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Augmented Reality Flipbook Innovation to Increase Self-Awareness for Cervical Cancer Early Detection Through HPV DNA Screening Among Women of Childbearing

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Abstract: Cervical cancer remains a health problem among women in low- and middle-income countries. Early detection through screening, including human papillomavirus (HPV) DNA testing, is a strategy. However, low knowledge and self-awareness regarding cervical cancer and HPV DNA screening remain barriers to screening utilization. Health education media are needed. This study aimed to develop an Augmented Reality-based flipbook to improve self-awareness in women of childbearing age. The study used the 4D model (Define, Design, Develop, and Disseminate). Validation involved material, media, and language experts, followed by a user test involving 15 women of childbearing age. The effectiveness test included 30 women of childbearing age using a one-group pretest-posttest design. Data were analyzed using the Wilcoxon Signed-Rank Test. The AR-based flipbook showed high feasibility, with scores of 85.94% for material, 92.50% for media, and 98.07% for language experts, while the user test scored 90.78%. High self-awareness increased from 3.3% to 43.3%, while the low category decreased from 26.7% to 0%. The Wilcoxon Signed-Rank Test showed a significant difference in self-awareness before and after intervention ($p = 0.004$). The AR-based flipbook demonstrated high feasibility and potential as an educational medium for improving self-awareness of cervical cancer early detection in women of childbearing age.

Keywords: Cervical Cancer, Augmented Reality, Flipbook, Self-Awareness, Early Detection.

INTRODUCTION

Cervical cancer continues to represent a considerable health burden among women worldwide and is particularly important in low- and middle-income settings. In addition to its effects on mortality, the disease creates social and economic consequences for affected women

and their families. Among cancers occurring in women, cervical cancer remains a major public health concern, especially where prevention and early detection services are not optimally utilized (Arbyn et al., 2020).

Persistent high-risk human papillomavirus (HPV) infection is the principal cause of cervical cancer, with HPV types 16 and 18 accounting for a substantial proportion of infections. Histologically, the disease is mainly represented by squamous cell carcinoma and adenocarcinoma. Other factors associated with cervical cancer include smoking, HIV infection, early sexual intercourse, prolonged hormonal contraceptive use, and multiple sexual partners (Hogi, 2018; Hogi & Pogi, 2025) (Arbyn et al., 2020) (Yirsaw et al., 2024) (Wu et al., 2025) (Kementrian Kesehatan, 2025)

Global estimates reported by the Global Cancer Observatory illustrate the continuing burden of cervical cancer. Approximately 570,000 cases and 311,000 deaths were recorded in 2018, followed by 604,127 cases and 341,831 deaths in 2020. For 2022, the reported estimates were approximately 662,044–662,301 new cases and 348,709 deaths. The persistence of this burden highlights the continuing gap between cervical cancer elimination goals and conditions in the community (Arbyn et al., 2020; Force et al., 2025; Y. Liu et al., 2024; Salehi et al., 2025; Singh et al., 2023) (Stelzle et al., 2021; WHO, 2024).

The situation in Indonesia also demonstrates a substantial cervical cancer burden. In 2021, cervical cancer was reported as the second most common cancer among Indonesian women after breast cancer, with 36,633 cases and 21,003 deaths (Kemenkes RI, 2021). The World Cancer Research Fund International estimated 36,964 new cervical cancer cases in Indonesia in 2022, placing the country among those with the highest numbers of new cases globally (World Cancer Research Fund International, 2022). Broader cancer estimates also indicate a considerable future burden if prevention and early detection are not strengthened (World Health Organization & International Agency For Research on Cancer, 2022).

The consequences of cervical cancer extend beyond survival. Women affected by the disease may experience impaired quality of life, limitations in physical activity, persistent fatigue, and reduced overall well-being. Clinical manifestations may include pelvic pain, abnormal bleeding, and abnormal vaginal discharge, while treatment can be accompanied by gastrointestinal and urinary problems, nausea, and fatigue (Chen et al., 2024) (Seyfu et al., 2024) (Stuopelytė et al., 2023).

Cervical cancer can also affect reproductive and sexual health. Reported consequences include infertility, menstrual disturbances, premature menopause, reduced libido, and dyspareunia. In advanced disease, metastasis may involve organs such as the lungs, liver, and bones. Some treatment-related effects, including chronic fatigue, hormonal disturbances, and lymphedema, may continue after treatment (Cianci et al., 2023) (Mishra et al., 2021) (Soares & Dantas, 2024) (D'Amato et al., 2024).

The burden is likewise experienced within families and communities. Guida et al. (2022) estimated that approximately one million children became orphaned following maternal cancer-related deaths in 2020, with breast and cervical cancer accounting for a substantial proportion of these deaths. These findings illustrate that cervical cancer prevention has implications not only for individual health but also for family well-being (Guida et al., 2022).

The World Health Organization (WHO) has established the 90–70–90 targets as part of its strategy to eliminate cervical cancer as a public health problem by 2030. The targets call for 90% of girls to be fully vaccinated against HPV by age 15, 70% of women to receive high-performance screening by ages 35 and 45, and 90% of women identified with cervical disease to receive appropriate treatment. Progress toward these targets depends on effective prevention, screening, and treatment systems (Guida et al., 2022)

Screening participation in Indonesia, however, remains limited. The Indonesian Health Survey (2023) reported that 92.2% of women aged 15 years or older had never undergone cervical cancer screening, while the corresponding proportion in Banten was 93.2%. During

2022–2024, early detection had reached 23.59% of the targeted women of childbearing age nationally and 57.39% in Banten Province (Kementrian Kesehatan RI, 2023). Limited knowledge and awareness may be among the factors associated with delayed screening and diagnosis (Patel et al., 2025; Rosidina Putri & Adyani, 2025).

HPV DNA testing provides a sensitive approach for identifying high-risk HPV infection before cervical abnormalities progress to precancerous or cancerous changes. WHO recommends HPV DNA testing as a primary screening approach for adult women because of its high sensitivity and consistent performance (World Health Organization, 2021). The PAHO–WHO Plan of Action for Cervical Cancer Prevention and Control 2018–2030 also emphasizes information, education, vaccination, and culturally appropriate communication as components of prevention (PAHO, 2018). In community education, however, greater attention has traditionally been given to visual inspection with acetic acid and Pap smears, leaving the advantages and procedures of HPV DNA testing less familiar to some women (Duval S & Wicklund R A, 1972).

Health education can bridge this information gap when the educational medium is matched to the needs of the target population. Appropriate media can organize health messages, support comprehension, strengthen awareness, and encourage preventive action (Ouchene et al., 2024; Septiana, Adnani, & Susiarno, 2025; Septiana, Adnani, Susiarno, et al., 2025). Previous studies have reported beneficial effects of both printed and digital educational approaches on knowledge and awareness related to cervical cancer and screening (Trisnowati & Aseta, 2020; Wardani et al., 2021). Nevertheless, interactive media specifically developed to explain HPV DNA testing remain limited, particularly for women of childbearing age (Lee & Reeves, 1900, 2017).

An Augmented Reality (AR) flipbook combines the sequential format of a conventional flipbook with digital visual elements that can be accessed interactively. Animations and virtual visualizations can be used to represent health information that may be difficult to explain through static text and pictures alone. Such an approach may make complex information more concrete and engaging for learners (Khusna et al., 2024; Nazilah & Saepul Ramdhan, 2021)

Existing evidence suggests that flipbook-based educational media can support comprehension, cognitive learning, and user engagement. However, the use of an AR-enhanced flipbook to address cervical cancer prevention and early detection through HPV DNA testing among women of childbearing age has not been widely described. In particular, interactive representations of HPV infection, cervical changes, and the HPV DNA testing process remain relatively uncommon in educational media for this population.

Accordingly, this study developed an AR-based flipbook that combines cervical cancer education with interactive visual content. The intervention was designed to support women's understanding and self-awareness concerning cervical cancer prevention and early detection through HPV DNA testing.

METHODS

A Research and Development (R&D) design was applied using Thiagarajan's 4D framework, comprising Define, Design, Develop, and Disseminate, to produce an Augmented Reality (AR)-based flipbook for cervical cancer early detection through HPV DNA testing among women of childbearing age. During Define, questionnaires, observations, and focus group discussions (FGDs) were used with experts and stakeholders to identify educational needs, preferred content, visualization requirements, and learning approaches. The Design stage translated these findings into storyboards, content sequences, illustrations, infographics, and AR components depicting cervical anatomy, HPV infection, and HPV DNA testing. During Develop, material, media, and language experts assessed the product using instruments evaluated through the Content Validity Index (CVI), followed by a user test involving 15 women of childbearing age who were excluded from the main effectiveness study. Feasibility

was scored with a Likert scale and interpreted as very feasible (76–100%), feasible (51–75%), fairly feasible (26–50%), or not feasible (0–25%). The Disseminate stage consisted of implementation with the intended population.

Effectiveness was examined with a quasi-experimental one-group pretest–posttest design among 30 women of childbearing age, 15–49 years, recruited purposively. The intervention was administered twice with a one-week interval between sessions, from July 26 to August 2, 2026. Univariate and bivariate analyses were performed. Data distribution was examined with the Shapiro–Wilk test; paired t-test analysis was planned for normally distributed data, whereas the Wilcoxon Signed-Rank Test was used for non-normally distributed data. Statistical significance was defined as $p < 0.05$. Ethical approval was granted by the Health Research Ethics Committee of Poltekkes Kemenkes Semarang (approval no. 615/EA/F.XXIII.38/2026).

RESULTS AND DISCUSSION

Results

The developed product was evaluated as an educational medium intended to strengthen self-awareness related to cervical cancer early detection through HPV DNA testing. Development followed the four stages of the 4D model. Overall feasibility was examined through expert assessments and a user test, while the effectiveness component evaluated changes in self-awareness among women of childbearing age.

Define

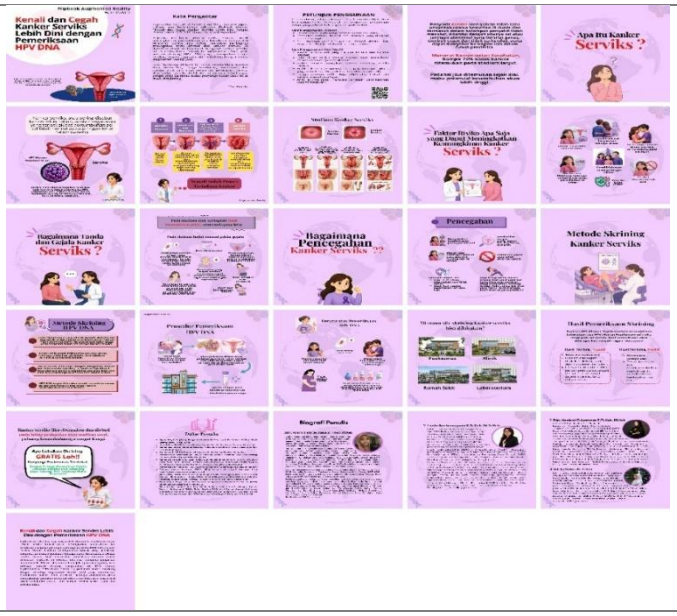
During Define, information was gathered through questionnaires, observations, and FGDs with subject, media, and language experts as well as representatives of women of childbearing age. The needs assessment showed that respondents preferred educational material that was concise, attractive, interactive, and straightforward. They particularly required clearer explanations of cervical cancer, HPV infection, HPV DNA testing, screening procedures, screening benefits, and service access. Participants also indicated that text and static illustrations alone did not sufficiently demonstrate HPV infection and changes in the cervix. Expert input therefore supported the inclusion of AR elements for concepts requiring visual explanation, together with brief and communicative wording.

Design

The Design stage converted the identified needs into the structure of the AR flipbook. Development included a storyboard, content sequence, page arrangement, illustrations, infographics, and interactive features. The material progressed from basic information about cervical cancer and HPV to risk factors, HPV infection, the rationale for early detection, and HPV DNA testing. AR components were prepared to depict cervical anatomy, HPV infection, cellular changes, and the screening procedure. The final product consisted of a printed flipbook linked to AR features through links and QR codes, accompanied by a digital version.

Table 1. Augmented Hasil Reality-Based Flipbook Design Results

No	Item	Results
1	Link and QR for AR Access in the Flipbook	Link: https://projects.web-ar.studio/v2/6db4d6ad26 QR Code:
2	Digital Final AR Flipbook Display	Link: https://pdflink.to/93a37d38/ QR Code:

3	AR Flipbook Display	

Develop

Expert review was conducted during the Develop stage. Material, media, and language experts gave feasibility scores of 85.94%, 92.50%, and 98.07%, respectively; all three assessments fell within the very feasible category. The assessments therefore supported the adequacy of the flipbook in terms of content, visual design, presentation, readability, language, and integration of AR technology.

Table 2. Results of Expert Validation of the AR-Based Flipbook

Validator	Aspects Assessed	Number of Questions	Maximum Score	Scores Obtained	Presented%	Categorical
Material Expert	Contents/Materials	16	64	55	85,94%	Highly feasible
Media Member	Media/Design	60	120	111	92,5%	Highly feasible
Linguist	Language	13	52	51	98,07%	Highly feasible

The small-group user assessment involved 15 women of childbearing age who were not part of the main effectiveness sample. Thirteen participants (86.67%) classified the product as very feasible, whereas two participants (13.33%) classified it as feasible. Individual scores extended from 75.00% to 100.00%, with a calculated mean of 90.00%. The findings indicate that the AR flipbook met the predefined feasibility criteria for use as an educational medium.

Table 3. User Feasibility Test Results of the AR-Based Flipbook

Variabel	Respondent	Number of Questions	Maximum Score	Score Obtainedd	Presentase %	Category
Presentation of Materials, Learning Interests, Augmented Reality	1	15	60	55	91,67%	**Highly feasible**
	2	15	60	57	95,00%	**Highly feasible**
	3	15	60	50	83,33%	**Highly feasible**
	4	15	60	52	86,67%	**Highly feasible**
	5	15	60	50	83,33%	**Highly feasible**
	6	15	60	57	95,00%	**Highly feasible**

Flipbook	7	15	60	59	98,33%	**Highly feasible**
Display	8	15	60	56	93,33%	**Highly feasible**
	9	15	60	59	98,33%	**Highly feasible**
	10	15	60	56	93,33%	**Highly feasible**
	11	15	60	50	83,33%	**Highly feasible**
	12	15	60	59	98,33%	**Highly feasible**
	13	15	60	45	75,00%	**feasible**
	14	15	60	60	100,00%	**Highly feasible**
	15	15	60	45	75,00%	**feasible**

Disseminate and Effectiveness Testing Stage

Following validation, the media was implemented with the target population to examine its potential effectiveness in increasing self-awareness related to cervical cancer early detection. Thirty women of childbearing age at Pamulang Health Center, South Tangerang City, participated in the one-group pretest–posttest evaluation. Self-awareness was measured with a questionnaire that had undergone validity and reliability testing.

Item validity was examined with Product Moment correlation at a 0.05 significance level (Notoadmodjo Soekidjo, 2018). An item was retained when its calculated correlation exceeded the critical value of 0.361. All 22 items met this criterion, with calculated correlations ranging from 0.390 to 0.870. Accordingly, every item was retained for the self-awareness assessment.

Table 4. Results of the Validity Test of *the Self Awareness Questionnaire*

Item	Corrected item-total correlation (r calculated)	r Table	Remarks
P01	0,870	0,361	Valid
P02	0,861	0,361	Valid
P03	0,838	0,361	Valid
P04	0,861	0,361	Valid
P05	0,842	0,361	Valid
P06	0,834	0,361	Valid
P07	0,623	0,361	Valid
P08	0,700	0,361	Valid
P09	0,749	0,361	Valid
P10	0,684	0,361	Valid
P11	0,664	0,361	Valid
P12	0,705	0,361	Valid
P13	0,390	0,361	Valid
P14	0,524	0,361	Valid
P15	0,749	0,361	Valid
P16	0,555	0,361	Valid
P17	0,573	0,361	Valid
P18	0,555	0,361	Valid
P19	0,516	0,361	Valid
P20	0,535	0,361	Valid
P21	0,581	0,361	Valid
P22	0,516	0,361	Valid

Reliability analysis produced a Cronbach's alpha of 0.944 for the 22-item questionnaire. This value exceeded the stated acceptability threshold of 0.60, supporting the internal consistency and use of the questionnaire for measuring self-awareness among women of childbearing age.

Table 5. Results of the Self Awareness Questionnaire Reliability Test

Variable	Reliability Coefficients	Cronbach's Alpha	Standard	Remarks
Self-Awareness	22 Items	0,944	0.60	Reliable

Participant characteristics were described to provide context for the effectiveness analysis. Variables included age, marital status, education, occupation, and previous HPV DNA screening experience. The effectiveness sample consisted of 30 women of childbearing age.

Table 6. Characteristics of Research Respondents (n=30)

Variable	f	%
Age		
<15 years old	0	0,0
15–49 years old	30	100,0
>49 years old	0	0,0
Marital status		
Married	30	100,0
Unmarried	0	0,0
Education		
Not in school	0	0,0
SD	0	0,0
Junior High School	4	13,3
High School	15	50,0
Diploma	1	3,3
S1	10	33,3
S2	0	0,0
S3	0	0,0
Occupation		
Not working	0	0,0
Housewives	20	66,7
Employees	9	30,0
Self-employed	1	3,3
Others	0	0,0
History of HPV DNA screening		
Ever	0	0,0
Never	30	100

All 30 participants were within the 15–49-year age range and were married. Half of the respondents had completed senior high school (15; 50.0%), followed by undergraduate education (10; 33.3%), junior high school (4; 13.3%), and diploma education (1; 3.3%). The occupation and previous screening characteristics are presented together with the other respondent characteristics in Table 6.

Because the effectiveness sample contained fewer than 50 participants, the Shapiro–Wilk procedure was used to assess distributional assumptions. Both pretest and posttest self-awareness scores produced significance values of $p = 0.001$, indicating non-normal distributions ($p < 0.05$). Consequently, the pretest–posttest comparison was performed using the Wilcoxon Signed-Rank Test.

Table 7. Results of the Self-Awareness Data Normality Test

Variable	Shapiro-Wilk Statistic	df	Sig.	Remarks
Self-Awareness Pretest	0,669	30	0,001	Not normally distributed
Self-Awareness Posttest	0,632	30	0,001	Not normally distributed

The Shapiro–Wilk test.

The distribution of self-awareness categories changed following exposure to the AR flipbook. At baseline, 21 participants (70.0%) were classified in the moderate category, 8 (26.7%) were in the low category, and only 1 (3.3%) was in the high category. After the intervention, 13 participants (43.3%) were classified as high and 17 (56.7%) as moderate, while the low category contained no participants.

Table 8 Distribution Comparison of Self-Awareness Levels Before and After Intervention

Self-Awareness *Level*	Before Intervention n (%)	After Intervention n (%)
High	1 (3,3%)	13 (43,3%)

Medium	21 (70,0%)	17 (56,7%)
low	8 (26,7%)	0 (0,0%)
Total	30 (100%)	30 (100%)

After the intervention, the proportion of participants in the high self-awareness category increased from 3.3% to 43.3%, while the low category declined from 26.7% to 0%.

Table 9. Difference in Self-Awareness Scores Before and After the Intervention

Variable	Before Intervention Median	After Intervention Median	Δ Median	Z	p-value*
Self-awareness	47	53	+6	−2.887	0.004

*Wilcoxon Signed-Rank Test.

The category distribution shifted toward higher self-awareness after the AR flipbook intervention. In addition, the median score rose from 47 at pretest to 53 at posttest, representing a 6-point difference. The Wilcoxon Signed-Rank Test produced Z = −2.887 with p=0.004, indicating a statistically significant difference between the paired measurements.

Discussion

Cervical cancer is one of the major health problems affecting women and can be prevented through HPV vaccination, healthy lifestyle practices, and early detection through screening. However, the utilization of cervical cancer screening remains a challenge due to low levels of knowledge and awareness, risk perceptions, and various barriers to accessing health services.(Chua et al., 2021; Farajimakin, 2024; Petersen et al., 2022; Robbers et al., 2021) Therefore, increasing awareness of the risk of cervical cancer and the importance of early detection is an essential component of cervical cancer prevention efforts.

Women of childbearing age are an important group in cervical cancer prevention efforts because they are within the age range targeted for various prevention and early detection interventions. In this study, all respondents were aged 15–49 years and were married. Most respondents had a high school education (15 respondents; 50.0%), followed by those with a bachelor's degree (10 respondents; 33.3%). Regarding occupation, the majority were housewives (20 respondents; 66.7%). These characteristics indicate that most respondents had an adequate educational background to receive and understand health information. However, none of the respondents had previously undergone HPV DNA screening (30 respondents; 100.0%). These findings suggest that an adequate level of formal education does not necessarily translate into actual screening experience or behavior.

This finding is consistent with the systematic review and meta-analysis by Pradnyantara and Chrisnanda (2022), which demonstrated a significant relationship between knowledge and attitudes toward cervical cancer screening. Women with a high level of knowledge were 3.63 times more likely to have a positive attitude toward cervical cancer screening than those with low knowledge. These findings suggest that knowledge and understanding of cervical cancer and screening are important components in shaping responses to prevention. However, formal education alone may not be sufficient to translate knowledge into screening behavior. Therefore, improving formal education should not be considered the sole determinant of screening behavior. Health information should also be delivered through approaches that are relevant to the characteristics of the target population and that specifically relate screening information to perceived health risks and individual needs. (Gusti et al., 2022)

In this study, none of the respondents had previously undergone HPV DNA screening (30 respondents; 100.0%). This finding indicates a gap between the availability of early detection services and respondents' awareness and utilization of screening services. These findings are consistent with the systematic review by Zhang et al. (2022), which demonstrated that educational interventions play an important role in increasing women's knowledge and

awareness of cervical cancer and encouraging screening behavior. The review indicated that various educational approaches, including information-based and interactive methods, have the potential to improve outcomes related to cervical cancer screening, although their effectiveness may vary depending on population characteristics and intervention approaches. (Zhang et al., 2022) Similarly, by Romli et al. (2022) showed that *e-health* interventions have the potential to improve knowledge of cervical cancer and increase participation in screening. (Romli et al., 2022) These findings were further supported by Liu et al. (2024) through a systematic review and meta-analysis of 15 studies involving 23,102 participants, which demonstrated that *electronic health* interventions significantly increased participation in cervical cancer screening. Therefore, the absence of previous screening experience among respondents in this study highlights the need for health education strategies that not only provide information but also strengthen women's awareness and readiness to engage in preventive health behaviors.(X. Liu et al., 2024a)

Self-awareness is the ability to understand one's strengths, motivations, judgments, and behaviors, as well as their effects on oneself and others. This ability can foster better perceptions, improve the recognition of consequences, and support informed decision-making.(Tang et al., 2022) Individuals with high self-awareness are better able to understand their feelings, recognize behaviors that may benefit themselves and others, and make informed decisions. (Khusumadewi et al., 2017) Self-awareness includes the ability to recognize emotions and their influences, accurately understand oneself, and develop self-confidence. (Habibzadeh et al., 2021) This concept is supported by Khoshnazar et al. (2024), who found that virtual education can increase perceived susceptibility, perceived severity, perceived benefits, and self-efficacy. (Khoshnazar et al., 2024a) Similarly, Chen et al. (2023) demonstrated that theory-based health education interventions can significantly improve women's knowledge, self-efficacy, and intention to undergo cervical cancer screening. Findings from other studies on multimodal interventions also indicate that education delivered through a combination of media can improve women's knowledge, attitudes, awareness, and participation in cervical cancer screening. Thus, self-awareness can be considered an important cognitive factor that supports the development of motivation and intention to engage in preventive health behaviors.(Zhang et al., 2023)

Health education plays an important role in the process of delivering health information. The use of appropriate educational media can facilitate effective communication and improve the delivery of health messages to individuals and groups. Health education supported by appropriate educational media is expected to produce optimal learning outcomes. Learning involves acquiring and integrating responses through repeated stimuli, whereby stronger and more frequent stimuli can reinforce responses. (Pandai Lolan et al., 2024)

Health education also plays an important role in increasing *self-awareness* because the learning process can activate five aspects of consciousness proposed by Robert Solso, namely *attention, wakefulness, architecture, recall of knowledge,* and *emotive*. Through health education, individuals are encouraged to focus on their physical and mental conditions (*attention*), become more aware of health risks and unhealthy lifestyles (*wakefulness*), develop conscious patterns through an understanding of bodily signals and biological processes (*architecture*), connect personal experiences and existing knowledge to support reflective decision-making (*recall of knowledge*), and develop emotional responses that may encourage behavioral change (*emotive*). (Solso, 2009)

This concept is consistent with self-awareness theory Duval and Wicklund's, which suggests that individuals with higher self-awareness are more likely to recognize discrepancies between their behavior and relevant standards or norms. This awareness can encourage individuals to adjust their behavior in accordance with those standards. In the context of cervical cancer prevention, health education may provide women of childbearing age with stimuli and experiences that encourage them to reflect on their health conditions, perceived

risks, and preventive behaviors. (Duval S & Wicklund R A, 1972) Therefore, health education is not merely a process of delivering information but also a psychological process that can strengthen individuals' awareness of their health and encourage appropriate preventive behaviors. (Solso, 2009)

In this study, the medium used to deliver the educational stimulus was an Augmented Reality (AR)-based flipbook. A flipbook is a minimalist visual medium consisting of sequential sheets designed in a compact format, resembling a small calendar measuring 13 × 11 cm. The AR-based flipbook is an innovation of the conventional flipbook that integrates augmented reality technology, allowing educational content to be presented interactively through 3D animations and virtual elements integrated into the real-world environment. This approach makes information more engaging, easier to understand, and potentially more effective in supporting learning. (Khusna et al., 2024; Nazilah & Saepul Ramdhan, 2021)

According to Edgar Dale's theory, visual materials such as images, videos, and other visual aids can support the learning experience by providing more concrete representations of information. Visual materials can help learners understand and retain information more effectively because they provide experiences that are closer to real-life situations. (Lee & Reeves, 2017) In health education, the appropriate use of educational media can facilitate effective information delivery, increase awareness and knowledge, and encourage positive changes in health behavior.(Ouchene et al., 2024; Septiana, Adnani, & Susiarno, 2025; Septiana, Adnani, Susiarno, et al., 2025) Various studies have also demonstrated that both print and digital educational media can improve women's understanding and awareness of cervical cancer and its screening.(Trisnowati & Aseta, 2020; Wardani et al., 2021)(Hombaiah et al., 2022)(Makadzange et al., 2022)(Thiel de Bocanegra et al., 2022)(Thompson et al., 2019)

The results of this study showed that health education using an Augmented Reality (AR)-based flipbook increased the *self-awareness* of women of childbearing age regarding cervical cancer prevention. Before the intervention, only 1 respondent (3.3%) had a high level of *self-awareness*, while 21 respondents (70.0%) were in the moderate category and 8 respondents (26.7%) were in the low category. After the intervention, the distribution changed considerably, with 13 respondents (43.3%) classified as having high *self-awareness*, 17 respondents (56.7%) in the moderate category, and none (0%) in the low category. These changes indicate that health education using an AR-based flipbook was able to shift respondents' *self-awareness* toward a more favorable level.

These findings are consistent with the systematic review by Zhang et al. (2022), which demonstrated that health education interventions can increase women's knowledge and *awareness* of cervical cancer. (Zhang et al., 2022) Similarly, Hombaiah et al. (2022) used a *mobile health* approach to provide information on cervical cancer prevention and reported improvements in knowledge regarding cervical cancer, risk factors, signs and symptoms, and prevention. These findings support the potential of digital technology as an effective medium for delivering health information in a more engaging and accessible manner.(Hombaiah et al., 2022)

Furthermore, the Wilcoxon Signed-Rank Test showed a statistically significant difference in *self-awareness* before and after the intervention **(**$p = 0.004$; $p < 0.05$**).** This result indicates that health education using an AR-based flipbook had a significant positive effect on the *self-awareness* of women of childbearing age regarding cervical cancer prevention. The findings are consistent with previous studies showing that health education interventions can improve knowledge and awareness of cervical cancer and encourage participation in screening.(Khoshnazar et al., 2024b; X. Liu et al., 2024b; Ozturk et al., 2024; Rademaker et al., 2022; Zhang et al., 2022)

The novelty of this study lies in the development of an Augmented Reality (AR)-based flipbook specifically designed to strengthen self-awareness regarding cervical cancer prevention and HPV DNA screening among women of childbearing age. The developed

medium integrates concise printed educational content with interactive AR visualizations of cervical anatomy, HPV infection, cellular changes, and the HPV DNA screening procedure. This integration provides a more interactive approach than conventional printed materials that primarily rely on static text and illustrations. In addition, this study integrates a structured 4D development process with expert validation, user feasibility assessment, and pretest–posttest evaluation within the development of a single educational medium. The findings demonstrated high feasibility based on expert and user assessments, while self-awareness increased following the intervention, as indicated by an increase in the median score from 47 to 53 and a statistically significant Wilcoxon Signed-Rank Test result ($Z = -2.887$; $p = 0.004$). Thus, the contribution of this study is the integration of interactive AR visualization into a compact health education medium specifically developed to support women's awareness of cervical cancer early detection and HPV DNA screening.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

Based on the findings of this study, health education using an Augmented Reality-based flipbook was associated with an improvement in self-awareness among women of childbearing age regarding cervical cancer prevention and early detection**.** The proportion of respondents with high self-awareness increased from 3.3% before the intervention to 43.3% after the intervention**,** while the proportion with low self-awareness decreased from 26.7% to 0%**.** The Wilcoxon Signed-Rank Test showed a statistically significant difference in self-awareness before and after the intervention ($p = 0.004$). These findings suggest that an Augmented Reality-based flipbook has the potential to serve as an alternative health education medium to support increased self-awareness regarding cervical cancer prevention and early detection among women of childbearing age.

Limitations

This study has several limitations. First, the effectiveness test involved a relatively small sample of 30 women of childbearing age recruited purposively from one health center, which may limit the generalizability of the findings to other populations and healthcare settings. Second, this study employed a one-group pretest–posttest design without a control group, making it difficult to determine whether the observed changes in self-awareness were attributable solely to the AR-based flipbook intervention. Third, the study focused on self-awareness as the primary outcome and did not assess whether the increase in self-awareness was sustained over time or translated into actual HPV DNA screening behavior. Finally, the intervention was evaluated over a relatively short period, so the long-term effectiveness and sustainability of the AR-based flipbook remain unclear.

Recommendations

Based on the findings of this study, the AR-based flipbook can be considered as an alternative interactive health education medium for increasing self-awareness regarding cervical cancer early detection through HPV DNA screening. Health workers, particularly midwives and healthcare providers, may utilize interactive digital and augmented reality-based educational media to provide information about cervical cancer prevention and HPV DNA screening to women of childbearing age. Future research is recommended to involve larger and more diverse samples from multiple healthcare settings and to use a randomized controlled or controlled pretest–posttest design to provide stronger evidence of effectiveness. Further studies should also examine whether increased self-awareness leads to actual HPV DNA screening uptake and assess the sustainability of the intervention’s effects through longer-term follow-up.

Author Contributions

The first author was responsible for the conceptualization of the study, development of the research methodology, data collection, data analysis, and drafting of the manuscript. The second author contributed to the development of the conceptual framework, methodological review, interpretation of the findings, and critical revision of the manuscript. The third author contributed to the development and validation of the educational media, interpretation of the results, and critical review of the manuscript. The fourth author contributed to data collection, data management, interpretation of the findings, and revision of the manuscript. All authors reviewed and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

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During the preparation of this manuscript, the author used ChatGPT Plus (OpenAI) for language editing, grammar improvement, and translation assistance. The author thoroughly reviewed and revised all AI-assisted content and takes full responsibility for the accuracy, originality, interpretation, and final content of the manuscript.

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REFERENCES

Arbyn, M., Weiderpass, E., Bruni, L., de Sanjosé, S., Saraiya, M., Ferlay, J., & Bray, F. (2020). Estimates of incidence and mortality of cervical cancer in 2018: a worldwide analysis. *The Lancet Global Health*, *8*(2), e191–e203. https://doi.org/10.1016/S2214-109X(19)30482-6

Chen, H., Zhou, L., Fong, D., Cun, Y., Yang, Z., & Wan, C. (2024). Quality of life and its related-influencing factors in patients with cervical cancer based on the scale QLICP-CE(V2.0). *BMC Women's Health*, *24*(1). https://doi.org/10.1186/s12905-024-03068-1

Chua, B., Ma, V., Asjes, C., Lim, A., Mohseni, M., & Wee, H. L. (2021). Barriers to and facilitators of cervical cancer screening among women in Southeast Asia: A systematic review. In *International Journal of Environmental Research and Public Health* (Vol. 18, Number 9). MDPI. https://doi.org/10.3390/ijerph18094586

Cianci, S., Tarascio, M., Arcieri, M., La Verde, M., Martinelli, C., Capozzi, V. A., Palmara, V., Gulino, F., Gueli Alletti, S., Caruso, G., Restaino, S., Vizzielli, G., Conte, C., Palumbo, M., & Ercoli, A. (2023). Post Treatment Sexual Function and Quality of Life of Patients Affected by Cervical Cancer: A Systematic Review. In *Medicina (Lithuania)* (Vol. 59, Number 4). MDPI. https://doi.org/10.3390/medicina59040704

D'Amato, A., Riemma, G., Agrifoglio, V., Chiantera, V., Laganà, A. S., Mikuš, M., Dellino, M., Maglione, A., Faioli, R., Giannini, A., Trojano, G., & Etrusco, A. (2024). Reproductive Outcomes in Young Women with Early-Stage Cervical Cancer Greater than 2 cm Undergoing Fertility-Sparing Treatment: A Systematic Review. In *Medicina (Lithuania)* (Vol. 60, Number 4). Multidisciplinary Digital Publishing Institute (MDPI). https://doi.org/10.3390/medicina60040608

Duval S, & Wicklund R A. (1972). *A theory of objective self-awareness*. Academic Press.

Farajimakin, O. (2024). Barriers to Cervical Cancer Screening: A Systematic Review. *Cureus*. https://doi.org/10.7759/cureus.65555

Force, L. M., Kocarnik, J. M., May, M. L., Bhangdia, K., Crist, A., Penberthy, L., Pritchett, N., Acheson, A., Deitesfeld, L., Bhoomadevi, A., Aalruz, H., Abbas, N., Bashash, M. A., Magied, A. H. A. A. Al, Elhafeez, S. A., Abdalla, A. N., Abdalla, M. A., Abdel-Rahman, W. M., Abdi, P., … Murray, C. J. L. (2025). The global, regional, and national burden of cancer, 1990–2023, with forecasts to 2050: a systematic analysis for the Global Burden of Disease Study 2023. *The Lancet*, *406*(10512), 1565–1586. https://doi.org/10.1016/S0140-6736(25)01635-6

Guida, F., Kidman, R., Ferlay, J., Schüz, J., Soerjomataram, I., Kithaka, B., Ginsburg, O., Mailhot Vega, R. B., Galukande, M., Parham, G., Vaccarella, S., Canfell, K., Ilbawi, A. M., Anderson, B. O., Bray, F., dos-Santos-Silva, I., & McCormack, V. (2022). Global and regional estimates of orphans attributed to maternal cancer mortality in 2020. *Nature Medicine*, *28*(12), 2563–2572. https://doi.org/10.1038/s41591-022-02109-2

Gusti, I., Ngurah, A., Pradnyantara, P., & Chrisnanda, A. (2022). Knowledge of Cervical Cancer Screening in Adult Women: Meta-Analysis. *Journal of Epidemiology and Public Health*, (01), 34–45. https://doi.org/10.26911/jepublichealth.2022.07

Habibzadeh, H., Shariati, A., Mohammadi, F., & Babayi, S. (2021). The effect of educational intervention based on Pender's health promotion model on quality of life and health promotion in patients with heart failure: an experimental study. *BMC Cardiovascular Disorders*, *21*(1). https://doi.org/10.1186/s12872-021-02294-x

Hogi. (2018). *Pedoman Nasional Pelayanan Kedokteran Kanker Ginekologi*.

Hogi, & Pogi. (2025). *Skrining Kanker Serviks Dan Tindak Lanjut Temuan Abnormal*.

Hombaiah, C., Madhu, B., Gopi, A., & Murthy, M. R. N. (2022). Effects of mobile Health (mHealth) application on cervical cancer prevention knowledge and screening among women social support groups with low-socioeconomic status in Mysuru city, Southern India. *PLoS ONE*, *17*(9 September). https://doi.org/10.1371/journal.pone.0273070

Kemenkes RI. (2021). *Profil kesehatan Indonesia 2021*.

Kementrian Kesehatan. (2025). *Gejala dan Penyebab Kanker Serviks Cervical Cancer yang Perlu Kita Ketahui*. https://keslan.kemkes.go.id/view_artikel/4169/gejala-dan-penyebab-kanker-serviks-cervical-cancer-yang-perlu-kita-ketahui

Kementrian Kesehatan RI. (2023). *Survei Kesehatan Indonesia*. https://www.badankebijakan.kemkes.go.id/hasil-ski-2023/

Khoshnazar, M. S., Tarrahi, M. J., & Shahnazi, H. (2024a). Impact of virtual education based on health belief model on cervical cancer screening behavior in middle-aged women: A quasi-experimental study. *Cancer Reports*, *7*(4). https://doi.org/10.1002/cnr2.2058

Khoshnazar, M. S., Tarrahi, M. J., & Shahnazi, H. (2024b). Impact of virtual education based on health belief model on cervical cancer screening behavior in middle-aged women: A quasi-experimental study. *Cancer Reports*, *7*(4). https://doi.org/10.1002/cnr2.2058

Khusna, M., Fatih, M., & Alfi, C. (2024). Pengembangan Media Flipbook Berbasis Augmented Reality Materi Keragaman Budaya Untuk Meningkatkan Self-Efficacy Siswa Kelas IV. *Perseda*, *VII Nomor 1*.

Khusumadewi, A., Warsito, H. W., & Dibyo Wiyono, B. (2017). *Pengembangan Modul Cultural Awareness Untuk Konselor Sebaya* (Vol. 01).

Lee, S. J., & Reeves, T. C. (1900). Teaching with Motion Pictures (1937). In *Audiovisual Methods in Teaching* (Vol. 47, Number 6).

Lee, S. J., & Reeves, T. C. (2017). *Edgar Dale and the Cone of Experience*. Audiovisual Methods in Teaching. https://open.byu.edu/lidtfoundations/edgar_dale

Liu, X., Ning, L., Fan, W., Jia, C., & Ge, L. (2024a). Electronic Health Interventions and Cervical Cancer Screening: Systematic Review and Meta-Analysis. In *Journal of Medical Internet Research* (Vol. 26). JMIR Publications Inc. https://doi.org/10.2196/58066

Liu, X., Ning, L., Fan, W., Jia, C., & Ge, L. (2024b). Electronic Health Interventions and Cervical Cancer Screening: Systematic Review and Meta-Analysis. In *Journal of Medical Internet Research* (Vol. 26). JMIR Publications Inc. https://doi.org/10.2196/58066

Liu, Y., Shi, W., Mubarik, S., & Wang, F. (2024). Assessment of secular trends of three major gynecologic cancers burden and attributable risk factors from 1990 to 2019: an age period cohort analysis. *BMC Public Health*, *24*(1). https://doi.org/10.1186/s12889-024-18858-3

Makadzange, E. E., Peeters, A., Joore, M. A., & Kimman, M. L. (2022). The effectiveness of health education interventions on cervical cancer prevention in Africa: A systematic review. In *Preventive Medicine* (Vol. 164). Academic Press Inc. https://doi.org/10.1016/j.ypmed.2022.107219

Mishra, N., Singh, N., Sachdeva, M., & Ghatage, P. (2021). Sexual Dysfunction in Cervical Cancer Survivors: A Scoping Review. *Women's Health Reports*, *2*(1), 594–607. https://doi.org/10.1089/whr.2021.0035

Nazilah, S., & Saepul Ramdhan, F. (2021). Augmented Reality Sebagai Media Pembelajaran Untuk Pengenalan Landmark Negara-Negara ASEAN Berbasis Android Dengan Menggunakan Metode Marker Based Tracking. *Ikra-Ith Informatika*, *5*.

Notoadmodjo Soekidjo. (2018). *Metodelogi Penelitian Kesehatan* (3rd ed.). PT. Rineka Cipta.

Ouchene, D., Boussalah, H., & Ziane, K. (2024). role of the media in health awareness. *International Journal of Health Sciences*, *8*(S1), 477–482. https://doi.org/10.53730/ijhs.v8ns1.14808

Ozturk, N. Y., Hossain, S. Z., Mackey, M., Adam, S., & Brennan, P. (2024). HPV and Cervical Cancer Awareness and Screening Practices among Migrant Women: A Narrative Review. In *Healthcare (Switzerland)* (Vol. 12, Number 7). Multidisciplinary Digital Publishing Institute (MDPI). https://doi.org/10.3390/healthcare12070709

PAHO, W. (2018). *Plan Of Action For Cervical Cancer Prevention And Control 2018-2030*. www.paho.org

Pandai Lolan, Y., Lau, Y., & Sinaga, D. Y. (2024). *Pengembangan Media Edukasi Promosi Kesehatan Pos Monopoli Anemia Dalam Upaya Peningkatan Konsusmi Tablet Tambah Darah Pada Remaja Putri Kota Bandung*. *12*(2). https://jurnal.unived.ac.id/index.php/jnph/article/view/7376/5142

Patel, M. V., Chandra, S., Shah, K., & Trivedi, Dr. K. (2025). Expanding uptake of cervical cancer screening: Feasibility and acceptability of menstrual blood-based HPV DNA testing for cervical cancer screening. *Journal of Clinical Oncology*, *43*(16_suppl). https://doi.org/10.1200/jco.2025.43.16_suppl.e17513

Petersen, Z., Jaca, A., Ginindza, T. G., Maseko, G., Takatshana, S., Ndlovu, P., Zondi, N., Zungu, N., Varghese, C., Hunting, G., Parham, G., Simelela, P., & Moyo, S. (2022). Barriers to uptake of cervical cancer screening services in low-and-middle-income countries: a systematic review. *BMC Women's Health*, *22*(1). https://doi.org/10.1186/s12905-022-02043-y

Rademaker, C., Bhandary, S., & Harder, H. (2022). Knowledge, awareness, attitudes and screening practices towards breast and cervical cancer among women in Nepal: a scoping review. In *Journal of Public Health (Germany)* (Vol. 30, Number 8, pp. 1995–2027). Springer Science and Business Media Deutschland GmbH. https://doi.org/10.1007/s10389-021-01688-7

Robbers, G. M. L., Bennett, L. R., Spagnoletti, B. R. M., & Wilopo, S. A. (2021). Facilitators and barriers for the delivery and uptake of cervical cancer screening in Indonesia: a scoping review. In *Global Health Action* (Vol. 14, Number 1). Taylor and Francis Ltd. https://doi.org/10.1080/16549716.2021.1979280

Romli, R., Rahman, R. A., Chew, K. T., Hashim, S. M., Wati Mohamad, E. M., & Nawi, A. M. (2022). Empirical investigation of e-health intervention in cervical cancer screening: A systematic literature review. In *PLoS ONE* (Vol. 17, Number 8 August). Public Library of Science. https://doi.org/10.1371/journal.pone.0273375

Rosidina Putri, A., & Adyani, K. (2025). Faktor-Faktor Yang Berhubungan Dengan Perilaku Deteksi Dini Kanker Serviks: Literature Review. *Jurnal Ilmiah Bidan*, *9*(2). www.e-journal.ibi.or.id

Salehi, A. M., Shahbazi, F., Garavand, R., Kamkari, S., & Jenabi, E. (2025). Global socioeconomic inequalities in breast, cervical, ovarian, and uterine cancers incidence, mortality, disability-adjusted life year's rates: a relative concentration index analysis. *BMC Women's Health*, *25*(1). https://doi.org/10.1186/s12905-025-03961-3

Septiana, K. S., Adnani, Q. E. S., & Susiarno, H. (2025). Influence of nutrition education media on anaemia and its effect on improving anaemia knowledge among adolescent girls. *Malahayati International Journal of Nursing and Health Science*, *7*(12), 1481–1494. https://doi.org/10.33024/minh.v7i12.656

Septiana, K. S., Adnani, Q. E. S., Susiarno, H., Tarawan, V. M., Arya, I. F. D., & Anwar, R. (2025). The Influence of Anemia Education Media on Increasing Self-Awareness and Compliance in Consuming Iron Supplements in Adolescent Girls: A Systematic Review. *International Journal of Women's Health*, *17*, 2277–2289. https://doi.org/10.2147/IJWH.S532950

Seyfu, D. T., Abebe, S. N., Haile, S., & Ayana, B. A. (2024). Health related quality of life and its predictive factors on cervical cancer patients in two teaching hospitals, Addis Ababa, Ethiopia. *BMC Women's Health*, *24*(1). https://doi.org/10.1186/s12905-024-03046-7

Singh, D., Vignat, J., Lorenzoni, V., Eslahi, M., Ginsburg, O., Lauby-Secretan, B., Arbyn, M., Basu, P., Bray, F., & Vaccarella, S. (2023). Global estimates of incidence and mortality of cervical cancer in 2020: a baseline analysis of the WHO Global Cervical Cancer Elimination Initiative. *The Lancet Global Health*, *11*(2), e197–e206. https://doi.org/10.1016/S2214-109X(22)00501-0

Soares, L., & Dantas, S. A. (2024). Cervical Cancer and Quality of Life: Systematic Review. *Clinical Journal of Obstetrics and Gynecology*, *7*(1), 017–024. https://doi.org/10.29328/journal.cjog.1001158

Solso, L. R. , M. H. O. , & M. K. M. (2009). *Psikologi Kognitif*. Erlangga.

Stelzle, D., Tanaka, L. F., Lee, K. K., Ibrahim Khalil, A., Baussano, I., Shah, A. S. V., McAllister, D. A., Gottlieb, S. L., Klug, S. J., Winkler, A. S., Bray, F., Baggaley, R., Clifford, G. M., Broutet, N., & Dalal, S. (2021). Estimates of the global burden of cervical cancer associated with HIV. *The Lancet Global Health*, *9*(2), e161–e169. https://doi.org/10.1016/S2214-109X(20)30459-9

Stuopelytė, R., Žukienė, G., Breivienė, R., Rudaitis, V., & Bartkevičienė, D. (2023). Quality of Life in Cervical Cancer Survivors Treated with Concurrent Chemoradiotherapy. *Medicina (Lithuania)*, *59*(4). https://doi.org/10.3390/medicina59040777

Tang, Y., Diao, H., Jin, F., Pu, Y., & Wang, H. (2022). The effect of peer education based on adolescent health education on the resilience of children and adolescents: A cluster randomized controlled trial. *PLoS ONE*, *17*(2 February). https://doi.org/10.1371/journal.pone.0263012

Thiel de Bocanegra, H., Dehlendorf, C., Kuppermann, M., Vangala, S. S., & Moscicki, A. B. (2022). Impact of an educational tool on young women's knowledge of cervical cancer

screening recommendations. *Cancer Causes and Control*, *33*(6), 813–821. https://doi.org/10.1007/s10552-022-01569-8

Thompson, B., Barrington, W. E., Briant, K. J., Kupay, E., Carosso, E., Gonzalez, N. E., & Gonzalez, V. J. (2019). Educating Latinas about cervical cancer and HPV: a pilot randomized study. *Cancer Causes and Control*, *30*(4), 375–384. https://doi.org/10.1007/s10552-019-01150-w

Trisnowati, T., & Aseta, P. (2020). Pemanfaatan Booklet Edukasi Dalam Peningkatan Kesadaran Ibu Melakukan Deteksi Dini Kanker Serviks. *PROFESI (Profesional Islam): Media Publikasi Penelitian*, *18*(1).

Wardani, S. W., Resmana, R., & Mulyati, S. (2021). Efektivitas Buklet Edukasi Terhadap Perilaku Deteksi Dini Kanker Serviks. *Jurnal Riset Kesehatan Poltekkes Depkes Bandung*, *13*(2), 381–388. https://doi.org/10.34011/juriskesbdg.v13i2.879

World Cancer Research Fund International. (2022). *Cervical Cancer Statistics*. https://www.wcrf.org/preventing-cancer/cancer-statistics/cervical-cancer-statistics/

World Health Organization. (2021). *Guidelines for Screening and Treatment of Precancerous Lesions for Cervical Cancer Prevention*. World Health Organization.

World Health Organization, & International Agency For Research on Cancer. (2022). *Global Cancer Observatory Indonesia*.

World Health Organization (WHO). (2024, March 5). *Cervical cancer*. World Health Organization. https://www.who.int/news-room/fact-sheets/detail/cervical-cancer

Wu, J., Jin, Q., Zhang, Y., Ji, Y., Li, J., Liu, X., Duan, H., Feng, Z., Liu, Y., Zhang, Y., Lyu, Z., Yang, L., & Huang, Y. (2025). Global burden of cervical cancer: current estimates, temporal trend and future projections based on the GLOBOCAN 2022. *Journal of the National Cancer Center*, *5*(3), 322–329. https://doi.org/10.1016/j.jncc.2024.11.006

Yirsaw, A. N., Tefera, M., Bogale, E. K., Anagaw, T. F., Tiruneh, M. G., Fenta, E. T., Endeshaw, D., Adal, O., Tareke, A. A., Jemberu, L., Getachew, E., Belayneh, A. G., Andarge, G. A., Seid, K., & Lakew, G. (2024). Applying the Health Belief Model to cervical cancer screening uptake among women in Ethiopia: a systematic review and meta-analysis. *BMC Cancer*, *24*(1). https://doi.org/10.1186/s12885-024-13055-2

Zhang, M., Sit, J. W. H., Chan, D. N. S., Akingbade, O., & Chan, C. W. H. (2022). Educational Interventions to Promote Cervical Cancer Screening among Rural Populations: A Systematic Review. In *International Journal of Environmental Research and Public Health* (Vol. 19, Number 11). MDPI. https://doi.org/10.3390/ijerph19116874

Zhang, M., Sit, J. W. H., Choi, K. C., & Chan, C. W. H. (2023). A theory-driven, culture-tailored educational intervention for cervical cancer screening among rural Chinese females: A feasibility and pilot study. *Asia-Pacific Journal of Oncology Nursing*, *10*(6). https://doi.org/10.1016/j.apjon.2023.100218