

Enhancing Human Papillomavirus Vaccine's Knowledge and Perception Among Rural Mothers: An Educational Intervention Based on the Health Belief Model

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Abstract

Background: Human papillomavirus remains a significant concern for public health, specifically in rural areas where there is limited knowledge and low levels of vaccination. Misconceptions and a lack of knowledge persist in rural areas regarding the effectiveness of the human papillomavirus vaccine in preventing cervical cancer and other related illnesses. **Aim:** Enhancing human papillomavirus vaccine's knowledge and perception among rural mothers: an educational intervention based on the health belief model. **Design:** This study utilized a quasi-experimental research design. **Settings:** This study was conducted at the Maternal and Child Health Care Center, Qibly and Bahari at Shebin El-Kom. **Sample:** The study used a purposive sampling method to recruit 200 rural mothers. **Instruments** utilized for data collection included a structured self-administered questionnaire and the Champion Health Beliefs Model scale for human papillomavirus infection and vaccination. **Results:** The findings showed that 70.0% of rural women had a fair level of knowledge about human papillomavirus vaccination before the intervention, compared to 90.0% who had a high level of knowledge after the intervention. Additionally, the research indicates that 80.0% of the women initially had a negative perception in human papillomavirus vaccination, while 90.0% had a positive belief following the intervention. **Conclusion:** Rural mothers showed greater knowledge scores and positive perception about human papillomavirus vaccination after engaging in the health belief model-focused on an educational intervention than before. **Recommendation:** Educational campaigns and endorsements from healthcare providers are essential for increasing vaccination rates concerning Human Papillomavirus.

Keywords: Educational intervention, Health belief model, Human papillomavirus vaccination, Knowledge and perception of rural mothers.

Introduction

Human Papillomavirus (HPV) is a group of viruses that infect the skin and mucous membranes, with over 200 identified types. These are classified into low-risk and high-risk types depending on their potential to cause cancer. Approximately 40 types can infect the genital area. High-risk types, such as HPV-16 and HPV-18, are strongly associated with several cancers, particularly cervical cancer, where nearly all cases are linked to high-risk HPV types. HPV can also contribute to other anogenital cancers (vulva, vagina, penis, anus) and oropharyngeal cancers (throat, tonsils, and base of the tongue) (World Health Organization (WHO), 2023).

Low-risk types, such as HPV-6 and HPV-11, are primarily associated with genital warts and respiratory papillomatosis, which involves the growth of warts in the throat. Although individuals who have not been vaccinated remain at significant risk of

developing these conditions, HPV vaccination has proven to be a highly effective primary prevention method in many countries, significantly reducing the incidence of cervical and other HPV-related cancers (Sung et al., 2021).

The goal of the HPV vaccine is to prevent certain strains of human papillomavirus that may cause cervical cancer, other cancers, and genital warts. The usual recommendation is for preteens (both boys and girls) to receive the vaccine at around 11 or 12 years old, although it can be administered as early as 9 and as late as 45. The HPV vaccine can stop almost all cases of cervical precancers, and genital warts caused by HPV types 16 and 18, which account for around 70% of cervical cancer cases (Ferrer et al., 2022).

Numerous countries have introduced nationwide HPV immunization initiatives, usually focusing on preadolescents. These programs have resulted in substantial decreases in HPV infections and associated illnesses.

Additionally, in certain areas, vaccination programs implemented in schools have proven to be highly effective in achieving high rates of vaccination coverage. For individuals who missed the first opportunity to get vaccinated, there are catch-up vaccination programs available for those up to age 26 or, in certain situations, up to age 45. The World Health Organization (WHO) has supported worldwide efforts to boost HPV vaccination rates, especially in nations with lower incomes where cervical cancer rates are highest (WHO, 2023).

The widespread use of the HPV vaccine has the potential to save millions of lives globally, making it a major step forward in preventing cancer and other HPV-related diseases. In nations with widespread vaccination, there has been a significant decrease in the number of HPV infections among those who have been vaccinated. Furthermore, there have been notable decreases in cervical pre-cancers (CIN2 and CIN3), which are early stages of cervical cancer. At the same time, there has been a significant decrease in the occurrence of genital warts in vaccinated groups, especially in the younger population. Additionally, herd immunity is enhanced by high vaccination rates, indirectly safeguarding unvaccinated people by reducing HPV spread. Moreover, the vaccine has demonstrated cost-effectiveness by decreasing healthcare expenses linked to treating HPV-related illnesses (Tobaqy & MacLure, 2024).

Regular screening is essential for the early detection and prevention of cervical cancer, which is often symptomless in its initial phases. However, obstacles to screening include limited knowledge of health, discomfort with exposing the body to healthcare providers, and the belief that screening is not necessary without symptoms. Additionally, lack of healthcare accessibility and ineffective communication are factors that contribute to low rates of screening (Wong et al., 2021).

The Health Belief Model (HBM) is a commonly employed theoretical framework in researching health behaviors. It suggests that a person's health habits are impacted by how likely they think they are to get a certain illness, how serious the disease is, the pros and cons of prevention methods, and external stimuli prompting action. Engaging in interventions

based on the HBM can address gaps in knowledge, rectify misconceptions, and positively impact attitudes and beliefs about HPV in women (Ampofo et al., 2022).

Nurses have a vital role in the prevention of cervical cancer. They play a crucial role in healthcare by providing health education and promoting wellness. Nurses have the duty of informing women about risk factors, detecting early symptoms of cervical cancer and HPV, and promoting routine cervical cancer screenings (Maver & Poljak, 2022).

Significance of the study

As indicated by references, in Egypt, cervical cancer ranks as the 14th leading cause of female cancers in all ages, and the 11th most common female cancer in women aged 15 to 44 years with an estimated age-standardized incidence rate of 2.3 per 100,000 individuals per year (Sharma et al., 2020). Recent estimates showed that 33.2 million women were at risk for cervical cancer in Egypt, with an annual incidence of 1320 cases, in 2020 (Bruni et al., 2021). Cervical cancer is also the 12th leading cause of cancer deaths in women aged 15 to 44 years in Egypt, with an age-standardized mortality rate of 1.5 per 100,000 individuals per year (Arbyn et al., 2020).

Educational interventions play a crucial role in enhancing women's knowledge about the Human Papillomavirus and the importance of vaccination, especially in rural areas where healthcare information and resources may be limited. Rural mothers often face barriers such as lower health literacy, limited access to healthcare facilities, and fewer educational resources with the rising incidence of HPV-related cancers, educating mothers about the benefits and importance of the HPV vaccine can significantly improve vaccine uptake in rural areas (Arbynet et al., 2020). Additionally, this study utilizes the Health Belief Model to modify rural mothers' perception about the HPV vaccine, potentially leading to higher vaccination rates and improved health outcomes.

The aim of the study

The aim of this study was to enhance human papillomavirus vaccine's knowledge and perception among rural mothers: an educational intervention based on the health belief model.

Research Hypotheses:

- **Null Hypothesis (H0):** There will be no significant difference in the knowledge and perception about the Human Papillomavirus vaccine among rural mothers before and after participating in an educational intervention based on the Health Belief Model.

- **Research Hypothesis (H1):** Rural mothers who participate in an educational intervention based on the Health Belief Model will demonstrate a significant increase in knowledge about the Human Papillomavirus vaccine compared to their knowledge before the intervention.

- **Research Hypothesis (H2):** Rural mothers who participate in an educational intervention based on the Health Belief Model will demonstrate more positive perception towards the Human Papillomavirus vaccine compared to their beliefs before the intervention.

Method

Research Design: This study utilized a quasi-experimental research design with one group for pre- and post-testing. This design involves measuring participants' knowledge and perception before and after the intervention. Changes in knowledge and beliefs are evaluated by comparing pretest and posttest scores.

Settings: This study was conducted at the Maternal and Child Health Care Centers (MCH) Quibly and Bahari at Shebin El-Kom.

Sample:

The study used a purposive sampling method to recruit 200 rural mothers from the Maternal and Child Health Care Centers (MCH) Quibly and Bahari. Eligibility criteria included:

- Mothers between the ages of 20-45.
- Residing in rural areas.
- Willingness to participate in both the pre-test and post-test assessments.

Exclusion criteria for the study:

- Mothers with prior formal education or training on HPV or HPV vaccination.
- Mothers do not reside in rural areas.
- Mothers are unable to commit to both pre- and post-test assessments.

Sample Size:

Reviewing the previous studies such as Ahmed et al. (2022) that examined the same outcomes and found significant differences in

women's scores of knowledges and beliefs with a moderate effect size, 80% power to detect this difference and a significant level of 5%. So, a purposive sample of 200 mothers was recruited for the study.

The formula for calculating the sample size is:

- $SS = Z^2 * P * (1-P) / M^2$
- $SS = (z\text{-score})^2 * P * (1-P) / (\text{margin of error})^2$
- $Z = Z\text{-value} = 1.96$ for 95 % confidence level.
- $P =$ Population proportion (in decimal form) (assumed to be 0.5(50%))
- $M =$ Margin of error at 5% (0.05)

Instruments of Data Collection:

The research used two Instruments to collect data, which are as follows:

Instrument I: A structured self-administered questionnaire was created by the researchers following a thorough review of Arabic and English literature (Johnson et al., 2019). It is made up of two parts:

Part 1: Personal Characteristics: This part compiles data on the personal traits of rural mothers, such as age, marital status, level of education.

Part II: Questionnaire to assess mothers' knowledge (pre/post-tests): This part contains 26 questions created to evaluate level of knowledge of HPV and its vaccine among rural mothers. The inquiries are sorted into six categories, which include purpose of HPV vaccination, effectiveness of HPV vaccination, prevention measures, recommended HPV vaccination schedule, management options, and complications of HPV.

Beliefs: Beliefs refer to individual attitudes towards HPV infection and HPV vaccination, influenced by factors such as perceived susceptibility to the disease, the severity of potential health outcomes, the benefits of vaccination, perceived barriers to action, and cues to action. It was measured using Instrument II (the Champion Health Belief Model Scale) to assess these beliefs and attitudes, focusing on participants' perceptions and potential behavior changes after the educational intervention.

Scoring System: Correct answers scored two points; incorrect answers scored one point and "don't know answers" scored zero point. The

total score ranges from 0 to 52. The level of mother's knowledge is categorized as follows:

- Poor knowledge: <50% (0-25)
- Fair knowledge: 50%-75% (26-29.6)
- Good knowledge: >75% (29.7-52)

Instrument II: Champion Health Belief Model Scale (CHBM) was originally developed by Champion (1999) and adapted for this study. The CHBM scale evaluates the health beliefs of rural women regarding HPV vaccination. The CHBM was revised to include questions focusing on HPV vaccination and its preventive benefits. This scale typically includes several constructs such as perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and cues to action.

Part 1: Perceived susceptibility: This section investigates how participants perceive their risk of contracting HPV and the seriousness of potential HPV-related health problems. It aims to determine if participants view themselves as susceptible to HPV and recognize the importance of vaccination as a preventive measure.

Part 2: Perceived severity: This section investigates how participants perceive the seriousness of potential HPV-related health problems. It aims to determine if participants recognize the importance of vaccination as a preventive measure.

Part 3: Perceived benefits: This part explores participants' perceptions of the advantages associated with HPV vaccination. It seeks to identify whether participants believe that vaccination is effective in preventing HPV.

Part 4: Perceived barriers: This part explores participants' perceptions of the obstacles associated with HPV vaccination. It seeks to identify whether participants believe that they encounter any barriers to receiving the vaccine.

Part 5: Perceived cues to action for HPV vaccination: This section evaluates participants' readiness and motivation to receive the HPV vaccination both before and after the intervention. It focuses on how educational initiatives influence their willingness to act upon vaccination recommendations.

Scoring system: The CHBM is composed of five sections containing a total of 39 questions: perceived susceptibility (7 items), perceived severity (10 items), perceived benefits (5 items), perceived barriers (10 items), and cues to

action (7 items). Each item is assessed using a Likert scale with three points (agree: 3, neutral: 2, disagree: 1). The total score ranges from 39 to 117 points, split as follows:

- Positive belief: $\geq 60\%$ (85.8-117).
- Negative belief: <60% (39-85.7).

Validity of the instruments: Four experts (two from maternal and newborn health nursing and two from obstetrics and gynecology medicine) assessed the instruments' validity for their content and internal validity. Modifications were based on panel feedback to ensure clear sentences, relevant content, item sequence, and accurate scoring.

Reliability of the instruments: The researchers used test-retest reliability to assess the internal consistency of the instruments. This was achieved by using the same instruments with the same people in similar situations on multiple occasions. Results from multiple rounds of testing were examined, leading to changes in certain questions.

Administrative Approvals

On January 5, 2023, the Faculty of Nursing at Menoufia University received permission from the Research and Ethics Committee. The Dean of the Faculty of Nursing at Menoufia University issued official letters to the manager of the mentioned settings for the study to proceed. The manager of the specified location officially approved the study to be carried out.

Ethical Considerations

Official approvals were obtained from the dean of the Faculty of Nursing and the manager of the mentioned settings to conduct this study. Before the implementation of the study, the rural women had been individually told about the study's nature and aim. Rural women were also assured of the obtained data's privacy and confidentiality. They were informed about their rights to withdraw from the study at any time without giving a reason.

Pilot Study

A preliminary trial was conducted to assess the instrument's suitability, the study's feasibility, and the amount of time required for data gathering with a sample size of 20 women (10% of the total sample). After reviewing the findings of the preliminary study, the researchers revised a few questions. As a result, the women selected for the pilot study were excluded from the study sample.

Field Work:

Study Duration

The research took place from January 2023 to June 2023. It included four steps: preparation, interviewing & assessment, implementation, and evaluation.

Preparation phase:

- **Literature Review:** A comprehensive review of relevant Arabic and English literature was conducted to create health educational program sessions on HPV vaccination based on the HBM.
- **Tool Development:** The researchers develop a structured self-administered questionnaire to assess personal characteristics and knowledge of HPV and its vaccine among rural mothers and adapt tool of the Champion Health Belief Model (CHBM) Scale to measure mother's beliefs and attitudes towards HPV vaccination.

Interviewing & assessment phase:

- **Researchers Visits:** The researchers visited the MCH Qibly and Bahari at Shebin El-Kom, three days a week to collect research data from the rural mothers.
- **Participant Recruitment:** Invitations were extended to rural women who met the eligibility criteria to participate in the study, and their participation required giving written consent after the study's purpose was explained.
- **Conducting Interviews:** Conduct interviews with participants to gather baseline data on their knowledge and perception towards HPV and the vaccine.
- **Initial Assessment:** Instruments were distributed to gather initial information on individual traits and overall understanding of the HPV vaccine (instrument I). The baseline assessment also included beliefs about susceptibility, seriousness, advantages, obstacles, and cues to action according to the HBM (pre-test). Questionnaires were distributed and collected on the same day.
- **Scheduling the session:** Participants and researchers scheduled the initial educational session at a time that was convenient for all.

Implementation Phase:

- **Division by group:** Rural women were organized into smaller groups of 10 to 15 participants, arranged according to their distribution within each MCH.
- **Teaching Sessions:** A series of five educational sessions, each lasting 30 to 40 minutes, were conducted weekly over five weeks to ensure thorough data collection without overwhelming the participants. The schedule for each subsequent session was set at the end of the previous one. The topics covered in the sessions were:
 - **Session 1:** Introduction to HPV vaccination, including its purpose, prevalence in Egypt, risk factors, signs of HPV, prevention methods, vaccination options, and screening techniques. Participants were provided with a pamphlet containing this information.
 - **Session 2:** Focus on the necessity of HPV vaccination and screening regardless of symptoms, family history, and overall health. The significance of the Visual Inspection of the cervix with Acetic Acid (VIA) test in detecting HPV was emphasized.
 - **Session 3:** Discussion on the seriousness of HPV-related health issues and the importance of vaccination, including potential severe health effects, treatment requirements, and the broader impact on personal and societal health.
 - **Session 4:** Addressing barriers to HPV vaccination, such as misconceptions about the vaccine, costs, and lack of knowledge about the vaccination process.
 - **Session 5:** Emphasis on the benefits of HPV vaccination, the role of early detection through VIA screening, and encouragement to take proactive steps for HPV prevention.
- **Methods of teaching:** Sessions utilized small group discussions, open forums, and brainstorming activities. An additional 30 minutes were allocated at the end of each session for answering participants' questions.

Evaluation Phase:

- **Reassessment after intervention:** At the conclusion of the fifth session, participants were reassessed using the same instruments as before to evaluate any

changes in their knowledge and perceptions regarding HPV vaccination. This included Instrument I, which measured understanding of HPV vaccination, and Instrument II, which assessed perceptions of susceptibility, severity, benefits, barriers, and cues to action according to the Health Belief Model.

Statistical analysis

Following encoding and input, the data is examined with the SPSS software package, specifically version 25, which stands for Standards for Statistical Product and Service Solutions. Continuous data were distributed normally and reported as the mean \pm standard deviation (SD). Categorical data was utilized by calculating its frequency and percentage. Paired sample t-tests were used to determine the comparisons between two variables with continuous data. The chi-square test was utilized to compare variables containing categorical data. A significant level of $p \leq 0.05$ was established.

Results:

The personal information of women under study is presented in Table 1. It is clear from the table that 30.0% of participants were aged between 30-35 years, 75.0% were married, and 65.0% were university graduates.

Table 2 displays the level of knowledge of rural women regarding HPV vaccination both before and after the intervention. It indicates that before the intervention, 75.0% of rural women were unaware of the purpose of HPV vaccination, while after the intervention, 82.0% of them had accurate knowledge. Before the intervention, 60.0% of rural women were unaware of the effectiveness of HPV vaccination, while after the intervention, 89.0% had accurate knowledge. Meanwhile, before the intervention, 65.5% of rural women were unaware of the HPV prevention measures, while 90.0% of them gave correct responses post-intervention. Moreover, before the intervention, 75.5% of rural women were unaware of the recommended HPV vaccination schedule, while post-intervention, 87.5% of them provided correct answers. Furthermore, before the intervention, 77.0% of rural women were unaware of the management options, while 87.0% had correct answers after the intervention. Additionally, before the

intervention, 65.5% of rural women were unaware of the complications of HPV, whereas 90.0% of them had accurate knowledge post-intervention.

Figure 1 shows the overall knowledge of the rural women about HPV vaccination before and after the intervention. It demonstrates that 70.0% of the women in the study had a fair knowledge level of HPV vaccination before the intervention, while 90.0% of them had a good knowledge level after the intervention.

Table 3 displays a comparison of the mean scores for rural women's beliefs about their vulnerability to HPV prevention pre- and post-intervention. Following the intervention, there was a notable rise in perceived susceptibility to HPV across all statements, including "receiving an HPV vaccination is a possibility for me", "I have a good possibility of getting an HPV vaccination in the next few years", "there is a high possibility that I will get an HPV vaccination", "I don't need an HPV vaccination if I don't have any symptoms", "my family history puts me at risk of needing an HPV vaccination", "My physical health makes it likely that I should get an HPV vaccination", and "I worry a lot about whether I should get an HPV vaccination", as indicated by a significant increase in mean scores from pre- (1.69 ± 0.82 , 1.13 ± 0.33 , 1.12 ± 0.32 , 1.33 ± 0.62 , 1.20 ± 0.52 , 1.16 ± 0.36 , 1.36 ± 0.72) to post-intervention assessments (2.82 ± 0.94 , 2.80 ± 0.43 , 2.83 ± 0.46 , 2.65 ± 0.64 , 2.90 ± 0.32 , 2.99 ± 0.39 , 2.95 ± 0.76) ($p \leq 0.001$). The total perceived susceptibility increased from 8.98 ± 1.44 before the intervention to 19.93 ± 1.84 after the intervention, showing similar patterns.

Table 4 displays a comparison of the mean scores for rural women's perceptions of the seriousness of HPV infection pre- and post-intervention. Following the intervention, there was a significant increase in perceived severity to HPV infection, as seen in higher mean scores for various statements, such as "not receiving the HPV vaccination may lead to serious health issues", "not getting the HPV vaccination may require extensive treatment in the future", "lack of HPV vaccination is a serious health concern", "skipping the HPV vaccination can necessitate comprehensive

medical treatment later", "if I don't get the HPV vaccination, my whole life could change", "the idea of not getting the HPV vaccination makes me feel uneasy", "when I think about not getting the HPV vaccination, my heart beats faster", "I think not receiving the HPV vaccination threatens my relationships with others", "not getting the HPV vaccination makes managing health more challenging", and "the cost of treatment due to not getting the HPV vaccination is very high", as indicated by a significant increase in mean scores from pre- (1.70 ± 0.64, 1.79 ± 0.92, 1.81 ± 0.87, 1.33 ± 0.62, 1.52 ± 0.77, 1.58 ± 0.71, 1.50 ± 0.57, 1.54 ± 0.63, 1.13 ± 0.37 and 1.82 ± 0.98) to post-intervention assessments (2.78 ± 0.76, 2.75 ± 0.96, 2.68 ± 0.98, 2.65 ± 0.64, 2.70 ± 0.55, 2.75 ± 0.61, 2.40 ± 0.91, 2.54 ± 0.84, 2.60 ± 0.80, and 2.83 ± 0.38) ($p \leq 0.001$). There was an increase in the overall perceived seriousness from 16.49 ± 2.54 before the intervention to 26.71 ± 3.65 after the intervention, demonstrating similar trends.

Table 5 displays a comparison of average scores for rural women's views on the advantages of HPV vaccination before and after the intervention. After the intervention, there was a notable rise in perceived benefits of HPV infection, reflected in increased average scores for statements like "the HPV vaccination can prevent abnormalities before they progress to cancer," "if HPV is prevented through vaccination, the risk of serious health issues is greatly reduced," "it is critical for a female to get the HPV vaccination to protect her health," "getting the HPV vaccination has the potential to save my life," and "the innovative HPV vaccination is an effective primary prevention strategy." This is backed by a significant increase in average scores from pre-intervention (1.54 ± 0.82, 1.73 ± 0.81, 1.77 ± 0.62, 2.17 ± 0.89, and 1.99 ± 0.86) to post-intervention assessments (2.67 ± 0.49, 2.99 ± 0.12, 2.79 ± 0.58, 2.55 ± 0.82, and 2.69 ± 0.46) ($p \leq 0.001$). The total perceived benefits increased from 9.19 ± 2.53 to 13.66 ± 3.32 after the intervention, showing comparable patterns.

Table 6 displays a comparison the mean scores for rural women's perceptions of the barriers to HPV vaccination before and after the intervention. After the intervention, there

was a decrease in perceived barriers to HPV infection, reflected in decreased average scores for statements like "getting the HPV vaccination would simply make me more concerned," "because there is no treatment for HPV, vaccination is not required," "the HPV vaccination is unpleasant," "the cost of an HPV vaccination is prohibitively high," "getting the HPV vaccination is too embarrassing," "not getting the HPV vaccination is due to a fear of possible side effects," "unawareness of the locations offering HPV vaccinations may affect my decision," "unawareness of the proper age for vaccination may affect my decision," "I am unaware that the number of HPV vaccination doses may affect my decision," and "I believe that obtaining the HPV vaccination series is risky or damaging to my health." This is backed by a significant decrease in average scores from pre-intervention (2.42 ± 0.82, 12.90 ± 0.67, 2.60 ± 0.89, 2.80 ± 0.66, 2.81 ± 0.57, 2.75 ± 0.43, 2.40 ± 0.72, 2.74 ± 0.97, 2.83 ± 0.51, and 2.78 ± 0.41) to post-intervention assessments (1.99 ± 0.85, 1.40 ± 0.63, 1.50 ± 0.72, 1.37 ± 0.48, 1.07 ± 0.25, 1.21 ± 0.40, 1.26 ± 0.53, 1.68 ± 0.79, 1.80 ± 0.45, and 1.07 ± 0.25) ($p \leq 0.001$). The total perceived barriers decreased from 27.06 ± 2.02 to 14.32 ± 1.91 after the intervention, showing comparable patterns.

Table 7 shows the average scores for the comparison of cues to action for HPV vaccination among rural women before and after the intervention. Following the intervention, there was a notable rise in perceived incentives for preventing HPV infection, as seen in higher average ratings for statements such as "I believe getting the HPV vaccination is part of a well-balanced health regimen," "I would get the HPV," "I regularly take steps to protect my health, including considering the HPV vaccination," "when I think my health might be at risk, I take preventive measures like getting vaccinated," "I make sure to keep up with annual health checkups, including vaccinations," "I make sure to keep up with annual health checkups, including vaccinations," and "I follow recommended health practices, such as getting the HPV vaccination." There was a significant increase in average scores from before to after the intervention (1.97 ± 0.41, 2.32 ± 0.83, 1.95

± 0.50 , 1.88 ± 0.91 , 1.81 ± 0.64 , 1.98 ± 0.93 , and 1.96 ± 0.60 to 2.51 ± 0.64 , 2.71 ± 0.97 , 2.49 ± 0.72 , 2.46 ± 0.83 , 2.77 ± 0.76 , 2.75 ± 0.43 , and 2.56 ± 0.49) ($p \leq 0.001$). After the intervention, there was a rise in the overall perceived cues to action from 13.86 ± 2.10 to 18.00 ± 2.86 , indicating similar trends.

Figure 2 presents the rural women's overall beliefs about HPV vaccination before and after the intervention. It shows that 80.0% of the women in the research initially held a negative belief about HPV vaccination, but 90.0% had a positive belief after the intervention.

Table 1: Personal Data of the Studied Women (n = 200)

Variables	The participants (n = 200)	
	No.	%
Age		
20- <25	33	16.5%
25-<30	50	25.0%
30-<35	60	30.0%
35-<40	25	12.5%
≥ 40	32	16.0%
Marital status		
Single	20	10.0%
Married	150	75.0%
Widowed	10	5.0%
Divorced	20	10.0%
Educational level		
Secondary	15	7.5%
Intermediate	45	22.5%
University graduate	130	65.0%
Postgraduate degree	10	5.0%

Table 2: The Level of Women's Knowledge about HPV Vaccination before and after the Intervention (n = 200)

Variables	The studied participants (n = 200)				X ²	P value
	before the intervention		after the intervention			
	No.	%	No.	%		
Purpose of HPV vaccination						
Don't know	150	75.0%	6	3%	501.56**	< 0.0001
Incorrect answers	10	5.0 %	30	15.0 %		
Correct answers	40	20.0%	164	82.0 %		
Effectiveness of HPV vaccination						
Don't know	120	60.0%	5	2.5 %	514.91**	< 0.0001
Incorrect answers	60	30.0%	17	8.5%		
Correct answers	20	10.0%	178	89.0%		
Prevention measures						
Don't know	131	65.5%	5	2 %	449.89**	< 0.0001
Incorrect answers	39	19.5%	15	6 %		
Correct answers	30	15.0%	180	90 %		
Recommended HPV vaccination schedule						
Don't know	151	75.5%	5	2.5%	556.27**	< 0.0001
Incorrect answers	30	15.0 %	20	10.0%		
Correct answers	19	9.5%	175	87.5%		
Management options						
Don't know	154	77.0%	6	3.0%	487.10**	< 0.0001
Incorrect answers	24	12.0%	20	10.0%		
Correct answers	22	11.0%	174	87.0%		
Complications of HPV						
Don't know	131	65.5%	5	2.0 %	449.89**	< 0.0001
Incorrect answers	39	19.5%	15	6.0 %		
Correct answers	30	15.0%	180	90.0 %		

**Note: indicates that differences are highly statistically significant.

Figure 1: Total Level of Knowledge of the Studied Women Regarding HPV Vaccination before and after the Intervention

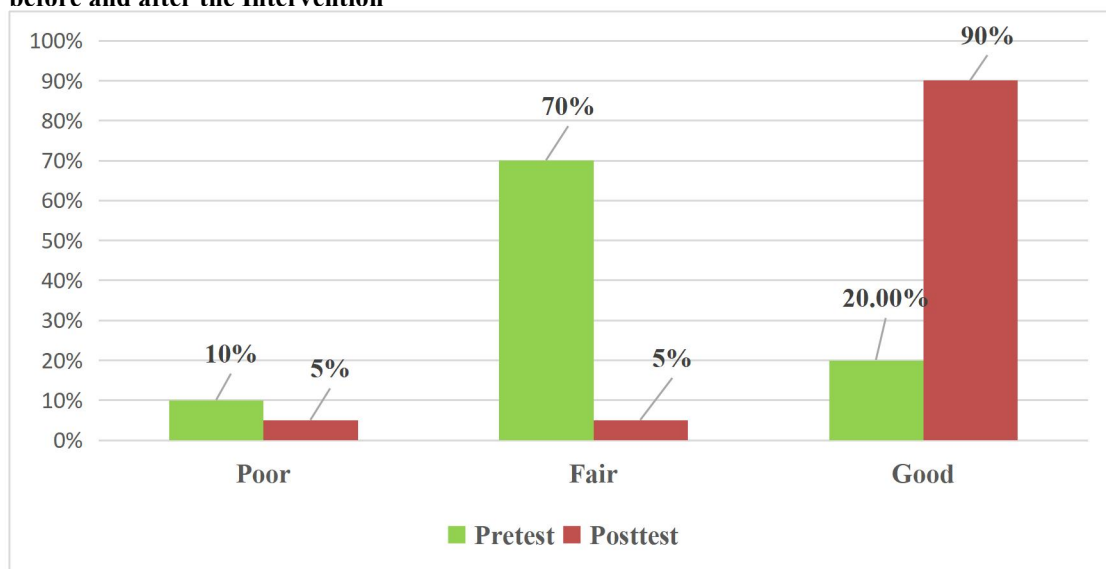


Table 3: Comparing the Mean Scores of Rural Mothers' Perception of Their Susceptibility to HPV before and after the Intervention

Variables	before intervention (mean ± SD)	after intervention (mean ± SD)	t-test	p-value
1. Receiving an HPV vaccination is a possibility for me.	1.69 ± 0.82	2.82 ± 0.94	16.868**	≤0.001
2. I have a good possibility of getting an HPV vaccination in the next few years.	1.13 ± 0.33	2.80 ± 0.43	43.185**	≤0.001
3. There is a high possibility that I will get an HPV vaccination.	1.12 ± 0.32	2.83 ± 0.46	43.615**	≤0.001
4. I don't need an HPV vaccination if I don't have any symptoms.	1.33 ± 0.62	2.65 ± 0.64	20.226**	≤0.001
5. My family history puts me at risk of needing an HPV vaccination.	1.20 ± 0.52	2.90 ± 0.32	40.200**	≤0.001
6. My physical health makes it likely that I should get an HPV vaccination.	1.16 ± 0.36	2.99 ± 0.39	66.412**	≤0.001
7. I worry a lot about whether I should get an HPV vaccination.	1.36 ± 0.72	2.95 ± 0.76	29.280**	≤0.001
Perceived susceptibility (total)	8.98 ± 1.44	19.93 ± 1.84	83.890**	≤0.001

**Note: indicates that differences are highly statistically significant.

Table 4: Comparing the Mean Scores of Rural Women's Perceptions of the Severity of HPV Vaccination before and after the Intervention

Variables	before intervention (mean \pm SD)	after intervention (mean \pm SD)	t	p
1. Not receiving the HPV vaccination may lead to serious health issues.	1.70 \pm 0.64	2.78 \pm 0.76	19.94**	\leq 0.001
2. Not getting the HPV vaccination may require extensive treatment in the future.	1.79 \pm 0.92	2.75 \pm 0.96	12.35**	\leq 0.001
3. Lack of HPV vaccination is a serious health concern.	1.81 \pm 0.87	2.68 \pm 0.98	12.602**	\leq 0.001
4. Skipping the HPV vaccination can necessitate comprehensive medical treatment later.	1.33 \pm 0.62	2.65 \pm 0.64	20.226**	\leq 0.001
5. If I don't get the HPV vaccination, my whole life could change.	1.52 \pm 0.77	2.70 \pm 0.55	15.341**	\leq 0.001
6. The idea of not getting the HPV vaccination makes me feel uneasy.	1.58 \pm 0.71	2.75 \pm 0.61	17.291**	\leq 0.001
7. When I think about not getting the HPV vaccination, my heart beats faster.	1.50 \pm 0.57	2.40 \pm 0.91	11.28**	\leq 0.001
8. I think not receiving the HPV vaccination threatens my relationships with others.	1.54 \pm 0.63	2.54 \pm 0.84	10.55**	\leq 0.001
9. Not getting the HPV vaccination makes managing health more challenging.	1.13 \pm 0.37	2.60 \pm 0.80	24.45**	\leq 0.001
10. The cost of treatment due to not getting the HPV vaccination is very high.	1.82 \pm 0.98	2.83 \pm 0.38	24.45**	\leq 0.001
Perceived severity (total)	16.49 \pm 2.54	26.71 \pm 3.65	39.44**	\leq 0.001

**Note: indicates that differences are highly statistically significant.

Table 5: Comparing the Mean Scores of Rural Women's Perceptions of the Benefits of HPV Vaccination before and after the Intervention

Variables	before intervention (mean ± SD)	after intervention (mean ± SD)	t	p
1. The HPV vaccination can prevent abnormalities before they progress to cancer.	1.54 ± 0.82	2.67 ± 0.49	15.534**	≤0.001
2. If HPV is prevented through vaccination, the risk of serious health issues is greatly reduced.	1.73 ± 0.81	2.99 ± 0.12	21.629**	≤0.001
3. It is critical for a female to get the HPV vaccination to protect her health.	1.77 ± 0.62	2.79 ± 0.58	16.819**	≤0.001
4. Getting the HPV vaccination has the potential to save my life.	2.17 ± 0.89	2.55 ± 0.82	4.387**	≤0.001
5. The innovative HPV vaccination is an effective primary prevention strategy.	1.99 ± 0.86	2.69 ± 0.46	9.844**	≤0.001
Perceived Benefits (total)	9.19 ± 2.53	13.66 ± 3.32	19.013**	≤0.001

**Note: indicates that differences are highly statistically significant.

Table 6: Comparing the Mean Scores of Rural Women's Perceptions of the Barriers to HPV Vaccination before and after the Intervention

Variables	before intervention (mean \pm SD)	after intervention (mean \pm SD)	t	p
1. Getting the HPV vaccination would simply make me more concerned.	2.42 \pm 0.82	1.99 \pm 0.85	5.104**	\leq 0.001
2. Because there is no treatment for HPV, vaccination is not required.	2.90 \pm 0.67	1.40 \pm 0.63	31.410**	\leq 0.001
3. The HPV vaccination is unpleasant.	2.60 \pm 0.89	1.50 \pm 0.72	17.385**	\leq 0.001
4. The cost of an HPV vaccination is prohibitively high.	2.80 \pm 0.66	1.37 \pm 0.48	30.665**	\leq 0.001
5. Getting the HPV vaccination is too embarrassing.	2.81 \pm 0.57	1.07 \pm 0.25	39.184**	\leq 0.001
6. Not getting the HPV vaccination is due to a fear of possible side effects.	2.75 \pm 0.43	1.21 \pm 0.40	39.927**	\leq 0.001
7. Unawareness of the locations offering HPV vaccinations may affect my decision.	2.40 \pm 0.72	1.26 \pm 0.53	18.053**	\leq 0.001
8. Unawareness of the proper age for vaccination may affect my decision.	2.74 \pm 0.97	1.68 \pm 0.79	15.526**	\leq 0.001
9. I am unaware that the number of HPV vaccination doses may affect my decision.	2.83 \pm 0.51	1.80 \pm 0.45	20.167**	\leq 0.001
10. I believe that obtaining the HPV vaccination series is risky or damaging to my health.	2.78 \pm 0.41	1.07 \pm 0.25	49.000**	\leq 0.001
Perceived Barriers (total)	27.06 \pm 2.02	14.32 \pm 1.91	39.44**	\leq 0.001

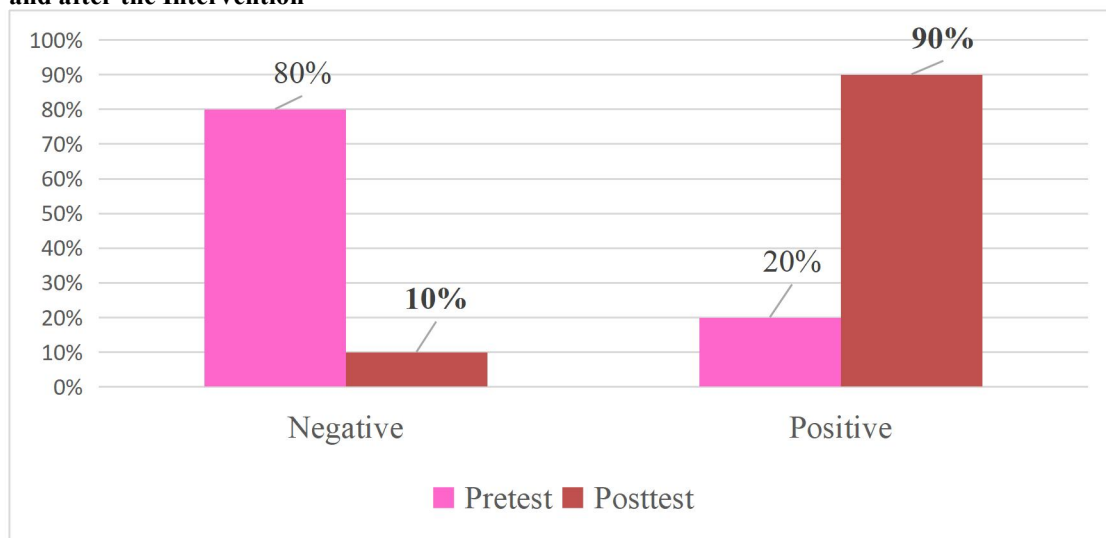
**Note: indicates that differences are highly statistically significant.

Table 7 Comparing the mean scores of Rural women's perceptions of the Cues to Action for HPV vaccination before and after the intervention

Variables	before intervention (mean ± SD)	after intervention (mean ± SD)	t	p
1. I believe getting the HPV vaccination is part of a well-balanced health regimen.	1.97 ± 0.41	2.51 ± 0.64	9.954**	≤0.001
2. I would get the HPV.	2.32 ± 0.83	2.71 ± 0.97	5.681**	≤0.001
3. I regularly take steps to protect my health, including considering the HPV vaccination.	1.95 ± 0.50	2.49 ± 0.72	7.896**	≤0.001
4. When I think my health might be at risk, I take preventive measures like getting vaccinated.	1.88 ± 0.91	2.46 ± 0.83	6.076**	≤0.001
5. I actively look for new health-related information, including information about HPV vaccination.	1.81 ± 0.64	2.77 ± 0.76	17.828**	≤0.001
6. I make sure to keep up with annual health checkups, including vaccinations.	1.98 ± 0.93	2.75 ± 0.43	5.722**	≤0.001
7. I follow recommended health practices, such as getting the HPV vaccination.	1.96 ± 0.60	2.56 ± 0.49	10.053**	≤0.001
Perceived cues to action (total)	13.86 ± 2.10	18.00 ± 2.86	15.586**	≤0.001

**Note: indicates that differences are highly statistically significant.

Figure 2: The Overall Perception Categories of Rural Women about HPV Vaccination before and after the Intervention



Discussion:

The current study findings showed a notable increase in women's understanding of the purpose of HPV vaccination, effectiveness of HPV vaccination, prevention measures, recommended HPV vaccination schedule, management options, and complications of HPV post-intervention in comparison to pre-intervention. The results of this study align with a recent quasi-experimental study carried out by Liu et al. (2023) in China, which examined how digital health education impacted women's understanding of HPV risks. It was determined that the experimental group's knowledge score rose following the receipt of health education.

In relation to women's knowledge about preventive measures for HPV-related diseases, the present study found that women's knowledge of preventive measures for HPV-related diseases improved after the intervention compared to before. This result aligns with a quasi-experimental study conducted by Patel and Sharma (2023) in India, which assessed the effect of an education bundle on prevention and early detection of HPV-related conditions. Their findings showed that the health education initiative positively impacted women's understanding of prevention and early detection.

Regarding the screening techniques for HPV-linked illnesses, the current research results revealed an enhancement in the study group's understanding of HPV testing methods following the intervention in comparison to before the intervention. This result is in line with a study done by Ahmed and Alghamdi (2022) on Saudi women, which aimed to evaluate the impact of interventions on promoting involvement in HPV screening. They observed an increase in overall knowledge scores following the training.

In terms of women's knowledge of HPV vaccination, the current study findings revealed that participation in the prevention program led to an enhancement in women's general knowledge about HPV vaccination. This may be attributed to the utilization of basic language in teaching sessions. The results of this research align with those of Hassan et al. (2023), who stated that after the session, the Egyptian women's overall understanding of HPV vaccination had increased.

According to the researchers, the study's findings are attributed to a successful educational program using the HBM, focusing on knowledge gaps and misconceptions about HPV. Utilizing plain and clear language helped make the information easy to comprehend, while interactive features actively involved participants in the educational experience. By concentrating on essential elements of the health belief model like perceived vulnerability, seriousness, advantages, and obstacles, the initiative effectively impacted participants' views and incentives concerning HPV prevention and vaccination. Moreover, the program was influenced by effective interventions in the past and customized to fit the cultural background of the participants, guaranteeing significance and approval. This thorough and research-supported method led to notable enhancements in women's understanding and attitudes towards HPV-related illnesses and how to prevent them.

Based on the HBM employed in this research, to engage in HPV preventative actions, an individual needs to believe that they are at risk (perceived susceptibility), recognize the severity of the symptoms in various areas of their life, understand the benefits (such as HPV vaccination) of reducing the risk or severity of the disease, and identify obstacles. To fulfill a risk-prevention role, one must also have confidence in the efficacy of HPV immunization (Nigusie et al., 2023).

Regarding the development of perceived susceptibility, the current study results revealed an increase in the belief score for perceived susceptibility post-educational program in comparison to pre-program. This result aligns with the outcome of prior quasi-experimental research done by Daryani et al. (2023) with Iranian women to assess the impact of HBM-based education on HPV screening. After the intervention, there was a notable rise in how vulnerable the women felt.

The severity of a disease, as perceived by an individual, is known as the perceived severity of a health issue (Tavafian, 2022). The current research found notable variations in perceived severity for all items before and after the program. This may be due to the severity being acknowledged and women becoming more informed through the nursing educational program.

The results of the current research confirmed the hypothesis that implementing a nursing educational program utilizing the HBM can succeed in improving health beliefs regarding HPV vaccination. This result aligns with prior quasi-experimental research conducted by Ahmed et al. (2022) in Helwan City involving Egyptian females to assess the impact of an educational program grounded in the HBM on women's understanding and attitudes towards HPV prevention. After the intervention, they observed a notable rise in perceived severity.

The present study revealed that, prior to the educational intervention; the mean scores for perceived barriers to HPV vaccination were high among the women studied. This could be because of insufficient awareness about HPV vaccines and the study participants not knowing where to get vaccinated, along with their embarrassment about sexually transmitted infections. Reis et al. (2023) conducted a quasi-experimental study to investigate Turkish women's knowledge, behaviors, and beliefs on HPV prevention and screening, which supports the current study findings. After introducing a teaching strategy rooted in the Health Belief Model, researchers found that the average scores indicating obstacles to getting HPV vaccines were notably reduced in the women they examined.

The results of the current research supported the findings of Yossif and EL Sayed (2023), who conducted a quasi-experimental study in Benha City involving female college students to assess the effect of a self-learning program using the HBM for HPV prevention. They found that barriers to HPV prevention techniques decreased significantly after the intervention compared to before the intervention.

These results are attributed to the successful addressing of key components needed for behavior change in the educational program based on the HBM, as seen by the researcher. The program raised awareness and perceived risk by improving participants' knowledge of their vulnerability to HPV and the serious outcomes of the disease. Moreover, the program highlighted the advantages of getting the HPV vaccine to prevent the disease, encouraging participants to view vaccination as a feasible way to prevent it. The intervention

aimed to address perceived obstacles by giving guidance on vaccination locations and tackling the shame and stigma related to STDs. Utilizing the HBM, this holistic strategy resulted in notable enhancements in understanding and attitudes, along with a decrease in perceived obstacles, essential for engaging in preventive health actions. The agreement seen in earlier research, as shown in studies by Daryani et al. (2023) and Reis et al. (2023), confirms the success of this educational approach in encouraging HPV prevention and vaccination.

Therefore, the current study results showed that the hypotheses were supported, indicating that educational interventions using the HBM are effective in enhancing women's understanding and beliefs about HPV vaccination.

Conclusion:

Based on the findings of the current research, it can be inferred that rural mothers showed greater knowledge scores about human papillomavirus vaccination after engaging in the health belief model-focused intervention compared to before the intervention. This supports the initial research hypothesis. Moreover, the findings of the current research indicated that rural mothers exhibited positive perception about human papillomavirus vaccination following their involvement in the health belief model-focused intervention compared to previous perception. This supports the second hypothesis in the research. Thus, the findings of this research supported the research prediction and did not confirm the null hypothesis.

Recommendations:

Following an intervention using the health belief model, recommendations are suggested due to notable improvements in knowledge and beliefs about HPV vaccination among rural mothers:

- Educational campaigns and endorsements from healthcare providers are essential for increasing vaccination rates.
- It is crucial to guarantee fair access to the vaccine, especially in areas with limited resources, to decrease worldwide inequalities in HPV-related illnesses.
- Regular feedback from participants can enhance the program and address any new

obstacles or misunderstandings regarding HPV vaccination.

- Continued monitoring and research are vital to oversee the vaccine's prolonged efficacy and safety and to adjust vaccination tactics as needed.

- Carrying out identical interventions in different rural areas can help close the information discrepancy and promote beneficial health habits.

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