PROCEEDING

2nd Banten International Conference on Health Advancement & Research
binar@poltekkesbanten.ac.id
https://binar.poltekkesbanten.ac.id/
Vol. 1 No. 2 (2026)

THE EFFECT OF HEALTH EDUCATION USING E-BOOKLET MEDIA ON PREGNANT WOMEN'S KNOWLEDGE LEVEL ABOUT TUBERCULOSIS PREVENTION

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ABSTRACT

Tuberculosis remains a global health issue, including among pregnant women. According to data from the World Health Organization (WHO), 151,000 pregnant women are diagnosed with tuberculosis each year. Tuberculosis during pregnancy can increase the risk of complications for both the mother and the fetus, such as anemia, preterm birth, low birth weight, and even maternal and neonatal mortality. Pregnant women's limited knowledge regarding tuberculosis prevention is one of the factors contributing to delayed detection and treatment of the disease. Therefore, effective health education through digital educational media, such as an E-Booklet, is necessary.

This study aims to determine the effect of health education using an E-Booklet on pregnant women's knowledge level regarding tuberculosis prevention. This is a quantitative study with a quasi-experimental approach using a one-group pre-test post-test design. The study sample consisted of 59 pregnant women selected using total sampling. Data were collected using a questionnaire comprising 22 items and analyzed using the Wilcoxon Signed Rank Test.

The results of the study show that the average knowledge score increased from 74.47 to 94.80, with an Asymp.Sig. (2-tailed) value of 0.000 ($p < 0.05$). The conclusion of this study is that health education using E-Booklet media is effective in increasing pregnant women's knowledge about tuberculosis prevention. The results of this study are expected to serve as a reference for the development of digital-based health education media.

Keywords: Health Education, E-Booklet, Knowledge, Pregnant Women, Tuberculosis

INTRODUCTION

Pregnancy is a physiological condition experienced by women and represents one of the most important phases in the life cycle, beginning with the fertilization of the sperm and ovum until reaching term age (±40 weeks) (Yulizawati et al., 2021). During this period, the mother's health status directly affects fetal growth and development, so pregnant women require special attention because they have a higher vulnerability to infectious diseases (Fitzgerald et al., 2020), particularly tuberculosis, which remains a global health problem to this day.

Tuberculosis (TB) is an infectious disease caused by Mycobacterium tuberculosis, an acid-fast bacillus (AFB) that attacks the lungs (Fitriani & Pratiwi, 2020). Tuberculosis infection during pregnancy can increase the risk of complications for both the mother and the fetus, such as anemia,

spontaneous abortion, preterm birth, low birth weight (LBW), and increased maternal and fetal mortality risk, as well as the risk of tuberculosis transmission during the neonatal period (Hui & Lao, 2022). The World Health Organization (WHO) reports that tuberculosis contributes to 6–15% of all maternal deaths, with an estimated 151,000 pregnant women diagnosed with TB each year, and the incidence risk of TB increasing 1.4-fold during pregnancy (World Health Organization, 2024). In Indonesia, the prevalence of tuberculosis in pregnancy reaches 1.6% of the 1,090,000 tuberculosis cases reported annually (Kemenkes RI, 2024). Data from the Semarang City Health Office in 2024 recorded 23 pregnant women confirmed with tuberculosis (Dinkes Kota Semarang, 2024), while the researchers' preliminary study at Puskesmas Kedungmundu found one pregnant woman currently undergoing TB treatment, indicating that this issue still requires ongoing attention.

Tuberculosis diagnosis in pregnant women is often delayed because its symptoms (cough, weight loss, fever, fatigue) resemble the physiological complaints of pregnancy (Miele et al., 2020). This delay is worsened by pregnant women's low level of knowledge about tuberculosis. A study by Betan et al. (2025) showed that only 26.7% of pregnant women had a correct understanding of tuberculosis before receiving education, and Khoza et al. (2023) confirmed a significant knowledge gap regarding the symptoms, transmission, and complications of tuberculosis, which contributes to weak awareness and delayed detection and treatment (Hui & Lao, 2022). The government has issued Presidential Regulation Number 67 of 2021 on Tuberculosis Control, which emphasizes the importance of active community participation in promotive and preventive activities (Fitriana et al., 2022), as such participation plays a role in increasing knowledge and awareness of tuberculosis prevention (Chavez-Rimache et al., 2023).

Various educational efforts have proven effective in increasing knowledge about tuberculosis, for example education through webinars that increased pregnancy-related tuberculosis knowledge scores from 36.23 to 80.60 (Judistiani, 2023), as well as the importance of diverse health information sources for pregnant women with TB to improve knowledge, awareness, and treatment adherence (Adrinah et al., 2024). Health education is a planned learning process to provide knowledge, skills, and motivation so that individuals are able to maintain their own health independently (Anin Wijayanti et al., 2024), which for pregnant women can take the form of information on modes of transmission, signs and symptoms, complications, prevention efforts, and the importance of treatment adherence (Kementerian Kesehatan, 2025). The success of health education is greatly determined by the media used to facilitate message delivery and reduce misperceptions (Kopong Tokan et al., 2024).

Along with technological developments, health education media has transformed from manual to digital forms, one of which is the E-Booklet, a digital book that combines text and images. The E-Booklet is considered effective because it presents information that is more complete, detailed, educational, repeatedly readable, and easily accessible via smartphone, laptop, or tablet (Nuraenah et al., 2025; Ningsih & Kholidiya Ulya, 2024). Research by Lestari et al. (2025) showed that the E-Booklet

can improve knowledge and preeclampsia prevention behavior (p=0.000), while Utaminingtyas et al. (2023) reported that E-Booklet education improved pregnant women's knowledge about stunting prevention, with 80% of respondents having good knowledge after the intervention. Based on this description, the researchers were interested in conducting a study to determine the effect of health education using E-Booklet media on pregnant women's knowledge level regarding tuberculosis prevention at Puskesmas Kedungmundu, Semarang City.

MATERIALS AND METHODS

This study is a quantitative study with a quasi-experimental approach using a one-group pre-test post-test design, in which the level of knowledge was measured before (pre-test) and after (post-test) the provision of health education using E-Booklet media, without a comparison (control) group (Sugiyono, 2023).

The study population consisted of all first- to third-trimester pregnant women in the working area of Puskesmas Kedungmundu, Semarang City, totaling 62 people. The study sample consisted of 59 pregnant women selected using the total sampling technique, because the population size was relatively small (n<100) (Arikunto, 2017). The inclusion criteria included pregnant women residing in and attending pregnancy classes in the working area of Puskesmas Kedungmundu, willing to become respondents by signing informed consent, having an electronic device to access the E-Booklet, and able to read and understand its content.

The study was conducted in the working area of Puskesmas Kedungmundu, Semarang City, from January 9–24, 2026. The independent variable was health education using E-Booklet media, while the dependent variable was pregnant women's knowledge level regarding tuberculosis prevention. The research instrument was a structured Guttman-scale questionnaire consisting of 22 true-false statement items (16 positive statements and 6 negative statements), with a score of 2 for correct answers and a score of 1 for incorrect answers. The questionnaire had been tested for validity on 32 pregnant women in Srondol and Ngesrep sub-districts, with results showing 22 of 25 items declared valid (r calculated > r table 0.349), and tested for reliability with a Cronbach's Alpha value of 0.739 (reliable). The E-Booklet media was developed by the researcher based on scientific literature and guidelines from the Ministry of Health of the Republic of Indonesia, containing material on the definition, causes, modes of transmission, signs and symptoms, complications, and prevention of tuberculosis in pregnancy, and had undergone content validity testing by a maternity nursing subject-matter expert and media validity testing by a media expert, with results indicating it was suitable for use without major revisions.

Primary data collection was carried out in three stages: pre-intervention (administration of the pre-test questionnaire), intervention (interactive health education using the E-Booklet with a duration of 1 hour per session, accompanied by a question-and-answer session), and post-intervention (re-administration of the same questionnaire as a post-test). Data analysis included univariate analysis to

describe respondent characteristics using descriptive statistical measures such as frequency, percentage, mean, and other data distributions, as well as bivariate analysis using the Wilcoxon Signed Rank Test, which was selected after the Kolmogorov-Smirnov normality test showed that the pre-test and post-test data were not normally distributed ($p=0.000 < 0.05$).

RESULTS AND DISCUSSION

1. Respondent Characteristics

This study involved 59 first- to third-trimester pregnant women attending pregnancy classes at Puskesmas Kedungmundu. Respondent characteristics based on maternal age, gestational age, parity, occupation, and education are presented in Table 1 and Table 2.

Table 1. Respondent Characteristics Based on Maternal Age and Gestational Age at Puskesmas Kedungmundu in 2026 (N=59)

Characteristic	Mean	Median	SD	Min	Max
Maternal Age (years)	28,53	28,0	5,43	16	42
Gestational Age (weeks)	23,03	23,0	7,97	9	37

Based on Table 1, the average age of pregnant women was 28.53 years, with the youngest being 16 years old and the oldest 42 years old, indicating that the majority of respondents were in the healthy reproductive age category (20–35 years). Within this age range, physical condition, reproductive organs, and psychological readiness are generally optimally developed, so the risk of pregnancy complications is relatively lower and mothers are more ready to receive and understand health information (Endjun, 2019; Suparni et al., 2025). Pregnancy at too young an age (<20 years) or too old an age (>35 years) is included in the at-risk age group because physical readiness, emotional maturity, and the ability to receive health information tend to be less than optimal (Maryunani, 2021). Overall, the dominance of respondents in the healthy reproductive age group supports the success of health education using E-Booklet media in improving pregnant women's knowledge about tuberculosis prevention.

The average gestational age of respondents was 23.03 weeks, indicating that most respondents were in the second and third trimesters of pregnancy. In the second trimester, the condition of pregnant women is generally more stable than in the first trimester, so mothers are better able to receive information and participate well in health education activities (Sari Wahyuni et al., 2025). Pregnant women in the third trimester also tend to have higher motivation to understand health information as they get closer to delivery, making education about tuberculosis easier to accept and understand. This condition supports the effectiveness of providing health education using E-Booklet media in improving pregnant women's knowledge about tuberculosis prevention.

Table 2. Respondent Characteristics Based on Parity, Occupation, and Education at Puskesmas Kedungmundu in 2026 (N=59)

Respondent Characteristic	Frequency (n)	Percentage (%)
Parity		
Nullipara	21	35,6
Primipara	27	45,8
Multipara	11	18,6
Total	59	100
Occupation		
Housewife	43	72,9
Private Sector	13	22,0
Civil Servant	3	5,1
Total	59	100
Education		
Elementary School	1	1,7
Junior High School	9	15,3
Senior High School/Vocational School	40	67,8
Higher Education	9	15,3
Total	59	100

Based on Table 2, the parity characteristics show that the majority of respondents were primiparous (45.8%), followed by nulliparous (35.6%) and multiparous (18.6%), meaning most respondents had low parity with limited pregnancy experience. Mothers with low parity tend to need more health information and are more receptive to new information because they have not been influenced much by personal experience. This is consistent with the study by Tunggal et al. (2026), which showed a significant relationship between parity and pregnant women's knowledge level (p=0.001), as well as Fransisca & Darmawati (2025), which confirmed that parity is significantly related to pregnant women's knowledge and behavior (p=0.041). The dominance of respondents with limited pregnancy experience makes health education using E-Booklet media increasingly relevant as a means of improving knowledge about tuberculosis prevention.

Based on occupational characteristics, the majority of respondents were housewives (72.9%), who generally have relatively more flexible time to participate in various health services during pregnancy, such as antenatal care (ANC) checkups and pregnancy classes. This time flexibility gives mothers a greater opportunity to obtain health information on an ongoing basis, consistent with research by Anggraeni et al. (2022) showing that regular ANC visits are related to pregnant women's knowledge level (p=0.034). Pregnant women with more flexible time also have a greater opportunity to read and

review E-Booklet material independently in their spare time, thereby supporting the success of the health education intervention in this study.

Respondents' education level was dominated by senior high school/vocational school graduates (67.8%), followed by higher education and junior high school (15.3% each), and elementary school (1.7%), indicating that the majority of pregnant women had a secondary education level. Education level is one of the fundamental factors influencing an individual's ability to receive, understand, and process health information (Notoadmodjo, 2018), and is thus positively correlated with health literacy ability (Nugraheni, 2017). This is consistent with research by Wongkar & Shofa Ilmiah (2025) showing a significant relationship between education level and pregnant women's knowledge of pregnancy danger signs (p=0.000). The majority of respondents with secondary education in this study facilitated the process of receiving health information through E-Booklet media, which was compiled using simple and communicative language, so that the educational material could be well understood by all respondents regardless of differences in educational background.

2. Pregnant Women's Knowledge Scores Before and After the Intervention

Table 3. Pregnant Women's Knowledge Scores on Tuberculosis Prevention Before and After the Intervention at Puskesmas Kedungmundu in 2026 (N=59)

	Mean	Median	SD	Min	Max
Pre-test	74,47	75,0	4,74	61,0	86,00
Post-test	94,80	95,0	2,98	89,0	100,0

Table 3 shows an increase in pregnant women's knowledge scores after the intervention was given. The average pre-test score of 74.47 (moderate category) increased to 94.80 (good category) at post-test, accompanied by an increase in the minimum value (61.00 to 89.00) and maximum value (86.00 to 100.00), as well as a decrease in standard deviation (4.74 to 2.98), indicating that the variation in knowledge among respondents became more homogeneous after the education was provided.

3. Normality Test and Analysis of the Effect of Health Education

Table 4. Results of the Kolmogorov-Smirnov Normality Test at Puskesmas Kedungmundu in 2026 (N=59)

	Statistic	df	Sig.
Pre-test	0,205	59	0,000
Post-test	0,201	59	0,000

The results of the Kolmogorov-Smirnov normality test in Table 4 show pre-test and post-test significance values of 0.000 each ($p<0.05$), so the data were declared not normally distributed and the analysis proceeded using the nonparametric Wilcoxon Signed Rank Test.

Table 5. Results of the Wilcoxon Signed Rank Test for Pre-test and Post-test Knowledge Scores at Puskesmas Kedungmundu in 2026 (N=59)

	N	Mean Ranks	Sum of Ranks
Negative Ranks	0	0,00	0,00
Positive Ranks	59	30,00	1770,00
Ties	0	-	-
Total	59	-	-

Table 5 shows that there were no respondents with negative ranks (N=0), meaning all respondents experienced an increase in knowledge scores (positive ranks) with a mean rank of 30.00 and a sum of ranks of 1770.00, with no respondents whose scores remained unchanged (ties=0).

Table 6. Results of the Test of the Effect of Health Education Using E-Booklet Media on Pregnant Women's Knowledge Level at Puskesmas Kedungmundu in 2026 (N=59)

Z	-6,689[b]
Asymp. Sig. (2-tailed)	0,000

Table 6 shows a Z value of -6.689 with an Asymp. Sig. (2-tailed) value of 0.000 ($p<0.05$), so the null hypothesis (H_0) is rejected and the alternative hypothesis (H_1) is accepted, meaning there is an effect of health education using E-Booklet media on the improvement of pregnant women's knowledge about tuberculosis prevention.

4. Discussion

Before the intervention, the average knowledge score of pregnant women was in the moderate category (74.47), indicating that respondents already had basic knowledge about tuberculosis but not comprehensively, particularly regarding modes of transmission, signs and symptoms, complications, and prevention efforts during pregnancy. This condition is consistent with Safiri et al. (2024), who found that 63% of pregnant women had moderate knowledge about LBW before education, and may be influenced by the limited exposure to specific information about tuberculosis during routine antenatal checkups and differences in education level, experience, and access to health information among respondents (Nugraheni, 2017).

After receiving health education using E-Booklet media, the knowledge score increased significantly to the good category (94.80), accompanied by a decrease in standard deviation indicating that understanding among respondents became more evenly distributed. This increase shows that the E-Booklet has an effect in helping pregnant women understand tuberculosis information because presenting material in the form of text, images, colors, and an attractive display facilitates understanding (Utaminingtyas et al., 2023), and can be accessed and reviewed at any time according to respondents' needs (Lestari et al., 2025). This result is consistent with research by Utaminingtyas et al. (2023), which reported that 80% of respondents had good knowledge after E-Booklet education. In addition, research conducted by K. P. Lestari et al. (2025) showed that the use of E-Booklet media can significantly improve pregnant women's knowledge about preeclampsia (p=0.000). Similar results were also found

in research by Diah Eka Nugraheni (2024), which stated that the E-Booklet is effectively used as a pregnancy monitoring medium with significant results (p=0.000).

The results of the Wilcoxon Signed Rank Test showing that all respondents (N=59) experienced an increase in knowledge with none experiencing a decrease (negative ranks=0) or remaining unchanged (ties=0), with a Z value of -6.689 and p=0.000, prove that health education using E-Booklet media has an effect on improving pregnant women's knowledge about tuberculosis prevention. This finding is consistent with research by Nur Caya et al. (2025) on E-Booklet education for anemia in pregnant women (p=0.000) and Purba et al. (2024) on E-Booklet education for exclusive breastfeeding (p=0.001), both of which confirm the advantages of the E-Booklet, namely ease of access via smartphone, practicality, the ability to be studied independently, and the presentation of illustrated material that improves respondents' memory and understanding compared to conventional media.

This increase in knowledge is important because a good understanding of modes of transmission, personal and environmental hygiene, cough etiquette, mask use, and the importance of routine health checkups can shape positive awareness and tuberculosis prevention behavior in pregnant women, thereby minimizing the risk of transmission and complications for both mother and fetus (Khoza et al., 2023). Therefore, health education using E-Booklet media can be recommended as an innovative, engaging, and effective alternative educational medium for health workers in improving pregnant women's knowledge, particularly regarding tuberculosis prevention.

CONCLUSION

The average age of respondents was 28.53 years with an average gestational age of 23.03 weeks; the majority were primiparous (45.8%), worked as housewives (72.9%), and had a senior high school/vocational school education (67.8%). The average knowledge score of pregnant women regarding tuberculosis prevention before the intervention was 74.47 (moderate category) and increased to 94.80 (good category) after health education using E-Booklet media was provided. The results of the Wilcoxon Signed Rank Test showed a significance value of 0.000 ($p<0.05$), meaning there is a significant effect of health education using E-Booklet media on the improvement of pregnant women's knowledge about tuberculosis prevention at Puskesmas Kedungmundu.

Based on these results, pregnant women are advised to actively seek health information about tuberculosis prevention and to practice preventive behaviors such as opening house ventilation, adopting a clean and healthy lifestyle, and undergoing routine health checkups. Health workers are advised to utilize E-Booklet media as a more engaging and easily accessible alternative educational medium in health education activities for pregnant women. Educational institutions are expected to support the development of digital-based educational media as an innovation in learning and community service. Future researchers are advised to develop studies with larger sample sizes, broader regional

coverage, research designs involving control groups, and consideration of other variables such as family support and access to information that may affect pregnant women's knowledge.

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