HEALTH PROMOTION

Impact of an Educational Intervention Video in HPV Prevention among Tunisian Female Students: A before-and-after Study

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Keywords

Educational intervention video • Cervical cancer • HPV vaccine •, Tunisian Medical School

Summary

Background. *Cervical cancer is the second most common gynecological cancer in Tunisia. The HPV vaccine is a crucial tool for preventing and controlling this disease. Training healthcare providers and equipping them with adequate knowledge is essential. This study aimed to evaluate the effectiveness of an educational intervention video (EIV) on the knowledge and perceptions of HPV, cervical cancer, and the HPV vaccine among Tunisian female students.*

Methods. *A quasi-experimental study involving a single interventional group was conducted among 158 female students. Participants were interviewed before and after watching the EIV. The chi-square test using McNemar's method assessed variations between pre- and post-intervention responses. A p-value <0.05 was considered statistically significant.*

Results. *The average age of participants was 19.74±1.7 years. The EIV had a positive impact on the scores for knowledge and perceptions related to HPV and cervical cancer. A significant difference was observed between the intention to receive the HPV vaccine and perceived severity of HPV, perceived benefits of vaccination, and perceived barriers. Notably, 50.6% of female students believed the HPV vaccine should be available upon request and covered by health insurance, while 46.2% thought it should be included in the Tunisian vaccination schedule.*

Conclusion. *The EIV improved students' knowledge and perceptions about HPV, cervical cancer, and the HPV vaccine. Tailored educational strategies may enhance vaccine acceptance, especially when integrated early in academic training.*

Introduction

Cervical cancer is one of the most common malignancies of the female reproductive tract. It occurs when abnormal cells in the lining of the cervix grow uncontrollably and may progress to invasive cancer if left untreated [1]. This malignancy ranks as the fourth most frequent cancer in women worldwide, both in incidence and mortality, despite the availability of prevention methods for over 70 years [2]. Current estimates show that each year, 604,127 women are diagnosed with cervical cancer, and 341,831 die from the disease [3].

In Tunisia, cervical cancer is the second most common gynecological cancer, following breast cancer, with an incidence rate of 5.8 per 100,000 women corresponding to around 250 to 300 new cases annually [2, 4]. This rate remains significantly higher than in many countries of the Global North, where organized screening and widespread HPV vaccination have reduced incidence to fewer than 10 cases per 100,000 women annually [5]. Recognizing the significant burden of this preventable disease, the Global Strategy to Accelerate the Elimination of Cervical Cancer as a Public Health Problem (2020-2030) has set targets for 2030 [6], aiming to reduce the incidence to fewer than 4 cases per 100,000 women [6]. Most cervical cancers (95-100%) are caused by persistent infection with human papillomavirus (HPV). Two high-risk types, HPV16 and HPV18, are responsible for nearly 70% of cases globally. In Tunisia, the combined contribution of these types reaches 69.5% (61% from HPV16 and 8.5% from HPV18) [3, 7]. HPV vaccination, cervical screening (using either the Papanicolaou smear to detect cytological abnormalities or the HPV-DNA test to identify high-risk HPV infections), and treatment of precancerous lesions are proven and cost-effective strategies for prevention [8, 9]. Currently, three types of HPV vaccines are available [10]. The bivalent vaccine (Cervarix) targets HPV types 16 and 18. It is given in two doses (5 to 13 months apart) for individuals aged 9-14 years, and in a three-dose schedule (at 0, 1-2.5 months, and 5–12 months) for those aged 15 years and older [11]. The quadrivalent vaccine (Gardasil) covers HPV types 6, 11, 16, and 18. It is administered in two doses (6 months apart) for individuals aged 9-13 years, and in three doses (at 0, 2-3 months, and 6-7 months) for those aged 14 years and older [11]. The nonavalent vaccine (Gardasil 9) provides additional protection against five more high-risk types (31, 33, 45, 52, and

58) along with the four types covered by the previous vaccines. It is recommended for individuals aged 9–14 years in a two-dose schedule (9-13 months apart), and for those aged 14 years and older in a three-dose schedule (at 0, 1-2 months, and 4-6 months) [11].

Although women carry a disproportionately higher burden of HPV infection, men are also impacted by the virus. A 2023 systematic review found that nearly one in three men aged 15 or older were infected with at least one type of HPV, and one in five had one or more high-risk HPV types [12]. HPV-16, the predominant type of HPV, is known to infect the anogenital tract in men as well as the epithelium of the oral cavity, oropharynx, and larynx [13].

Tunisia is in a favorable position to implement broad HPV vaccination. The Tunisian Society of Gynecology and Obstetrics (STGO) is actively advocating for its inclusion in the national immunization schedule [14]. A Tunisian study suggests that introducing the HPV 16/18 vaccine could reduce cervical cancer cases by two-thirds [15]. In 2025, the Ministry of Health plans to introduce the HPV vaccine in the national school vaccination program, targeting girls in the 6th year of primary school (typically aged 11 to 12 years in Tunisia) [16].

Acceptance of the HPV vaccine depends on multiple factors, including knowledge and understanding of HPV infection, perceived risk of cervical cancer, trust in vaccine safety and efficacy, cultural or religious beliefs, and recommendations from healthcare providers [17-19]. A systematic review identified limited knowledge about HPV and its link to cervical cancer as a key barrier to vaccination among individuals aged 9 to 26 [17]. Moreover, a meta-analysis revealed that parental concerns, particularly fears that vaccination might encourage sexual activity, can negatively influence acceptance [18]. In contrast, strong recommendations from trusted healthcare professionals remain one of the most effective motivators for vaccine uptake [19]. As future healthcare professionals, medical and health sciences students will play a key role in the success of vaccination programs. It is therefore necessary to assess whether they have sufficient knowledge to deliver accurate information and guide informed public choices.

The present study was conducted to evaluate (i) the effectiveness of an educational intervention on the knowledge and perceptions of HPV, cervical cancer, and HPV vaccination among female students at the Higher School of Sciences and Technology of Health in Sfax, as well as (ii) their acceptability of the HPV vaccination.

Methods

Study population and sampling

A prospective quasi-experimental study involving a single interventional group was conducted among female medical students aged 18-23, enrolled at the Higher School of Sciences and Technology of Health in Sfax (Tunisia) during the 2023-2024 academic year.

This study was approved by the Ethics Committee of the Faculty of Medicine of Sfax, Tunisia (Reference: 28/25, dated 21 May 2025). Informed consent was obtained from all participants prior to data collection.

Participants were selected using cluster random sampling. No formal sample size calculation was performed. The number of participants was determined based on available classroom sessions, the total number of eligible female students, and logistical feasibility during the academic calendar. All sections were first grouped by academic level: 1st, 2nd, and 3rd year. Then, using a random number generator [20], two class groups were selected from each group, resulting in three random sub-samples. The selected class groups were: Radiology Imaging and Midwives for the first year; Midwives and Anaesthesiology and Resuscitation for the second year; and Operating Instrumentation and Medical Biology for the third year. The sampling frame included all female students enrolled in these six selected class groups.

Male students were excluded, as the study focused on females due to the direct relevance of HPV-related diseases and vaccination to this population. This allowed the study to address sex-specific health concerns more accurately.

Random sampling across academic levels (first-, second-, and third-year students) was used to ensure diversity in educational background and enhance the representativeness of the study population.

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Educational Intervention

The Health Belief Model (HBM) was used as the theoretical framework on which the interventional study was centered. It aids in explaining and predicting health behaviours and is used in assessing health behaviour interventions by focusing on the attitudes and beliefs of individuals.

This psychological model includes several key concepts: perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy. The HBM has been extensively applied to examine beliefs and behaviors related to vaccination, helping to identify participants' perceptions of both diseases and vaccines [21-23].

In this study, the HBM guided both the construction of the questionnaire and the design of the educational video. The questionnaire explored four core constructs of the HBM, and the video was developed to target the same dimensions: it provided information on HPV risks and complications (severity), highlighted the prevalence of HPV infection (susceptibility), emphasized vaccine effectiveness and public health recommendations (benefits), and addressed concerns related to safety, stigma, and accessibility (barriers).

The HBM assumes that health-related action depends on the simultaneous occurrence of perceived susceptibility, perceived severity, perceived benefits, and low perceived barriers, in addition to cues to action and self-efficacy [24]. This framework is widely used in public health to design and evaluate interventions that aim to influence attitudes and health behaviors, particularly vaccination uptake [24, 25].

An educational intervention video (EIV) on HPV and cervical cancer was selected and adapted for use in this study. The original video, titled "Cervical Cancer: Prevention and Control," was published by the World Health Organization (WHO) in 2022 and accessed via the official WHO YouTube channel [26]. It was selected by the research team for its scientific accuracy, visual accessibility, and alignment with public health guidelines. The video addressed HPV transmission, the link between HPV and cervical cancer, preventive strategies, and the importance of HPV vaccination. The original language was English. French subtitles were added, and slides were integrated at the end to include Tunisian epidemiological data (cervical cancer incidence and HPV type distribution in Tunisia). These modifications were guided by national data published by the Tunisian Society of Gynecology and Obstetrics and the Ministry of Health, as reported by Bruni et al. [27].

The final version lasted 2 minutes and 28 seconds. It was projected in the classroom prior to a regular lecture session. A brief standardized oral introduction (less than one minute) was given by a member of the research team to introduce the video and encourage attention. No discussion or debriefing occurred after the video to avoid biasing the post-intervention questionnaire responses.

The choice of a short video was based on its low cost, reproducibility, and ease of dissemination, particularly in resource-limited settings.

Questionnaire

A structured questionnaire was designed to collect data. The questionnaire was adapted from previously published questionnaires, based on the study's objectives [28, 29]. It consisted of three parts. The first part included sociodemographic information (age, academic level). HPV vaccination status was not included as all participants were unvaccinated, given that the HPV vaccine was not yet available in the national immunization schedule at the time of data collection.

The second part comprised 35 items representing knowledge regarding HPV, cervical cancer, and HPV vaccination (items 1-9) as well as the four dimensions of the HBM (items 10-35): 'perceived severity' (six items), 'perceived susceptibility' (three items), perceived general benefits' (nine items), and 'perceived general barriers' (eight items).

The third part consisted of two closed questions on the intention to vaccinate and the place of the vaccine in the future, whether it should be included in the vaccination schedule or only available on request.

The questionnaire was pretested in a group of 15 female students who were not included in the final analysis. The pretest, conducted two weeks before the main data collection, aimed to assess clarity, comprehension, and structure of the items. Minor modifications were made to improve wording and formatting. Internal consistency of the HBM-related items was assessed using Cronbach's alpha.

Completion time was not limited but usually took less than 10 minutes.

Recruitment

The questionnaires were distributed to the female students at the beginning of the lectures. Participants were informed of the purpose of the study. Each student was interviewed before and after the EIV using the same questionnaire. Each participant gave written consent to participate in the study. The recruitment period started in November 2023 and ended in May 2024.

Outcome variables

The knowledge statements regarding HPV, cervical cancer, and the HPV vaccine were presented as multiple-choice responses (five items) and true or false responses (four items).

Knowledge was scored with 1 point per correct answer and 0 for incorrect ones. When two answers were correct, each was awarded 0.5 points. Perceptions of severity, benefits, and barriers were measured using a 7-point Likert scale (1-3: strongly disagree; 7: strongly agree), with item-specific scales for items 19 and 32 ("very unlikely" to "very likely") and item 29 ("not expensive" to "very expensive"). Perceived susceptibility was rated on a 0-100% scale, in 30% intervals.

Statistical analysis

Data were entered in Excel 2013 and analyzed using SPSS 23.0. Qualitative variables were expressed as

Tab. I. Distribution of included female students by academic year and selected class group.

Academic Year	Class groups	Included (n)	Total Enrolled (n)	Participation Rate (%)
Ast Year	Radiology Imaging	28	28	100
	Midwives	27	39	69.2
2nd Year	Midwives	33	34	97.1
	Anaesthesiology and Resuscitation	19	19	100
3rd Year	Operating Instrumentation	26	41	63.4
	Medical Biology	25	28	89.3
Total		158	548	28.8

proportions and percentages. Quantitative variables were presented as means and standard deviations, as normality was verified.

For item-level analysis, only matched pre- and post-intervention responses were included. Missing answers were treated as missing data without imputation.

For dichotomous variables, McNemar's chi-square test was used to assess changes between pre- and post-intervention responses. For continuous or scored data (*e.g.,* knowledge scores, perception scores), paired t-tests were performed. Normality of distributions was verified prior to analysis. A p-value < 0.05 was considered statistically significant.

Results

Socio-demographic Characteristics

Among the 548 eligible female students enrolled during the academic year, 189 were randomly selected for inclusion. Of these, 31 were excluded due to absenteeism, resulting in a final sample of 158 participants. Most participants were aged 18-20 years (n = 118; 74.7%), while 40 participants (25.3%) were aged 21-23 years.

Table I presents the distribution of participants by academic year and selected class groups. Thirty-eight percent of participants were enrolled in midwifery programs within the health science (n = 60; Tab. I).

A few responses were missing for certain items at either time point. As such, only paired responses were retained for the comparative analyses (Tab. II).

Effect of educational intervention video on Knowledge

The knowledge score was significantly increased after EIV from 4.23 ±1.64 to 6.16 ±1.48 (paired t-test, $p < 0.001$) (Fig. 1). There was a significant difference between the items assessing knowledge pre-EIV and post-EIV (Tab. II). Most of the female students understood that "cervical cancer is the biggest problem related to HPV", "HPV infection prevented by vaccination", and "HPV vaccine prevents cervical cancer" with a significant increase in correct responses after EIV, indicating a 33.2%, 26%, and 36.7% rise in correct responses (Tab. II). The proportion of female students who answered "yes" to the questions "HPV only affects women?", "HPV can be asymptomatic?", "Is HPV one of the most common sexually transmitted infections?" and "The cervical smear can detect the HPV virus" was decreased after the EIV (Tab. II).

Effect of educational intervention video on perceptions and attitudes

Perceived severity of HPV

The perceived severity of HPV score was significantly increased after EIV from 26.31 ± 5.58 to 28.59 ± 5.28 (paired t-test, $p < 0.001$) (Fig. 1B). EIV positively impacted the perceived severity of HPV (Table II). After EIV, many respondents perceived HPV infection as a serious condition with potential impact on long-term partner relationships ($p < 0.001$), physical health ($p = 0.022$), and mental health ($p < 0.001$) (Tab. II).

Perceived susceptibility of HPV vaccine

The perceived susceptibility of HPV vaccine score was significantly increased after EIV from 1.45 ± 0.58 to 1.94 ± 0.62 (paired t-test, $p < 0.001$) (Figure 1C). After EIV, many female students perceived the HPV vaccine as essential in preventing HPV, cervical cancer, and genital warts (Tab. II).

Perceived general benefits of HPV vaccine

The perceived general benefits of the HPV vaccine score were significantly increased after EIV from 39.95 ± 8.06 to 43.82 ± 7.35 (paired t-test, $p < 0.001$) (Fig. 1D). As illustrated in Table II, female students had a positive opinion that the HPV vaccine was effective in preventing HPV, genital warts, cervical cancer, and certain types of oral cancer.

Perceived general barriers to HPV vaccine

The score of perceived general barriers to the HPV vaccine did not differ between before (27.94 ± 6.28) and after EIV (27 ± 7.21) (paired t-test, $p = 0.191$) (Fig. 1E). However, there was a significant difference in the items "the vaccine is likely to cause significant side effects" and "i'd be embarrassed if other people knew I'd had the vaccine" between pre-EIV and post-EIV, showing an 18.3% and 4.4% decrease, respectively for correct responses (Tab. II).

Detailed item-level results are available in Supplementary Table I.

Tab. II. Effect of educational intervention video on knowledge, perceptions, and attitudes related to HPV.

Number	Items	Pre-intervention N (%)	Post-intervention N (%)	*p*-value
Items assessing knowledge				
I1	What is the most problem related to HPV?			
	Cervical cancer/ heart disease/ HIV/ Genital warts/ I don't know	105/0/0/40/0 (66.5)/(0)/(0)/(25.3)/(0)	165/0/0/73/0 (98.7)/(0)/(0)/(46.2)/(0)	< 0.001
I2	How is HPV spread?			
	Cough or sneeze/ Sexual contact/ Blood and body fluid contact/ I don't know	0/75/0/0 (0)/(47.5)/(0)/(0)	0/114/0/0 (0)/(72.2)/(0)/(0)	< 0.001
I3	How can HPV infection be prevented?			
	Abstinence/ Antibiotics/ Condoms/ vaccinated/ I don't know	11/2/0/107/0 (7)/(1.3)/(0)/(67.7)/(0)	24/0/0/148/0 (15.2)/(0)/(0)/(93.7)/(0)	< 0.001
I4	The HPV vaccine can prevent:			
	Genital warts/ Cervical cancer/ HIV/ herpes/ I don't know	38/92/0/0/0 (24.1)/(58.2)/(0)/(0)/(0)	77/150/0/0/0 (48.7)/(94.9)/(0)/(0)/(0)	< 0.001
I5	What is the main side effect of the HPV vaccine?			
	Vomiting/ Pain at blow site/ Headache/ Joint pain/ I don't know	0/68/0/0/1 (0)/(43)/(0)/(0)/(0.6)	0/91/0/0/0 (0)/(57.6)/(0)/(0)/(0)	< 0.001
I6	HPV affects only women?			
	Yes / No	130/28 (82.3)/(17.7)	97/61 (61.4)/(38.6)	< 0.001
I7	The HPV can be asymptomatic?			
	Yes / No	52/106 (33)/(67)	25/133 (15.8)/(84.2)	< 0.001
I8	Is HPV one of the most common sexually transmitted infections?			
	Yes / No	64/94 (40.5)/(59.5)	32/126 (20.2)/(79.8)	< 0.001
I9	The uterine cervix smear can detect the HPV virus?			
	Yes / No	53/105 (33.5)/(66.5)	22/136 (13.9)/(86.1)	< 0.001
Items assessing perceived severity				
I10	Is HPV embarrassing?			
	Strongly disagree (1 to 3)/ Agree (4 to 6)/ Strongly agree (7)	62/80/16 (38.6)/(49.4)/(9.5)	59/76/23 (37.5)/(48.3)/(14.2)	0.136
I11	Could HPV prevent a woman from getting pregnant?			
	Strongly disagree (1 to 3)/ Agree (4 to 6)/ Strongly agree (7)	46/89/23 (28.8)/(56.5)/(14.7)	33/105/20 (20.9)/(66.5)/(12.5)	0.062
I12	Could HPV damage relationships with short-term partners?			
	Strongly disagree (1 to 3)/ Agree (4 to 6)/ Strongly agree (7)	53/86/19 (33.5)/(54.5)/(19)	42/95/21 (26.6)/(60.1)/(13.3)	0.187
I13	Could HPV interfere with long-term partner relationships?			
	Strongly disagree (1 to 3)/ Agree (4 to 6)/ Strongly agree (7)	46/91/21 (28.7)/(57.8)/(13.5)	25/104/29 (15.8)/(65.8)/(18.4)	< 0.001
I14	Could HPV cause long-term damage to a woman's physical health?			
	Strongly disagree (1 to 3)/ Agree (4 to 6)/ Strongly agree (7)	24/94/40 (15.2)/(59.5)/(25.3)	9/107/42 (5.7)/(67.7)/(26.6)	0.022
I15	Could HPV affect a woman's mental health?			
	Strongly disagree (1 to 3)/ Agree (4 to 6)/ Strongly agree (7)	64/71/23 (40.5)/(44.9)/(14.6)	39/88/31 (24.4)/(56)/(19.6)	< 0.001
Items assessing perceived susceptibility				
I16	What is the risk of HPV infection without the HPV vaccine?			
	30%/60%/100%	46/81/31 (29.1)/(51.3)/(19.6)	24/45/89 (15.2)/(28.5)/(56.3)	< 0.001
I17	What is the risk of developing cervical cancer without the HPV vaccine?			
	30%/60%/100%	44/70/44 (27.8)/(44.3)/(27.8)	17/47/94 (10.8)/(29.7)/(60.5)	< 0.001
I18	What is the risk of getting genital warts without the HPV vaccine?			
	30%/60%/100%	50/74/34 (31)/(46.2)/(20.9)	26/54/78 (16.5)/(34.2)/(49.3)	< 0.001

▶

Tab. II *(follows).* Effect of educational intervention video on knowledge, perceptions, and attitudes related to HPV.

Number	Items	Pre-intervention N (%)	Post-intervention N (%)	*p*-value
Items assessing perceived general benefits				
I19	Is it likely that the benefits of the vaccine outweigh the potential side effects?			
	Very unlikely (1 to 3)/ Likely (4 to 6)/ Very likely (7)	43/105/10 (27.2)/(66.5)/(6.3)	34/109/15 (21.5)/(69)/(9.5)	0.053
I20	Is the HPV vaccine effective in preventing HPV infection?			
	Strongly disagree (1 to 3)/ Agree (4 to 6)/ Strongly agree (7)	23/114/21 (14.5)/(72.2)/(13.3)	11/109/38 (7)/(69)/(24)	< 0.001
I21	Is the HPV vaccine effective in preventing genital warts?			
	Strongly disagree (1 to 3)/ Agree (4 to 6)/ Strongly agree (7)	49/101/8 (31)/(63.9)/(5.1)	25/101/22 (15.8)/(70.3)/(13.9)	< 0.001
I22	One of the benefits of the vaccine is the feeling that I've done everything I can to protect myself from HPV.			
	Strongly disagree (1 to 3)/ Agree (4 to 6)/ Strongly agree (7)	34/100/24 (21.5)/(63.3)/(15.2)	18/100/40 (11.4)/(63.3)/(25.3)	< 0.001
I23	Is the HPV vaccine effective in preventing cervical cancer?			
	Strongly disagree (1 to 3)/ Agree (4 to 6)/ Strongly agree (7)	31/108/19 (19.7)/(68.4)/(12)	17/109/32 (10.8)/(69)/(20.2)	< 0.001
I24	Is the HPV vaccine effective in preventing certain types of oral cancer?			
	Strongly disagree (1 to 3)/ Agree (4 to 6)/ Strongly agree (7)	118/36/4 (74.7)/(22.8)/(2.5)	100/55/3 (63.3)/(34.8)/(1.9)	0.007
I25	Is the HPV vaccine effective in preventing the spread of HPV to partners?			
	Strongly disagree (1 to 3)/ Agree (4 to 6)/ Strongly agree (7)	51/92/15 (32.3)/(58.2)/(9.5)	34/105/19 (21.5)/(66.5)/(12)	0.051
I26	Is the HPV vaccine important for your health?			
	Strongly disagree (1 to 3)/ Agree (4 to 6)/ Strongly agree (7)	24/81/53 (15.2)/(51.3)/(33.5)	14/94/50 (8.9)/(59.5)/(31.6)	0.292
I27	One of the benefits of vaccination is peace of mind.			
	Strongly disagree (1 to 3)/ Agree (4 to 6)/ Strongly agree (7)	37/91/30 (23.5)/(57.6)/(19)	17/103/36 (10.8)/(65.2)/(24)	0.006
Items assessing perceived general barriers				
I28	Is it difficult to request the vaccine because it is associated with a sexually transmitted disease?			
	Strongly disagree (1 to 3)/ Agree (4 to 6)/ Strongly agree (7)	57/86/15 (36.1)/(54.4)/(9.5)	50/97/11 (31.7)/(61.4)/(7)	0.614
I29	How much do you think the vaccine costs?			
	Not expensive (1 to 3)/ Expensive (4 to 6)/ Very expensive (7)	35/103/20 (22.2)/(65.2)/(12.7)	38/106/14 (24)/(67.1)/(8.9)	0.587
I30	Is it a waste of time to receive several doses of the vaccine?			
	Strongly disagree (1 to 3)/ Agree (4 to 6)/ Strongly agree (7)	80/75/3 (50.7)/(47.5)/(1.9)	82/69/7 (51.9)/(43.7)/(4.4)	0.516
I31	Is the vaccination painful?			
	Strongly disagree (1 to 3)/ Agree (4 to 6)/ Strongly agree (7)	81/72/5 (51.3)/(45.6)/(3.2)	80/70/8 (50.6)/(44.3)/(5.1)	0.585
I32	Is the vaccine likely to cause significant side effects?			
	Very unlikely (1 to 3)/ Likely (4 to 6)/ Very likely (7)	69/83/6 (43.7)/(52.5)/(3.8)	98/57/3 (62)/(36.1)/(1.9)	< 0.001
I33	I'd be embarrassed if my partner knew I'd had the vaccine.			
	Strongly disagree (1 to 3)/ Agree (4 to 6)/ Strongly agree (7)	101/54/3 (63.9)/(34.8)/(1.9)	99/55/4 (62.6)/(34.8)/(2.5)	0.400
I34	I'd be embarrassed if other people knew I'd had the vaccine.			
	Strongly disagree (1 to 3)/ Agree (4 to 6)/ Strongly agree (7)	106/47/7 (67.1)/(28.5)/(4.4)	113/41/4 (71.5)/(26)/(2.5)	0.045
I35	Vaccination goes against my beliefs.			
	Strongly disagree (1 to 3)/ Agree (4 to 6)/ Strongly agree (7)	118/40/0 (74.7)/(25.3)/(0)	122/34/2 (77.2)/(21.5)/(1.3)	0.758

p-values were calculated using McNemar's test for paired categorical data. Slight discrepancies in sample sizes between pre- and post-intervention responses are due to unanswered items. Only paired responses were included in the statistical analysis for each question.

Tab. III. Intention to receive the HPV vaccine before educational intervention video

		Intention to receive the HPV vaccine			*p*-value
		No	Yes	No response	
Knowledge level	Low	17	28	2	0.44
	Medium	20	60	4	
	High	7	20	0	
Perceived severity of HPV level	Low	15	29	0	0.002
	Medium	25	49	1	
	High	4	30	5	
Perceived susceptibility of HPV vaccine level	Low	12	30	1	0.09
	Medium	27	47	2	
	High	5	31	3	
Perceived general benefits of HPV vaccine level	Low	17	23	3	< 0.001
	Medium	20	61	3	
	High	7	24	0	
Perceived general barriers to HPV vaccine level	Low	6	33	3	< 0.001
	Medium	24	51	2	
	High	14	24	1	

p-values were calculated using McNemar's test for paired categorical data.

Tab. IV. Changes in knowledge scores before and after EIV stratified by academic year.

	Educational background	Pre-intervention	Post-intervention	*p*-value
Knowledge score (±ET)	1st year	3.6 (± 1.6)	5.5 (± 1.7)	< 0.001
	2nd year	4.7 (± 1.3)	6.3 (± 1.2)	0.087
	3rd year	4.3 (± 1.6)	6.8 (± 1.1)	0.031
Perceived severity of HPV score (±ET)	1st year	25.7 (± 6.1)	28.5 (± 5.6)	< 0.001
	2nd year	27.3 (±)	29.7 (± 5.8)	< 0.001
	3rd year	25.5 (± 5.3)	27.6 (± 4.1)	0.011
Perceived susceptibility of HPV vaccine score (±ET)	1st year	1.5 (± 0.4)	2 (± 0.5)	0.001
	2nd year	1.6 (± 0.6)	2.1 (± 0.6)	< 0.001
	3rd year	1.2 (± 0.5)	1.8 (± 0.6)	0.003
Perceived general benefits of HPV vaccine score (±ET)	1st year	39.8 (± 7.8)	44.1 (± 6.5)	< 0.001
	2nd year	44.5 (± 6.5)	46.4 (± 7.4)	0.015
	3rd year	35.7 (± 7.4)	41.7 (± 6.5)	0.005
Perceived general barriers to HPV vaccine score (±ET)	1st year	29.6 (± 6.7)	29.2 (± 7.8)	< 0.001
	2nd year	27.1 (± 6.3)	25 (± 7.2)	< 0.001
	3rd year	27.1 (± 5.7)	26.7 (± 6.1)	< 0.001

p-values were calculated using paired t-tests.

Impact of academic level on response shifts

To examine the influence of academic level on EIV effectiveness, score changes were analyzed by year of study (Tab. IV). All groups showed improvements in knowledge and perceptions. First-year students recorded the highest score increases across most domains.

Participants' acceptability of the HPV vaccine before educational intervention video

108 (68.4%) participants intended to receive the HPV vaccine in the future if made available in Tunisia.

A significant relationship was found between the intention to receive the HPV vaccine and the levels of perceived severity, perceived general benefits of the HPV vaccine, and perceived general barriers to vaccination (Tab. III). However, no statistically significant difference was found with knowledge or perceived susceptibility levels (Tab. III).

Student attitudes toward HPV vaccine availability are summarized in Supplementary Table II.

The place of the HPV vaccine in Tunisia as perception of female students

50.6% of female students believe that the HPV vaccine should be available upon request and reimbursed, while 46.2% think it should be included in the Tunisian vaccination schedule.

Students suggested alternatives to the HPV vaccine, including well-established awareness campaigns aimed at educating younger generations about sexually

transmitted diseases (STD) at an early age, along with providing information on prevention methods.

Discussion

This study assessed the impact of an educational video (EIV) on the knowledge, perceptions, attitudes, and acceptability of HPV vaccination among female students at the Higher School of Sciences and Technology of Health in Sfax. The intervention was based on the Health Belief Model (HBM). To our knowledge, this is the first Tunisian study to evaluate such an intervention.

Although HPV vaccination is primarily recommended during adolescence, our target population included women aged 18 to 23. Many in this age group may have missed earlier vaccination opportunities. The vaccine remains beneficial in this age range and can still prevent HPV-related diseases. Assessing the views of this population helps guide future public health strategies.

The results show a significant improvement in knowledge and vaccine acceptability after exposure to the EIV. Beliefs related to HPV, cervical cancer, and attitudes toward HPV vaccination were evaluated using a structured self-administered questionnaire based on the five dimensions of the HBM. This instrument was administered both before (pre-test) and after (post-test) the intervention. The proportion of correct answers increased significantly between the pre- and post-intervention assessments.

Item-level analysis revealed substantial gains on questions related to HPV transmission, its link to cervical cancer, and vaccine effectiveness. These findings suggest that the video effectively addressed major misconceptions. However, more limited progress on items concerning HPV screening and its asymptomatic nature highlights areas for improvement in future educational tools.

Knowledge scores increased significantly after the intervention. This suggests a positive impact of the video. However, the absence of a control group limits causal interpretation. Other factors, such as prior exposure to related information or testing effects, could also explain part of the improvement.

Most students understood that the HPV vaccine prevents infection with a virus strongly linked to cervical cancer. Similar improvements were reported in other intervention studies [30–34].

In Africa, various educational and multicomponent strategies have been implemented to promote HPV vaccination [30]. For example, a study conducted in South Africa found high HPV vaccine acceptance among a well-educated cohort of Master of Business Administration students in KwaZulu-Natal [31]. Similarly, Redd et al. showed that educational tools effectively increased HPV vaccine intention in a Christian population in the US [32].

The EIV also reduced common misconceptions. Fewer participants believed that HPV is asymptomatic, affects only women, or can be detected through a cervical smear. Our results are consistent with those mentioned by Drokow et al., who observed that educational videos improved understanding of HPV and cervical cancer among Ghanaian adults [33]. In contrast, Ampofo et al. reported limited change in knowledge following a similar video intervention among high school students in Ghana [34]. This discrepancy may be due to differences in participants' age, educational background, or the format and content of the video used.

Correcting such misconceptions likely contributed to improved knowledge and perception scores. Eliminating false beliefs about HPV symptoms or gender restriction may have increased perceived susceptibility. A better understanding of vaccine efficacy may have reinforced perceived benefits and acceptability.

One factor that may explain the high baseline knowledge in certain areas is the academic background of participants. Thirty-eight percent were enrolled in midwifery programs within−the health science. These students may have had prior exposure to key concepts such as cervical screening, which could explain the relatively high performance on related questions.

The EIV significantly impacted HBM-related scores, especially in perceived severity, susceptibility, and general benefits. However, not all items within the severity dimension improved. Only two items showed statistically significant change. This suggests that participants may have already recognized the seriousness of HPV-related disease before the intervention. Future educational efforts may benefit from shifting focus away from severity and toward misconceptions, perceived susceptibility, and barriers to vaccination. These elements may have greater potential to influence decision-making. Public health actors in Tunisia should consider these insights when designing HPV awareness campaigns.

After the EIV, students showed stronger beliefs in HPV prevention. Scores related to perceived susceptibility and severity also increased. According to the HBM, these two factors combine to form the perceived threat [24].

Adolescents often show heightened awareness of sexually transmitted infections, especially males, and may engage in more risk-taking behaviors [35, 36]. The increase in perceived threat among female students is a positive sign. It may influence future choices related to sexual health. Similar patterns were reported in Egypt [37] and Sweden [38], where educational programs improved perceptions of susceptibility, severity, and benefits.

Subgroup analysis by academic year showed that first-year students gained the most in knowledge and perception scores. These students may be more receptive to structured content. This suggests that timing and tailoring interventions to the student's academic stage could increase impact.

Regarding perceived barriers, scores remained largely unchanged after the EIV. This contrasts with findings by Ebrahim Mahmoud et al., who reported significant improvement in all HBM dimensions after an intervention in Egyptian nursing students [39]. The lack of change may be due to the limited scope of our video. It emphasized disease burden, transmission, and benefits of vaccination. It did not focus on practical or

emotional barriers, such as fear of side effects, vaccine access, or social norms. These elements may need to be better addressed in future materials.

Regarding HPV vaccine acceptability, 68.4% of participants reported an intention to receive the vaccine if it becomes available in Tunisia. A previous Tunisian study from 2016 reported a higher acceptability rate of 90% among adolescents and young adult women [40].

We found a significant relationship between the intention to receive the vaccine and three HBM dimensions: perceived severity, perceived general benefits, and perceived general barriers. These associations are in line with other findings [41-46]. Despite these results, our study did not assess whether the changes in knowledge and perception would lead to actual vaccination. Measuring vaccine uptake over time requires longitudinal research. Future studies should explore the long-term behavioral impact of this type of intervention. For example, Kahn JA et al. showed that a higher likelihood of vaccination was linked to greater perceived severity and fewer practical barriers [42]. Our study is the first in Tunisia to examine the relationship between intention to receive the vaccine and perceived benefits among college-aged women. Previous research focused on adult women and parents [43, 44].

We did not find a statistically significant link between knowledge level and vaccination intention. This aligns with earlier studies [45, 46]. This result was expected because intention was measured before exposure to the educational video. In contrast, Jones M and Cook R reported that students who correctly answered two or more knowledge questions were up to eight times more likely to accept the vaccine [41]. Our intervention focused on immediate knowledge gain. We did not assess knowledge retention. Future research should include delayed follow-up to examine whether increased awareness persists and influences long-term decision-making.

Half of the female students in our study believed the HPV vaccine should be available upon request and covered by insurance. Additionally, 46.2% supported its inclusion in the Tunisian national vaccination schedule. These results differ from those of Gamaoun et al., who reported that 90% of adolescents and young adult women favored the inclusion of the HPV vaccine in the national immunization program [40]. The lower support observed in our study may reflect differences in awareness, perceived risk, or attitudes toward vaccination among older students. A more tailored educational model addressing the specific concerns of this age group may improve understanding and acceptance. Future studies should explore targeted interventions adapted to adult women's needs and reservations.

Strengths and Limitations

Our findings suggest that integrating structured educational interventions into academic programs can improve students' knowledge about HPV and its prevention. This can inform broader health education strategies. To our knowledge, this is the first randomized, school-based, face-to-face intervention in Tunisia assessing students' knowledge of HPV and cervical cancer prevention.

Despite the novelty of this study, it is not exempt from limitations. First, it included only female students from a single medical faculty and used a non-interactive video format, limiting the generalizability of the results. Broader studies, including participants from diverse socio-cultural and educational backgrounds, and using more engaging approaches, such as workshops or face-to-face sessions, to improve understanding and retention. Second, the study relied solely on quantitative data. Incorporating qualitative methods, such as focus groups or interviews, could help explain the reasoning behind participants' responses. These approaches would offer deeper insight into beliefs, attitudes, and social factors influencing vaccine acceptance and awareness. Finally, due to logistical and resource constraints, no control group was included. This limits the ability to attribute changes solely to the intervention. Although we observed statistically significant changes, the lack of a comparison group restricts the interpretation of efficacy. Future studies should include control groups to isolate the effects of educational interventions and account for confounding variables.

Conclusion

The EIV improved knowledge, corrected misconceptions, and increased HPV vaccine acceptability. Educational interventions based on health behavior models should be integrated into academic curricula to improve awareness and guide prevention strategies.

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Conflict of Interest statement

The authors declare that they have no conflict of interest.

Authors' contributions

All authors contributed to the design and implementation of the research, to the analysis of the results, and to the writing of the manuscript.

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Supplementary material

Tab. S1. Breakdown of Item-Level Changes in Perceived General Barriers to HPV Vaccination (Pre- and Post-EIV)

Barrier Item	Pre-EIV (n, %)	Post-EIV (n, %)	% Change (Correct Response)
The vaccine is likely to cause significant side effects	89 (56.3%)	60 (38.0%)	↓ 18.3%
I'd be embarrassed if other people knew I had received the vaccine	34 (21.5%)	27 (17.1%)	↓ 4.4%
The vaccine is too expensive	99 (62.7%)	101 (63.9%)	↑ 1.2%
I don't know where to get the vaccine	75 (47.5%)	73 (46.2%)	↓ 1.3%
The vaccine is not effective	41 (25.9%)	29 (18.4%)	↓ 7.5%

Tab. S2. Students' Attitudes Toward HPV Vaccine Availability Post-EIV	
Statement	**Agreement (n, %)**
The HPV vaccine should be available upon request and covered by health insurance	80 (50.6)
The HPV vaccine should be included in the Tunisian vaccination schedule	73 (46.2)
I would be willing to receive the vaccine if it became available	108 (68.4)