful (Rahayuningsih & Kristinawati, 2023).

The higher proportion of respondents with a high level of knowledge in the audio-visual group in the posttest indicates that the use of audio-visual media can lead to better understanding. The visual and audio effects in this media may facilitate the learning process and improve information retention. Audio-visual media can present complex information in a more understandable format. Visualization and animation can help respondents understand abstract concepts and complex processes (Rahayuningsih & Kristinawati, 2023).

Knowledge is "knowing" that occurs after someone experiences the process of feeling an object. Optimal sensing will produce new knowledge, while the senses of sight and hearing are significant influences on a person's knowledge. Knowledge plays a crucial role in shaping a person's actions. Pregnant women's knowledge of healthy lifestyles during pregnancy results from a complex interaction among factors such as education level, personal experience, cultural background, socioeconomic conditions, and exposure to information (Rahayuningsih & Kristinawati, 2023).

A person's knowledge can be enhanced through both formal and informal educational processes. Education can be delivered through media such as videos and leaflets. Video is an effective audio-visual medium for health education because it stimulates the senses of hearing and sight and is more engaging, making it easier for respondents to remember and understand the content. This aligns with Edgar Dale's cone of consciousness theory, which explains that participants' ability to remember health education messages is based on the techniques and media used. According to one point of the cone, hearing and seeing can increase memory by up to 50% (Haka et al., 2022). Providing education through audio-visual media, such as videos, can facilitate more effective information absorption through sight and hearing, compared to sight alone. Audio-visual media have many advantages, including the ability to transcend distance and time. Videos can be played continuously as a learning medium. The information is presented in a unique, engaging way to make it easier to remember and generate enthusiasm, thereby increasing acceptance.

Ayatulloh et al. (2021) emphasize that effective knowledge management in the information delivery process can improve decision-making skills, performance, the quality of health services, and overall organizational effectiveness (Ayatulloh et al., 2021). Furthermore, other research highlights the important role of health workers in providing information on good nutrition during pregnancy (Saepul et al., 2019). Research findings also indicate that health education through booklets and diaries can improve housewives' self-efficacy (Rasdiyanah et al., 2020).

Effectiveness of educational media on pregnant women's attitude of stimulation to enhance fetal brain health

There was a significant increase in attitudes in both groups after receiving the education. The audio-visual group showed a slightly higher average increase in attitudes than the leaflet group. In the posttest, the proportion of respondents with a positive attitude was greater in the audio-visual group than in the leaflet group. The video intervention group also had a smaller standard deviation in the posttest, indicating greater homogeneity in respondents' attitudes. There was a significant increase in attitudes in both groups (video and leaflet) after the intervention. This indicates that the education provided was effective in increasing respondents' positive attitudes. Audio-visual media are thought to be more effective at increasing positive attitudes than leaflets (Hasanica et al., 2020).

In the posttest, the proportion of respondents with a positive attitude was greater in the audio-visual group than in the leaflet group. This finding supports previous research suggesting that audio-visual media are more effective at increasing positive attitudes. The smaller standard deviation in the audio-visual group at posttest indicates more homogeneity in respondents' attitudes. This can be interpreted as indicating that audio-visual media is more effective in standardizing respondents' positive attitudes (Ostic et al., 2021). This finding supports previous research suggesting that audio-visual media is more effective at improving practical skills (Noetel et al., 2021). There are several possible reasons why audio-visual media showed a slightly greater improvement in attitudes than leaflets. One reason is that audio-visual learning is multisensory, involving both sight and hearing, the two primary senses involved in the learning process (Volpe & Gori, 2019). This allows respondents to process information through two sensory pathways, thereby improving retention and comprehension. Audio-visual media also present information in a more engaging manner than leaflets (Mahdi, 2022).

The use of images, video, and audio can capture respondents' attention and help them focus more on the educational material. Audio-visual media can present complex information more understandably. Visualization and animation can help respondents understand abstract concepts and complex processes (Strømme & Mork, 2021). Furthermore, audio-visual media can utilize emotional and motivational elements, such as music, stories, and testimonials, to encourage attitude change in respondents. The education provided is effective in improving respondents' attitudes toward fetal brain stimulation. Audio-visual media showed a greater increase in attitudes than leaflets. Significant attitude improvements occurred in both groups (audio-visual and leaflet) after receiving the education (Ibe & Abamuche, 2019). This indicates that the education provided was effective in improving respondents' practical skills.

Effectiveness of educational media on pregnant women's behavior of stimulation to enhance fetal brain health

Based on the research results, both media were effective in increasing pregnant women's stimulation behavior to enhance fetal brain health. This indicates a change in behavior before and after the intervention using audio-visual media and leaflets. However, the average increase in behavioral scores among respondents who received education using audio-visual media was higher than that of those who received education using leaflets. These results are in line with Setyaningsih & Maliya (2018), who stated that health education can improve health behavior.

Multisensory learning in audio-visual media involves the senses of sight and hearing, thus stimulating the two main senses that play a role in the learning process (Rahayuningsih & Kristinawati, 2023). This allows respondents to process information through two sensory pathways, thereby increasing retention and understanding. Audio-visual media is able to present information in a more interesting and engaging way than leaflets. The use of images, videos, and audio can attract respondents' attention and help them focus more on educational materials (Dai & Wang, 2023). Audio-visual media can also present complex information more understandably. Visualizations and animations help respondents grasp abstract concepts and complex processes (Bobek & Tversky, 2016). Furthermore, audio-visual media can simulate virtual practice, allowing respondents to practice without risk and in a safe environment (Kman et al., 2023).

CONCLUSION

Based on the study results, it can be concluded that both educational media: educational videos and leaflets significantly improved pregnant women's knowledge, attitudes, and behaviors after the intervention. However, educational video media were proven to be more effective than leaflet media. Pregnant women who received the educational video intervention demonstrated more significant improvements across all variables, namely knowledge, attitudes, and behaviors, compared to those who received the leaflet intervention.

AUTHOR'S DECLARATION

Authors' contributions and responsibilities

WW: Writing original draft, visualization, funding acquisition, conceptualization; **IFE**: Writing original draft (supporting), funding acquisition, validation (equal), review and editing.

Availability of data and materials

All data are available from all authors.

Competing interests

The authors declare no competing interests.

ACKNOWLEDGEMENT*

The authors would like to express their sincere gratitude to all parties involved in the implementation of this research, especially to the Head of the Kalianda Community Health Center for their permission and support throughout the research process, as well as to Midwife Mila and the cadres who assisted. The authors also thank all pregnant women who volunteered as respondents in this study.

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