The effect of an empowerment program on knowledge and cancer cervical screening participation among reproductive age women in Indonesia: A randomized clinical trial

Nofa Anggraini*, Susi Susanti, Rima Akhiri, Sisi Amelia, Dewi Cahyani

Sekolah Tinggi Ilmu Kesehatan Abdi Nusantara, Bekasi, Indonesia

Abstract

Background: Cervical cancer in Indonesia is the second leading cause of death and a significant health burden, largely due to low screening coverage. Indonesia faces challenges in developing women's health due to a lack of information, studies, weak relationship between research, management, planning, and service provision, and limited resources and expertise.
Purpose: This study aimed to examine the effect of an empowerment-based educational intervention on improving knowledge and participation in cervical cancer screening among women of reproductive age in Indonesia.
Methods: A randomized clinical trial was conducted in Jakarta, Indonesia, from February to July 2023, involving 150 eligible women. Participants were allocated to intervention or control groups using block randomization (block size = 4) with a 1:1 ratio. The intervention group received a three-week empowerment program consisting of six educational sessions. Outcomes, including cervical cancer knowledge and screening participation, were measured at baseline and eight weeks post-intervention. Data were analyzed using t-tests, chi-square tests, and linear regression. Risk ratios and differences were estimated using marginal standardization. Analyses followed the intention-to-treat principle, with blinding applied during data analysis.
Results:A randomized study with 80 participants showed an improvement in knowledge about cervical cancer and cancer cervical screening participation at 8 weeks. The intervention group showed a mean difference of 3.91 (1.38) and 4.24 (0.45) p<0.05. More participants in the intervention group reached Minimal Clinically Important Differences (MCIDs) in knowledge about cervical cancer and cancer cervical screening participation than in the control group, with a relative risk of 2.34 (95% CI=1.08-4.36) and 2.57 (95% CI=1.21-4.90), respectively.
Conclusion: An empowerment program significantly enhances knowledge and participation in cancer cervical screening among reproductive age women in Indonesia after intervention, but further studies are needed to determine its long-term impact.

Keywords: cancer cervical; empowerment; Indonesia; knowledge; screening participation

Introduction

Cervical cancer is the second biggest cause of death with 36,633 cases and a growing death rate in 2020 globally (WHO, 2020). The World Health Organization (WHO) estimates that 95% of cases are caused by Human Papillomavirus (HPV) (WHO, 2020). Nevertheless, the Ministry of Health (Ministry of Health of Republic of Indonesia, 2018) has identified insufficient screening coverage as a prominent contributing cause to the elevated prevalence of cervical cancer in Indonesia. As of 2021, only 9.32% of

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Corresponding author

Nofa Anggraini*
Sekolah Tinggi Ilmu Kesehatan Abdi Nusantara, Bekasi, Indonesia; Address: Jl. Swadaya No.7, RT.001/RW.014, Jatibening, Kec. Pd. Gede, Kota Bks, Jawa Barat 17412.; Phone: (021) 86901352; E-mail: nofaanggraini06@gmail.com

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women aged 30–50 years in Indonesia underwent Visual Inspection with Acetic Acid (VIA) screening, according to Ministry of Health reports (Ministry of Health of Republic of Indonesia, 2018). By 2023, cervical cancer screening coverage in Indonesia is projected to reach only 7.02%, significantly below the national target of 70%. Regular screening remains crucial for the early detection of precancerous lesions, timely intervention, improved survival rates, and better long-term clinical outcomes (NASEM, 2019).

Women's decisions about whether or not to participate in cervical cancer screening have been shown to be complex and multi-factorial. Tran et al. (2022) have identified several household-level factors that can influence the adoption of screening practices. These factors encompass both direct costs associated with diagnosis and treatment, such as out-of-pocket expenses, as well as indirect costs including transportation expenses and potential loss of pay during hospital visits. Furthermore, sociodemographic and cultural variables, with medical distrust and perceived vulnerability, advantages, and obstacles have been identified as influential determinants (Ibekwe et al., 2021; Vrinten et al., 2019). Conceptual models like the Health Belief Model (HBM) and the Ecological Systems Theory provide insight into the various levels of influence affecting cervical cancer screening behavior. The HBM centers on personal beliefs, including perceived risk, seriousness of the condition, expected benefits of screening, and perceived barriers, offering a lens through which individual health-related choices can be understood (Rosenstock, 1974). In contrast, the Ecological Model considers the interconnections across multiple levels ranging from personal and interpersonal relationships to community dynamics and broader societal systems which together influence health behavior (McLeroy et al., 1988). Ahmadian and Samah (2013) emotional and cognitive factors such as fear, misinformation, and low motivation often deter women from participating in screening programs. Yet, limiting analysis to these behavioral dimensions may overlook deeper social determinants. The Fundamental Cause Theory (FCT), introduced by Link and Phelan (1995), underscores the role of structural factors, such as income level, educational access, and social support in shaping both health outcomes and access to healthcare services. Applied to cervical cancer screening, this perspective implies that even when women are informed, those with fewer socioeconomic resources may still encounter barriers. Thus, while psychological models like the HBM are valuable in understanding readiness for action, incorporating structural frameworks like FCT enriches our understanding of the persistent inequalities in screening uptake. Combining both approaches is crucial for designing interventions that are both behaviorally effective and socially responsive.

Interventions targeting the enhancement of screening uptake represent a significant strategy for addressing multiple issues. Behavior change is a complex and multifaceted process, as demonstrated by an international consensus that identified 93 distinct Behavior Change Techniques (BCTs) as part of a standardized taxonomy for designing and reporting behavior change intervention (Michie et al., 2013). Active components found in behavior change interventions include a variety of tactics, such as financial incentives, threat perception, habit reversal, social support, knowledge development, imagining future outcomes, and goal-setting, among others. A growing body of randomized controlled trials (RCTs) has explored the effectiveness of interventions designed to increase participation in cervical cancer screening. These studies typically compare screening uptake between individuals who received targeted interventions and those provided with standard care (Mehta et al., 2020; Moscicki et al., 2021; Valdez et al., 2018). Across the literature, numerous strategies have been implemented to improve health literacy and reduce access barriers. Interventions commonly include automated screening reminders, personalized counseling delivered by lay health workers or trained professionals, culturally adapted educational materials (print or video), and, in some cases, financial incentives to motivate individuals to undergo screening (Mehta et al., 2020; Moscicki et al., 2021; Tanjasiri et al., 2019; Valdez et al., 2018). For instance, Mehta et al. (2020) reported a significant increase in screening completion among women who received community health worker-led home education visits compared to the control group. Similarly, Valdez et al. (2018) found that tailored video interventions in Spanish significantly improved screening intent among Latina women. However, Moscicki et al. (2021) highlighted that while informational interventions raised awareness, their impact on actual screening uptake was modest, indicating the need for more comprehensive approaches.

Despite these efforts, structural and sociocultural factors continue to constrain women's ability to engage with screening services. In particular, limited autonomy and restricted decision-making power within the household have been identified as persistent barriers in many low- and middle-income contexts. Women who lack control over financial resources or healthcare decisions are less likely to prioritize preventive care, even when interventions are available (Tanjasiri et al., 2019). These constraints highlight a critical gap in the existing literature, while many interventions focus on improving knowledge and access, few address the deeper social dynamics that shape women's health behaviors. Therefore, further research is needed to develop and evaluate interventions that not only inform but also empower women to act on that information within their social and familial contexts.

The enhancement of women's empowerment is a crucial and indispensable goal in the field of public health. Studies have suggested that women who

possess economic empowerment are capable of assuming a more proactive role in making decisions for their families, as well as gaining improved access to health and educational resources (Woods, 2008). Kabeer (1999, 2017) explains the concept of women's empowerment as a transformative process wherein individuals who have been deprived of the ability to make choices acquire this capability. This process encompasses interconnected and inseparable aspects, namely resources (pre-conditions), agency (process), and achievements (outcomes). Kabeer (2017) further underscores the notion that women play a significant role as integral and engaged participants in their own societies. Consequently, the empowerment of women possesses the potential to instigate transformative social progress in contexts where gender parity remains elusive. Empowerment models have demonstrated efficacy in facilitating the promotion of women's health and enhancing their overall quality of life (Ghanbari et al., 2017). Alhani (2004) proposed an innovative empowerment paradigm aimed at enhancing health promotion and illness prevention. The aforementioned approach has been employed in several studies to enhance the overall well-being of individuals suffering from chronic illnesses such as iron deficiency anaemia (Roshan et al., 2014), myocardial infarction (Vahedian-Azimi et al., 2015), diabetes (Sadeghi et al., 2013), and asthma (Rajabi et al., 2013). The primary aim of this model is to facilitate individuals in developing an in-depth awareness of health promotion. It encompasses four key elements, including the perception of health threats, problem-solving, educational engagement, and evaluation (Alhani, 2004).

The expansion of women's health services in Indonesia continues to face significant challenges, including limited data on the specific health needs of women, a shortage of relevant and contextualized research, weak integration between research, policy, program implementation, and service delivery, as well as constrained resources and workforce capacity (Ministry of Health, 2018; Titaley et al., 2020). Despite the growing burden of cancer among women, few studies have focused on empowerment-based interventions tailored to cancer survivors in Indonesia. To the best of the authors' knowledge, this study is among the first to explore the implementation of an empowerment program specifically for female cancer survivors, thereby offering a novel contribution to women's health research and survivorship care in the Indonesian context (Eyanoer et al., 2020). This study was conducted to assess the impact of an empowerment program on both the level of knowledge and the participation rate of women in Indonesia for cervical cancer screening.

Materials and Methods

Study design

This randomized clinical trial was conducted at a Community Health Center in Jakarta, Indonesia, with 150 eligible women from February to July 2023. The study followed both the original Consolidated Standards of Reporting Trials (CONSORT) guideline proposed by Moher et al. (2010) and the CONSORT Extension guideline proposed by Eysenbach and Group (2011) (Figure 1).

Sample

Participants in this study were Indonesian women who met the following inclusion criteria: aged 18 years or older, married, not currently pregnant or breastfeeding, free from any clinically diagnosed chronic illnesses or psychological disorders, and able to read and write. Women were excluded if they had previously participated in a similar educational program or were unable to attend two or more consecutive intervention sessions, as the empowerment-based approach required sequential and continuous participation to ensure conceptual understanding and progression. A consecutive sampling technique was employed to recruit eligible participants from community health centers in Jakarta. This method was chosen due to its practicality in identifying and enrolling participants who met the study criteria within a defined time frame and location.

The G*Power analysis software version 3.1 was used to determine the appropriate sample size for this study. To assess whether the educational intervention would produce a statistically significant effect, the sample size calculation was based on a 95% confidence interval, an 80% power (1–β), and a medium effect size threshold of d = 0.3, as reported in a previous study by Tanjasiri et al. (2019). Based on this analysis, a minimum of 30 participants per group was required. To accommodate a potential dropout rate of 10%, the sample size was increased to 40 participants in each group.

Randomization

The researchers gained written approval from the Ethics Committee of Sekolah Tinggi Ilmu Keperawatan Abdi Nusantara, with the assigned code ETIK/134/2023. After the completion of the sampling process, the research objectives were explained to participants throughout two distinct sessions. Following that, the participants were asked to complete the demographic information questionnaires that corresponded to their personal details. In advance of conducting baseline assessments, informed consent was acquired electronically via the use of an online form. Subjects meeting the specified inclusion and exclusion criteria were subsequently chosen for participation. Participants who met the eligibility criteria and provided informed consent were randomly assigned to either the intervention or control group using a block randomization method. This approach was selected to ensure that group sizes remained balanced throughout the enrollment period, thereby minimizing potential allocation bias. A fixed block

Table 1. Intervention protocol

Session	Empowerment Phase	Topic/Material	Activities	Format
1	Risk Awareness	Understanding cervical cancer: risk factors, signs, and severity	Lecture, group discussion	Group (10–15)
2	Risk Awareness	Screening methods (IVA, Pap smear), national recommendations	Video, Q&A, myth-busting exercise	Group
3	Problem Solving	Identifying barriers to screening; hypothetical scenarios	Problem-solving simulation, paired activity	Group
4	Problem Solving	Building decision-making skills; managing health priorities	Case studies, reflection, role-play	Group
5	Educational Engagement	Health-promoting behaviors & their benefits	Interactive game, behavior mapping, personal action plan	Group
6	Outcome Evaluation	Evaluating understanding and intention to undergo screening	Quiz, recap discussion, booklet distribution	Group

Table 2. Demographic comparison between intervention and control group (n=80)

Variables	Intervention group n=40 (%)	Control group n=40 (%)	p-value
Age, years, Mean ± SD	27.67 ± 3.41	26.13 ± 3.22	0.455a
Education Attainment			0.732b
Primary school	19 (47.5)	15 (37.5)	
Secondary school	15 (37.5)	19 (47.5)	
Higher than secondary school	6 (15.0)	6 (15.0)	
Employment status			0.216b
Yes	11 (27.5)	16 (40.0)	
No	29 (72.5)	24 (60.0)	
Having national health insurance			0.376b
Yes	19 (47.5)	23 (57.5)	
No	21 (52.5)	17 (42.5)	

Note: a p-value obtained from t test, b p-value obtained from Chi Square test.

Table 3. Change within groups and difference in change between groups

Variable	Group	Baseline, mean (SD)	At 8-weeks, mean (SD)	Change within groups a, mean (SD)	p-value
Knowledge in cervical cancer	Intervention group	9.65 (2.76)	13.56 (3.56)	3.91 (1.38)	0.003
	Control group	8.35 (3.09)	10.24 (3.44)	1.89 (1.22)	0.076
	Difference in change between groups b, Mean difference (95% CI)			2.02 (1.04 to 3.59)	0.001
Cervical cancer screening participation	Intervention group	4.65 (1.22)	8.89 (1.33)	4.24 (0.45)	0.001
	Control group	5.35 (1.34)	5.87 (2.14)	0.52 (0.32)	0.882
	Difference in change between groups b, Mean difference (95% CI)			3.8 (0.43 to 3.76)	0.001

Note: a: posttest-pretest; b: pretest to post test. Within groups, positive change indicates improvement. Positive group change differences favour the intervention.

Table 4. Percentage of participants achieving minimal clinically important improvements

Improvement, units	Inter-vention	Control	Relative risk (95% CI) a	p-value	Risk difference (95% CI) b	p-value
Overall knowledge, ≥3.0	76.4	32.4	2.34 (1.08-4.36)	0.001	0.45 (0.13-0.75)	0.001
Overall participation, ≥2.2	70.3	27.4	2.57 (1.21-4.90)	0.001	0.57 (0.11-0.91)	0.001

Note: a: Relative risk of >1 favors the intervention; b Risk difference of >0 favors the intervention.

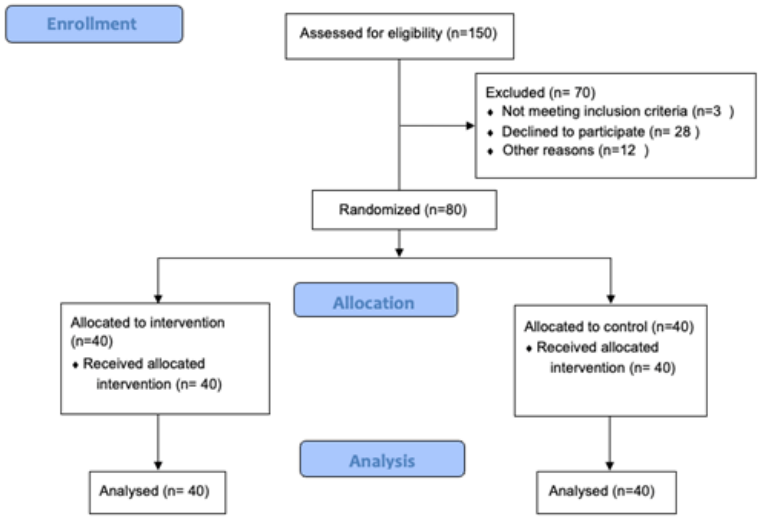

Figure 1. CONSORT Flow Diagram

size of four was used in conjunction with a 1:1 allocation ratio, meaning that for every block, two participants were assigned to the intervention group and two to the control group in a randomized order. The randomization sequence was generated using an online randomization tool (https://www.randomization.com), which produced a pre-specified allocation list. To maintain allocation concealment, the sequence was prepared in advance by an independent researcher not involved in participant recruitment or data collection. Upon enrollment, each participant was assigned to their group in accordance with the predetermined sequence, thereby preserving the methodological rigor and internal validity of the study.

To ensure allocation concealment, opaque envelopes were prepared for all participants. Each envelope contained a sealed card with the randomly generated allocation sequence. At the beginning of the participant registration process, each individual received an envelope containing the instructions for their assigned group. Allocation concealment was managed by two neutral staff members who were not involved in the sampling process.

Blinding

This study employed a single-blind design. Although it was not feasible to blind participants or intervention facilitators due to the nature of the educational program, measures were taken to minimize bias. Specifically, the individuals responsible for collecting post-intervention outcome data were not informed of participants' group allocations, helping to maintain objectivity during assessment. In addition, statistical analysis was conducted by an independent analyst who was not involved in the intervention delivery and remained blinded to group assignments throughout the analysis phase.

Measures

In this study, outcome data were collected at two time points: the first measurement was conducted at week 0 (prior to the intervention), and the second was carried out at week 11, which corresponds to eight weeks after the completion of the three-week intervention. The data gathering instrument utilized in this study was a questionnaire. The majority of the items utilized in this study were derived from the works of Ebu et al. (2014) and Walton et al. (2014), supplemented by a limited number of newly produced items informed by the existing body of literature.

Knowledge of cervical cancer was measured using a 15-item questionnaire adapted from

the Indonesian version of the Cervical Cancer Awareness Measure (Cervical CAM), originally developed by Della Devara et al. (2020). This tool evaluates participants' understanding of cervical cancer across four domains: general definition, risk factors, symptoms and signs, and screening methods. Each item offers a "Yes" or "No" response, with correct answers scored as 1 and incorrect as 0. Individual scores range from 0 to 15, with higher totals indicating greater knowledge. The adapted questionnaire underwent psychometric evaluation to ensure its appropriateness in the Indonesian context. Content validity was established through review by three experts in maternal and reproductive health, resulting in a scale-level CVI (S-CVI) of 0.92, which indicates excellent agreement. Construct validity was supported by exploratory factor analysis, with a Kaiser–Meyer–Olkin (KMO) value of 0.78 and Bartlett's test of sphericity reaching statistical significance ($p < .001$). Factor loadings ranged from 0.52 to 0.81, confirming acceptable structural validity. Reliability testing demonstrated strong internal consistency, with a Cronbach's α of .84, indicating that the instrument was reliable for measuring cervical cancer knowledge among Indonesian women.

The objective of this study was to assess the level of participation in cervical cancer screening (CCS) among the target population. Participants were presented with a series of ten statements designed to explore their motivations and attitudes toward cervical cancer screening. They were asked to indicate whether they agreed or disagreed with each statement. Individuals who had previously undergone screening were also asked about their willingness to participate in future screening, while those with no prior screening history were queried about their openness to undergoing screening for the first time. Responses were binary, with participants selecting either "yes" or "no" for each item. A higher cumulative score reflected a greater degree of engagement in cervical cancer screening, with the composite score calculated by summing the total number of affirmative responses.

Content validity of the instrument was confirmed through expert panel review by three specialists in oncology nursing and reproductive health, yielding a scale-level CVI (S-CVI) of 0.91, which indicates excellent agreement. Construct validity was supported by exploratory factor analysis, which produced a Kaiser–Meyer–Olkin (KMO) value of 0.76 and a significant Bartlett's test of sphericity ($p < .001$), confirming sampling adequacy and factorability of the data. Factor loadings ranged from 0.48 to 0.79 across the ten items, indicating acceptable structural validity. The instrument also demonstrated good internal consistency, with a Cronbach's α of .80, reflecting acceptable reliability for use in this study.

Data were collected on various socio-demographic parameters to evaluate the participants' characteristics, including age, marital status, health insurance coverage, educational attainment, and employment status (see Table 1).

Intervention

To design the intervention, the research team utilized an empowerment-based approach rooted in a thorough understanding of the participants' educational needs. Before launching the intervention, an initial assessment was conducted to explore the women's current knowledge, misconceptions, barriers to screening, and preferred learning formats. This preliminary phase ensured that the educational content was tailored to the participants' specific context. Reference materials were sourced from established health authorities, including the World Health Organization and the Ministry of Health of Indonesia, to ensure accuracy and cultural relevance. Insights from prior studies emphasizing empowerment strategies in women's health promotion, such as Noori et al. (2021), also informed the conceptual and structural framework of the intervention. Following content development, several professionals with expertise in oncology, health education, and public health reviewed and validated the learning materials for clarity, relevance, and educational value.

Prior to the full trial, the intervention was pilot-tested with 15 women from a different community health center to examine feasibility, clarity of materials, and appropriateness of session length. Feedback from this pilot led to minor revisions in language simplification and the addition of more visual aids. The final version of the intervention was reviewed and validated by a panel of three professionals in oncology, reproductive health, and health education to ensure content accuracy, cultural relevance, and educational value. While the study was not formally registered as a clinical trial, the intervention protocol was documented and reviewed by the institutional ethics committee, aligning with local requirements for health education programs.

The intervention itself was implemented over a span of three weeks, consisting of six sessions delivered twice weekly. Each session lasted approximately one hour and was held at accessible community health centers during regular operational hours. The sessions were conducted in small groups of 10 to 15 participants, led by qualified health educators or nurses with experience in women's reproductive health. A group setting was intentionally selected to encourage collaborative discussion, enhance motivation through peer interaction, and build a sense of collective learning. The session themes aligned with the four key elements of the empowerment model: understanding health risks, applying problem-solving techniques, participating in interactive education, and reflecting on learning outcomes. Educational strategies used throughout the sessions included participatory lectures, open discussions, simulated scenarios, role-play exercises, and distribution of printed information booklets (Table 1).

During the first week, the focus was on raising awareness about cervical cancer, including risk factors, signs, and the significance of early screening. These discussions also addressed common misconceptions and provided clear explanations about screening techniques like IVA and Pap smears. The second week shifted toward developing practical problem-solving abilities. Women engaged in scenario-based discussions that mimicked real-life challenges in accessing screening services, and were encouraged to propose feasible solutions. These exercises were designed to strengthen self-confidence and decision-making skills. In the third week, participants explored ways to adopt healthier behaviors and created individualized action plans for maintaining their health. The final session served as a wrap-up, allowing for a review of key concepts, clarification of remaining questions, and reflection on personal intentions related to screening practices. Educational materials were compiled and shared with participants in printed form at the end of the program for future reference.

Participants assigned to the control group continued to receive standard care as provided in the community health centers. Standard care in this context consisted of routine maternal and child health services, occasional general health education sessions provided by local health cadres, and access to existing informational leaflets on women's health topics (e.g., maternal nutrition, child immunization, and hygiene practices). Importantly, no structured or empowerment-based cervical cancer education sessions were delivered to the control group during the study period. This ensured that differences observed between groups could be attributed to the empowerment-based intervention.

Data collection was carried out at two points during the study. The first round, or pre-test, was administered before the start of the intervention using a structured questionnaire to assess baseline indicators. The second round, or post-test, was conducted eight weeks after the final session, providing adequate time for participants to absorb the material and potentially apply what they had learned. Both groups, intervention and control completed the same instruments at both stages. While the control group had no contact with the research team, women in the intervention group received supportive follow-up calls twice a week throughout the three-week period to clarify concepts and address any concerns. After the study concluded, all individuals in the intervention group received printed copies of the educational content to support long-term learning.

Ethical consideration

Prior to conducting the baseline evaluations, informed consent was obtained digitally via an online form. We successfully secured approval from the Ethics Committee of Sekolah Tinggi Ilmu Keperawatan Abdi Nusantara, with approval code ETIK/134/2023. Participants were provided with their results upon request, and strict adherence to anonymity and confidentiality standards was maintained throughout the process.

Data analysis

Differences in baseline characteristics between groups were analyzed using independent t-tests for numerical data and chi-square tests for categorical variables. To analyze the change in outcomes within the intervention group from before to after the intervention, a paired t-test was selected. This statistical method is appropriate when comparing measurements taken from the same participants at two different time points. When comparing the differences between the intervention and control groups at either the baseline or the follow-up stage, independent t-tests were applied, provided that the data met the assumptions of normal distribution and equal variance. The use of both t-test approaches was based on the structure of the dataset: paired testing for intra-group comparisons and independent testing for inter-group differences. To further explore the impact of the intervention while adjusting for potential confounders, such as initial knowledge scores, linear regression modeling was used. This method is appropriate for analyzing continuous outcomes when the data meet the necessary assumptions, particularly normal distribution of residuals. The Kolmogorov–Smirnov test indicated that the distribution of the main study variables did not significantly deviate from normality ($p > .05$ for all variables). Visual inspection of Q–Q plots confirmed that data points closely followed the diagonal line, supporting the assumption of normality. Residual-versus-fitted value plots showed no evidence of heteroscedasticity, and residuals appeared randomly scattered, confirming the assumption of constant variance. In addition, residuals were independent across observations, fulfilling the assumption of independence. Collectively, these diagnostics confirmed that the assumptions of normality, linearity, homoscedasticity, and independence were adequately met. It should be noted that linear regression was not intended to compare groups directly, but rather to evaluate adjusted changes over time within the intervention group. By incorporating baseline scores into the model, the analysis accounted for individual variability at the start of the study. This approach allowed for a more precise understanding of the intervention's effect. Linear regression also provides flexibility in controlling for additional variables, such as age, education, and other demographic characteristics that might influence the results.

The analysis followed the intention-to-treat (ITT) approach, ensuring that all participants who were initially randomized were included, regardless of their level of participation. In addressing missing data at the eight-week follow-up, the study employed multiple imputation techniques. The imputation procedure incorporated baseline measures, follow-up outcomes, and participant demographics to

estimate missing values, thus helping to minimize bias and preserve statistical power. Both analyses using imputed datasets and those limited to complete cases were conducted to confirm the reliability of the results. All statistical procedures were performed using SPSS version 26. The significance level was set at $p < .05$ for all two-sided tests.

Results

Study participants

Out of 150 individuals who met the eligibility criteria for this study, 80 participants agreed to enroll and completed the baseline assessment, resulting in a recruitment rate of 53.3%. The reduction in sample size from eligibility to enrollment was primarily due to eligible individuals declining to participate after being informed about the study procedures. Common reasons for refusal included lack of time, disinterest, or concerns related to follow-up commitments. These 80 participants were then randomly assigned into two equal groups: 40 individuals in the intervention group and 40 in the control group. Out of the 40 individuals allocated to the intervention group, all participants attended at least 5 of the 6 scheduled sessions, and 37 participants (92.5%) completed the full six-session program. Three participants missed one session each due to family or work commitments but continued in subsequent sessions and were retained for follow-up assessments. Importantly, all 40 participants in the intervention group completed the pre-test and post-test assessments, ensuring that their data were included in the final analysis. No participants withdrew from the study, and there was no attrition in either the intervention or control group (Figure 1).

Table 2 outlines the demographic profiles of participants across the intervention and control groups. The average age of individuals in the intervention group was 27.67 years (SD = 3.41), while those in the control group had a mean age of 26.13 years (SD = 3.22). Baseline demographic characteristics, including age, education, employment status, and health insurance coverage, were comparable between the intervention and control groups. None of the identified variables differed significantly ($p > .05$), confirming that randomization produced well-balanced groups at baseline (Table 1). These findings confirm that baseline demographic characteristics were well balanced between groups, supporting the validity of the randomization process.

Table 3 presents the within-group and between-group comparisons of changes in cervical cancer knowledge and screening participation over an eight-week period. In the intervention group, the mean knowledge score significantly increased from 9.65 (SD = 2.76) at baseline to 13.56 (SD = 3.56) at eight weeks, reflecting a mean improvement of 3.91 points ($p = 0.003$). In contrast, the control group showed a smaller, non-significant increase in knowledge, from 8.35 (SD = 3.09) to 10.24 (SD = 3.44), with a mean change of 1.89 points ($p = 0.076$). When comparing the change between the two groups, the intervention group demonstrated a significantly greater improvement, with a mean difference of 2.02 points (95% CI: 1.04 to 3.59; $p = 0.001$), favoring the effectiveness of the educational intervention.

For cervical cancer screening participation, the intervention group also experienced a notable increase, with mean scores rising from 4.65 (SD = 1.22) at baseline to 8.89 (SD = 1.33) post-intervention, indicating a significant gain of 4.24 points ($p = 0.001$). The control group, however, exhibited a minimal change, increasing from 5.35 (SD = 1.34) to 5.87 (SD = 2.14), with a non-significant improvement of 0.52 points ($p = 0.882$). The difference in change between the groups was statistically significant, with a mean difference of 3.8 points (95% CI: 0.43 to 3.76; $p = 0.001$), again supporting the effectiveness of the intervention in promoting screening participation (Table 3).

Table 4 further supports these findings by presenting the percentage of participants who achieved clinically meaningful improvements. Among those in the intervention group, 76.4% experienced a knowledge improvement of at least 3.0 points, compared to only 32.4% in the control group. This corresponds to a relative risk of 2.34 (95% CI: 1.08 to 4.36; $p = 0.001$) and a risk difference of 0.45 (95% CI: 0.13 to 0.75; $p = 0.001$), indicating that participants in the intervention group were more than twice as likely to experience a meaningful improvement in knowledge. Regarding screening participation, 70.3% of the intervention group achieved an increase of 2.2 points or more, versus 27.4% in the control group. This yielded a relative risk of 2.57 (95% CI: 1.21 to 4.90; $p = 0.001$) and a risk difference of 0.57 (95% CI: 0.11 to 0.91; $p = 0.001$), further emphasizing the positive impact of the intervention (Table 4).

Discussion

The objective of this study was to examine the impact of an empowerment program on the knowledge and participation in cervical cancer screening among women of reproductive age in Indonesia. The results indicated that the empowerment program had a significant positive effect on various health-promoting behaviors, enhancing both the knowledge and involvement of women in cervical cancer screening. According to Brandstetter et al. (2015), in a systematic review, revealed that only a limited number of studies had focused on empowerment strategies for fostering healthy behaviors, particularly regarding diet. In line with this, our study demonstrates that empowerment-based interventions can also be effective in the context of cancer prevention services, specifically by enhancing women's understanding and increasing their participation in cervical cancer screening as a secondary prevention strategy. According to a recent

study conducted by Noori et al. (2021), it has been claimed that treatments rooted in the empowerment model might effectively enhance health-promoting behaviors. These findings align with the outcomes observed in the current study. According to Pender (WHO, 2021), health-promoting behaviors can be described as voluntary daily activities that are impacted by various demographic, environmental, and social factors, and have a significant impact on an individual's health status. Hence, research employing passive teaching approaches such as lectures and question-and-answer sessions proved ineffective in eliciting behavioral modifications. Based on the findings of this study, it is imperative to involve individuals in the process of devising strategies for adopting novel health behaviors, thereby fostering active engagement and ultimately facilitating behavioral modifications (Safabakhsh et al., 2016).

The present study adopted an empowerment-based educational approach aimed at enhancing participants' self-efficacy, with the ultimate goal of increasing their knowledge and participation in cervical cancer screening. Participants provided feedback throughout the evaluation phase, contributing to the continuous refinement of the intervention. The development of the health education program was informed by an assessment of the participants' specific health needs, allowing the intervention to be tailored accordingly. This personalized approach helped to optimize the use of participants' time and energy, encouraged a sense of involvement, and improved both engagement and self-confidence in the learning process (Ghanbari et al., 2017). As participants gain accurate knowledge and practical strategies through structured education, their confidence in managing their health and making informed decisions improves. This growing sense of capability empowers individuals to overcome psychological barriers such as fear, doubt, or perceived helplessness, which often deter screening participation. Increased self-efficacy, therefore, facilitates a transition from intention to action, promoting higher rates of screening adherence (Rajabi et al., 2013). Furthermore, the empowerment model emphasizes active participation and shared decision-making, which reinforces autonomy and perceived control; two essential components in enhancing self-efficacy. When women feel capable and supported in their decision to undergo cervical cancer screening, they are more likely to translate awareness into sustained health-promoting behaviors. Thus, the link between self-efficacy and screening participation lies in the empowerment of individuals to believe in their ability to engage with preventive health services confidently and consistently.

Empowerment is a healthcare intervention utilized by midwives and nurses that is rooted on the actual expectations of both the participants themselves and others around them. The idea under consideration is one that is characterized by a positive outlook, since it takes into account the strengths and capabilities of participants, as well as their surrounding environment, in order to identify problems and areas of improvement. Subsequently, appropriate interventions are implemented to address these identified issues. Empowerment is a dynamic process that facilitates the transfer of power from one individual to another or across groups through the enhancement and fortification of individual capacities (Borghei et al., 2016). Hence, the findings of this study indicate that treatments targeting the empowerment of female workers provide discernible good outcomes in terms of women's engagement in health-promoting behaviors. Furthermore, the intervention employed in this study holds potential for empowering individuals who are susceptible to vulnerability.

Strengths and Limitations

There exist multiple strengths associated with academic studies. The implementation of a rigorous randomized clinical trial methodology, which integrates dependable and credible measures of outcomes, as well as a high level of participant retention, contributes to enhancing the internal validity of the research. To enhance the generalizability of the study, it is important to establish inclusive eligibility criteria and recruit participants from Jakarta, the capital city of Indonesia. Jakarta is known for its culturally diverse and complex population.

This study is subject to several noteworthy limitations. To begin with, while the participants primarily came from backgrounds with limited formal education, the construct of self-efficacy was not directly measured using a standardized assessment tool. As such, any assumptions about participants' confidence or motivation to engage in health-promoting behaviors should be interpreted cautiously. Without validated data, conclusions regarding self-efficacy remain speculative. Future research would benefit from incorporating established instruments to assess this important psychological factor. Another limitation concerns the use of self-administered questionnaires to evaluate both knowledge and reported behavior. This method carries an inherent risk of bias, particularly related to social desirability and recall inaccuracies. It is possible that participants, especially after receiving an intervention, may have overestimated their understanding or their likelihood of following through with screening. Additionally, the follow-up period of eight weeks may be insufficient to gauge whether the observed changes are sustained over time. Longer-term follow-up is essential to determine the durability of the intervention's effects. Selection bias also presents a potential concern. Individuals who chose to participate may have been more engaged with their health or more motivated than those who declined, thereby limiting the extent to which these findings can be generalized. Moreover, the study did not account for a number of potentially influential

factors, such as existing health knowledge, cultural attitudes toward cancer, prior experiences with the healthcare system, or structural barriers like financial costs and transportation access that could have shaped participants' screening behaviors independently of the intervention. Given these considerations, the findings should be applied with caution beyond the immediate study sample. Future investigations should strive to address these limitations by including broader, more heterogeneous populations and by systematically evaluating additional psychosocial and contextual variables that may impact outcomes.

Nursing implication

The findings of this study demonstrate that structured empowerment programs can effectively enhance knowledge and screening participation for cervical cancer among Indonesian women of reproductive age. These results reinforce the pivotal role of nurses as health educators, advocates, and facilitators of behavior change in community-based settings. By integrating empowerment-based strategies into routine nursing practice, nurses can optimize women's understanding of cervical cancer risks, address misconceptions, and actively encourage participation in screening programs. Furthermore, the group-based and participatory learning methods used in this study illustrate how nursing interventions can be designed to foster engagement, confidence, and self-determination, thereby contributing to sustainable health-promoting behaviors. At the knowledge level, this study expands the evidence base supporting empowerment as a theoretical and practical framework within nursing. At the practice level, it provides actionable insights for implementing nurse-led educational interventions in primary health care and community health centers. Taken together, the findings underscore that empowerment-focused approaches can serve as an effective, culturally relevant nursing strategy for strengthening women's preventive health behaviors, particularly in resource-limited contexts.

Conclusion

The findings of this study demonstrate that structured empowerment programs can effectively enhance knowledge and screening participation for cervical cancer among Indonesian women of reproductive age. While the findings of this study highlight the positive impact of an empowerment-based educational program on women's knowledge and participation in cervical cancer screening, several constraints experienced by participants warrant further exploration. Many of the women involved in the intervention faced challenges such as limited access to healthcare facilities, low baseline awareness about cervical cancer, fear or stigma surrounding screening procedures, and competing responsibilities such as childcare or work obligations that limited their availability to attend sessions. In some cases, cultural norms and misconceptions about cervical health also acted as barriers to participation. These factors may have affected not only engagement with the program but also follow-through with actual screening behavior. Future research should investigate strategies to overcome these barriers, such as incorporating community-based outreach, flexible scheduling, and involvement of family or peer support to enhance accessibility and sustainability of participation. Additionally, longer-term studies are needed to determine whether behavioral changes can be maintained once these constraints are addressed more systematically.

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Authors' contributions

NA: Contribute to the conception design of the work, the acquisition, analysis and interpretation of data, have drafted the work or substantively revised it;SS, RA, SA, DC: Contribute the acquisition, analysis and interpretation of data, have drafted the work or substantively revised it; All authors have read and approved the manuscript.

Availability of data and materials

The data that support the findings of this study are available from [NA] but restrictions apply to the availability of this data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of [NA].

Declaration

Ethics approval and consent to participate

Digital informed consent was obtained using an online form prior to baseline assessments. The written approval of the Ethics Committee of Sekolah Tinggi Ilmu Keperawatan Abdi Nusantara was obtained (code: ETIK/134/2023). The principles of anonymity and confidentiality were applied and the participants were provided with the results upon their request.

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Conflicts of interest

There are no conflicts of interest.

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