



## Research article

## Human papillomavirus (HPV) vaccine status and knowledge of students at a university in rural Thailand



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## ABSTRACT

**Background:** Human papillomavirus (HPV) is a sexually transmitted virus that causes cancers of the cervix, anus, vagina, penis, and oropharynx. HPV vaccination prevents HPV types that commonly cause these cancers. HPV vaccines have been approved in Thailand since 2007. However, the vaccination rate remains low, particularly in young people.

**Objectives:** This study aimed to investigate the information level regarding HPV infection and vaccination in the younger Thai population, the self-reported vaccination rate, the vaccine intention, and factors affecting the intention.

**Methods:** This cross-sectional study enrolled a total of 521 undergraduate students (77% female). We used a 34 items self-administered questionnaire (18 questions assessing knowledge level).

**Results:** The mean score of knowledge was  $7.53 \pm 4.95$  (total score 18), indicating a low-to-moderate level of knowledge. Female gender and health-related majors were significant factors associated with greater knowledge. The self-reported vaccination rate was 1.9% among only female participants. Only 30.3% of the unvaccinated subjects had the intention to receive the vaccine. The factors affecting vaccine intention were female gender and having knowledge score  $\geq 7$ . The barriers to HPV vaccination were cost (52.2%), and the perception of no need due to low-risk behavior (45.1%).

**Conclusion:** Education programs on HPV infection and vaccination should be included in the curriculum earlier, if possible, since primary school because the vaccine works best before the onset of sexual activity. In university students, the education programs may encourage the sexually inexperienced students to receive the vaccines, as they are still the ideal group for catch-up vaccination. Moreover, parental education is essential, as national vaccination programs usually target younger people. Knowledge sharing by educated people and organizations could enhance the information level in the communities. Consequently, people become aware of primary prevention by vaccination, which may lead to an increase in vaccination rates and eventually decrease HPV-related cancers.

## 1. Introduction

Human papillomavirus (HPV) is the most common sexually transmitted infection. The virus can spread through sexual contact or skin-to-skin contact and can be spread by an individual showing no signs and symptoms. There are over 200 types of HPV, which are classified into low- and high-risk types [1]. The low-risk types, such as HPV 6 and 11, cause 90% of anogenital warts. HPV 6 and 11 also cause respiratory papillomatosis, a potentially deadly disease. The high-risk types, such as HPV 16, 18, 31, and 33, cause most cervical cancers as well as cancers of the anus, vulva, vagina, penis, and oropharynx. Among the high-risk

types, HPV types 16 and 18 cause 70% of cervical cancers worldwide [2, 3, 4].

In Thailand, cervical cancer is the second most common cancer and the second leading cause of cancer death among females [5]. Although the incidence of HPV-related cancers other than cervical cancer is low, HPV infection is a significant risk factor for these cancers [3, 5]. Prevention of HPV infection, especially the high-risk types, would reduce the incidence of HPV-related cancers. There are two available prophylactic vaccines against HPV infection in Thailand (Cervarix® and Gardasil®). Both vaccines prevent HPV types 16 and 18. Gardasil® also prevents HPV types 6 and 11. The HPV vaccination is recommended for females aged 9

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through 26 years and males aged 13 through 21 years. Catch up vaccination to age 26 is recommended for men who have sex with men (MSM), transgender people, and immunocompromised persons [6, 7]. Both vaccines are safe (the most frequent adverse event being injection-site reactions) and effective at preventing disease related to the vaccine-specific genotypes [8, 9, 10].

Many countries have implemented publicly-funded HPV immunization programs since 2006. However, the vaccination coverage rate remains low in some countries, and the coverage rate is higher in the more developed regions compared to the less developed regions [11]. The Food and Drug Administration of Thailand has approved two HPV vaccines (Cervarix® and Gardasil®) since 2007. These vaccines were not included in the routine free national immunization program until the Ministry of Public Health implemented free vaccines for girls in fifth grade nationwide in 2017. Others besides girls in fifth grade should also receive vaccines [6, 7]. So far, there is no available data on HPV vaccination coverage across the country [5].

HPV vaccines are most effective when given before the onset of sexual activity. Approximately 67% of young Thai men and 34% of young Thai women have had sexual intercourse by age 16.7 years [12]. Moreover, more than half of young Thai people reported having unprotected sexual intercourse [12, 13, 14].

This study focused on young Thai people because they are at risk of HPV infection. In Thailand, approximately 62 % of secondary school graduates enter universities or colleges. Most students begin university at 18 years of age. The bachelor's degree typically takes four years to complete [15]. Therefore, more than half of young Thai people are students at colleges or universities. Previous studies reported a low HPV vaccination rate in female Thai university students, and the intention to be vaccinated was associated with knowledge related to HPV disease and vaccination [16, 17]. Currently, there are limited studies about knowledge regarding HPV and its vaccine among university students in Thailand, and they included only female participants.

This study aimed to investigate the information level regarding HPV infection and HPV vaccine in the younger Thai population, the self-reported vaccination rate, and the vaccine intention in unvaccinated subjects as well as the factors affecting vaccine intention.

## 2. Methods

### 2.1. Study design and participants

This is a cross-sectional study conducted from July to December 2018. The study was approved by the Human Research Ethics Committee of Walailak University, certification ID number WUEC-18-066-01. We recruited participants at the student's semester meeting. The eligible criteria were undergraduate students at Walailak University, aged more than 18 years, and willing to participate after giving informed consent. The paper-based questionnaire was given to the eligible participants before the meeting and collected at the end of the meeting by the principal investigator.

### 2.2. Measurements

An anonymous self-administered questionnaire consisted of three parts and contained 34 questions in total (Appendix). Part 1 explored demographics and sexual history. The demographics included age, gender, religion, year of study, the study major, and family's monthly income. The study major was categorized either as a health-related major or a non-health related major. Health-related majors included the students who were studying in the School of Medicine, School of Nursing, School of Pharmacy, School of Allied Health Sciences, and School of Public Health. Non-health related majors were the others besides the five schools mentioned in the health-related majors. The sexual history addressed (a) ever had sex; (b) condom use; (c) age of initiation; (d) the number of lifetime partners; (e) ever had a sexually transmitted disease;

and (f) the type of intercourse. The type of intercourse included oral, vaginal, and anal intercourse. Participants could choose more than one option.

Part 2 consisted of 18 questions regarding knowledge about HPV infection and HPV vaccine. The questions were developed from previous studies [18, 19]. In this study, we focused on accessing knowledge regarding (a) behaviors that increase the risk of HPV infection; (b) HPV-related disease, especially cancers; and (c) HPV vaccine's efficacy and safety. The answers were "true," "false," or "do not know." One point was given for each correct answer, and no point was given to "do not know." A summation of all items produced a total score, with a higher score reflecting greater knowledge. The level of knowledge was categorized into low ( $\leq 10$  scores), moderate (11–13 scores), and high ( $\geq 14$  scores).

A pilot study was carried out to examine the validity and reliability of the questionnaire. The validity of using item-objective congruence (IOC) was calculated from the scores given by three medical oncologists. The average score of item-objective congruence (IOC) was 0.94. The reliability measured by Cronbach's alpha was 0.937.

Part 3 determined self-reported HPV vaccination status, intention to receive the vaccine among unvaccinated subjects, and reasons for not wishing to be vaccinated.

### 2.3. Statistical analysis

Statistic Package for Social Sciences (SPSS) version 25 was used for data analyses. Descriptive statistics were used to describe the demographic characteristics of the participants. The means between two groups were compared using the independent t-test. Logistic regression was performed to identify the significant factors associated with HPV infection and its vaccine knowledge, and intention to receive the vaccine among unvaccinated subjects.

## 3. Results

### 3.1. Demographics of participants

A total of 600 students were invited to participate, and 572 (95%) of them returned the questionnaires. Fifty-one participants were excluded due to incomplete responses. Therefore, a total of 521 students (91%) were included for data analysis. The mean age of the participants was 19.8 years (SD = 1.2, range 17–25). As shown in Table 1, most of the participants were females (77%), in the first year at the university (42%), Buddhists (78.9%), in non-health related majors (54.3%), and with a family monthly income of 500–1000 USD (45.9%). About 85.8% of the participants reported never having had sexual intercourse, and 3.6% did not answer this question.

Among 55 participants who reported ever having had sexual intercourse, most of them were female (54.5%) and studied in non-health related majors (70.9%). The mean age of first sexual intercourse was 17.7 years (SD = 2.2, range 7–21). About 43.6% had had more than one-lifetime sexual partners. Only 58.2% had used a condom during every incidence of sexual intercourse. None of the participants has ever had a sexually transmitted disease. Among 25 male participants who ever had sex, 24% were men who have sex with men (MSM).

### 3.2. Knowledge about HPV infection and its vaccine

Among the participants, 43.6% had heard about HPV infection, and 25.3% had heard about the HPV vaccine. Participants were asked to select either one or more sources of information where they have heard about HPV infection and its vaccine. The most common source of information about HPV infection was from the Internet (37.8%), followed by teachers (31.7%), television (22.1%), healthcare providers (21.9%), brochures (16.7%), posters (14.2%), family (9.4%), friends (9.6%), and radio (6.0%). The main sources of information about the HPV vaccine

**Table 1.** Demographic variables (N = 521).

	N (%)
<b>Gender</b>	
Female	401 (77.0)
Male	120 (23.0)
<b>Religion</b>	
Buddhism	411 (78.9)
Muslim	101 (19.4)
Christian	3 (0.6)
Others	6 (1.2)
<b>Major</b>	
Health-related	238 (45.7)
Non-health related	283 (54.3)
<b>Year of study</b>	
1 <sup>st</sup>	219 (42.0)
2 <sup>nd</sup>	154 (29.6)
3 <sup>rd</sup>	72 (13.8)
4 <sup>th</sup>	67 (12.9)
5 <sup>th</sup> or more	9 (1.7)
<b>Family's monthly income (USD)</b>	
<500	102 (19.5)
500–1000	234 (45.9)
1001–1500	105 (20.2)
1501–3000	55 (10.6)
> 3000	20 (3.8)
<b>Ever had sex</b>	
Yes	55 (10.6)
Never	447 (85.8)
Not answered	19 (3.6)

were from the Internet (20.5%), teachers (17.3%), and healthcare providers (12.5%). Other sources, such as brochures, posters, television, friends, and family, accounted for less than 10%.

The mean knowledge score for HPV infection and its vaccine was 7.53 (SD 4.95, range 0–17). The percentage of participants' correct answers are displayed in Table 2. Regarding the knowledge about HPV-related diseases, approximately 60% of the participants did not know that HPV

infection causes genital warts. Only 33% of the participants answered correctly that HPV infection causes anal cancer and penile cancer. Only 22.1% of the participants responded correctly that HPV infection causes oropharyngeal cancer. More than half of the participants (52.8%) knew that HPV causes cervical cancer.

Regarding the knowledge on HPV transmission, approximately 65% of the participants knew that HPV spreads by sexual contact and causes infection in both men and women, and 52.4% knew that having sex at an early age increases the risk of HPV infection. Most participants (73.9%) knew that having multiple sexual partners increases the risk of HPV infection. However, 49.7% of the participants were aware that using a condom prevents HPV infection.

Regarding the knowledge about HPV vaccination, approximately 35% of the participants knew that the vaccine is safe, and 38% knew that the vaccine has high efficacy. Only 31.7% of the participants knew that vaccine works best if taken before the onset of sexual activity. Only 4.4% of the participants knew that the HPV vaccine effect might decrease in persons who already have sexual activities. More than half of the participants (57%) did not know that the vaccine protects against HPV infection in both men and women.

As displayed in Table 3, we use a median score of 7 as a cut-off for defining low and high knowledge groups. Being female (OR: 2.1, CI: 1.4–3.2) and studying health-related majors (OR: 3.6, CI: 2.5–5.4) were associated with high knowledge of HPV infection and its vaccine (score  $\geq 7$ ).

### 3.3. Self-reported vaccination rate and vaccine intention among unvaccinated subjects

Only ten participants (all female) reported receiving at least one dose of the HPV vaccine. The overall self-reported rate was only 1.9%. Among 511 of the unvaccinated participants, only 158 (30.3%) reported the intention to receive vaccines. In the group intending to receive vaccines, the mean score of knowledge about HPV and its vaccine ( $8.56 \pm 4.71$ ) was higher than the group with no intention to be vaccinated ( $7.06 \pm 5.01$ ,  $p = 0.002$ ).

Among the unvaccinated participants, being female (OR: 1.6, CI: 1.0–2.7), having heard about HPV infection (OR: 1.5, CI: 1.0–2.3), having heard about the HPV vaccine (OR: 2.2, CI: 1.4–3.4), and having HPV and its vaccine knowledge score  $\geq 7$  (OR: 1.7, CI: 1.1–2.5) were significantly

**Table 2.** Participants' answers for each question about human papillomavirus and its vaccine (N = 521).

Question	Correct answer	True N (%)	False N (%)	Do not know N (%)
1. HPV infection is transmitted by sexual contact	True	340 (65.3)*	31 (6.0)	150 (28.8)
2. People can transmit HPV to their partners even if they have no symptoms of HPV infection	True	291 (55.9)*	54 (10.4)	176 (33.8)
3. Having sex at an early age increases the risk of HPV infection	True	273 (52.4)*	62 (11.9)	186 (35.7)
4. Having multiple sexual partners increases the risk of HPV infection	True	385 (73.9)*	17 (3.3)	119 (22.8)
5. In most cases, HPV infected persons do not show symptoms	True	198 (38.0)*	79 (15.2)	244 (46.8)
6. HPV infection can be prevented by using a condom	True	259 (49.7)*	52 (10.0)	210 (40.3)
7. Both male and female can be infected with HPV	True	337 (64.7)*	39 (7.5)	145 (27.8)
8. HPV infection can cause genital warts	True	219 (42.0)*	39 (7.5)	263 (50.5)
9. HPV infection is the risk factor for cervical cancer	True	275 (52.8)*	20 (3.8)	226 (43.4)
10. HPV infection is the risk factor for anal cancer	True	176 (33.8)*	68 (13.1)	277 (53.2)
11. HPV infection is the risk factor for penile cancer	True	172 (33.0)*	65 (12.5)	284 (54.5)
12. HPV infection is the risk factor for oropharyngeal cancer	True	115 (22.1)*	118 (22.6)	288 (55.3)
13. HPV vaccine has high efficacy	True	198 (38.0)*	27 (5.2)	296 (56.8)
14. Assumed to have lifelong protection	True	96 (18.4)*	145 (27.8)	280 (53.7)
15. HPV vaccine is safe	True	179 (34.4)*	35 (6.7)	307 (58.9)
16. HPV vaccine protects against HPV infection in both men and women	True	224 (43.0)*	44 (8.4)	253 (48.6)
17. HPV vaccine is best taken before starting to have sexual activities	True	165 (31.7)*	53 (10.2)	303 (58.2)
18. HPV vaccine has the same effect in persons who are already sexually active	False	224 (43.0)	23 (4.4)*	274 (52.6)

\* Answer correctly.

associated with the intention to receive the vaccine (Table 4). None of the men had received the vaccine, and 76.6% of them reported no intention to do so. Compared to other years, more students in their first year of study had no intention to receive the vaccine (OR: 0.5, CI: 0.3–0.8,  $p = 0.001$ ).

Among the 353 with no intention to receive the HPV vaccine, 253 (71.6%) indicated why they did not want to be vaccinated. The reasons included the cost of the vaccine (52.2%), no need due to low-risk behavior (45.1%), do not know enough about vaccines (1.9%), and fear of needles (0.8%).

#### 4. Discussion

This is the first quantitative study to explore self-reported vaccination rate, the intention to receive the HPV vaccine, and knowledge of HPV and its vaccine among both male and female university students in Thailand. Participants had a mean score of knowledge regarding HPV infection and its vaccine of 7.53 (total score 18), indicating low to moderate knowledge. Most of the participants knew how HPV is transmitted and which sexual behaviors can reduce or increase the risk of infection. Participants knew that HPV could be transmitted from an asymptomatic person, but they did not know that most cases of HPV infection do not show symptoms. These results were consistent with previous studies at other universities in Thailand and other countries [17, 18, 19, 20]. It is necessary to emphasize that most of the HPV infected persons do not show signs and symptoms. Therefore, consistent condom use is encouraged to reduce unexpected transmission of HPV or other sexually transmitted diseases (STDs) [21].

In terms of knowledge of HPV-related cancers, most earlier studies focused on only cervical cancers, which report findings consistent with our study, demonstrating that most of the participants knew about HPV as a cause of cervical cancers [16, 17, 19]. In our perspective, it is important to access the knowledge of other HPV-related cancers other than cervical cancer. This is because there are various types of sexual contact (vaginal, anal, and oral) that can increase the risk of other HPV-related cancers. We found that most of the participants did not know about HPV as a cause of penile cancer, anal cancer, and oropharyngeal cancer. This result suggests that we should increase the awareness of every HPV-related cancer.

Even though consistent use of a condom provides good protection against HPV infection, HPV infection can still occur [22, 23]. Therefore, HPV vaccination is essential for preventing HPV infection and HPV-related diseases. We found that only 25.3% of the participants had ever heard about the HPV vaccine. Most participants answered “did not know” for every question regarding the HPV vaccine, indicating a low knowledge about the HPV vaccine. The factors associated with better knowledge were being female and studying a health-related major, which is in line with a study from the US [18]. Females might have greater knowledge because of the high prevalence of cervical cancer so that they have likely heard about HPV infection and its vaccine as part of cervical cancer prevention programs.

The Internet and teachers are the main sources of knowledge, indicating that health education in university should be encouraged for all majors. Social media, such as Facebook and Instagram, are used worldwide, and these can play an important role in the rapid distribution of knowledge to the public.

In this study, only ten female participants (1.9%) reported receiving HPV vaccination. The results were compatible with earlier studies showing a vaccination rate of less than 3.3% [16, 17]. No male participants in this study have received the HPV vaccine. This might be explained by the fact that HPV vaccines have not been incorporated into the national immunization program. The vaccination rate in our study was lower than the global HPV vaccine coverage rate of 39.7 % among the targeted females (aged 9–45 years) in countries that have implemented publicly funded HPV immunization programs [11].

Nevertheless, this rate can be improved through the government's help, as seen in the data of the HPV pilot project, which was supported by the Ministry of Public Health of Thailand. The project included female students in the fifth grade in Ayutthaya, Thailand, during 2014, who received a two-dose immunization against HPV, resulting in a vaccine coverage rate of 87%. In 2017, the government implemented vaccination nationwide for 9-year-old girls, which will increase the vaccination coverage rate among the female population [24]. However, HPV vaccines are also recommended for females between 9 and 26 years old who have not yet been vaccinated. The vaccines should also be given to the high-risk male population, such as those who have sex with men or those with HIV [6].

**Table 3.** Logistic regression analysis of independent factors for knowledge about human papillomavirus and its vaccine (N = 521).

Variables	Group N (%)		OR (95% CI)	p-value
	High knowledge Score $\geq 7^*$ (N = 303)	Low knowledge Score $< 7^*$ (N = 218)		
<b>Sex</b>				
Female	250 (82.5%)	151 (69.3%)	2.1 (1.4–3.2)	<0.001
Male	53 (17.5%)	67 (30.7%)	0.5 (0.3–0.7)	<0.001
<b>Major</b>				
Health-related	177 (58.4%)	61 (28.0%)	3.6 (2.5–5.4)	<0.001
Non-health related	126 (41.6%)	157 (72.0%)	0.3 (0.2–0.4)	<0.001
<b>Year of study</b>				
1 <sup>st</sup> year	121 (39.9%)	98 (45.0%)	0.8 (0.6–1.2)	0.252
2 <sup>nd</sup> year	83 (27.4%)	71 (32.6%)	0.8 (0.5–1.2)	0.202
3 <sup>rd</sup> year	45 (14.9%)	27 (12.4%)	1.2 (0.7–2.2)	0.421
4 <sup>th</sup> year	46 (15.2%)	21 (9.6%)	1.7 (0.9–3.1)	0.062
5 <sup>th</sup> year or more	8 (2.6%)	1 (0.5%)	5.9 (0.8–262.3)	0.059
<b>Ever had sex</b>				
No	265 (87.5%)	182 (83.5%)	1.4 (0.8–2.3)	0.200
Yes	27 (8.9%)	28 (12.8%)	0.7 (0.4–1.2)	0.150
Not answered	11 (3.6%)	8 (3.7%)	1.0 (0.4–2.9)	0.981

OR = unadjusted odds ratio; CI = confidence interval.

\* The participants received one point for each correct answer. We used a median of 7 as a cut off to classify into low and high knowledge group, with a higher score indicating a greater knowledge about HPV and its vaccine.

**Table 4.** Logistic regression analysis of independent factors for intention to receive the HPV vaccine among unvaccinated participants (N = 511).

Variables	Group N (%)		OR (95% CI)	p-value
	Intention to receive vaccines (N = 158)	No intention to receive vaccines (N = 353)		
<b>Sex</b>				
Female	130 (82.3%)	261 (73.9%)	1.6 (1.0–2.7)	0.040
Male	28 (17.7%)	92 (26.1%)	0.6 (0.4–1.0)	0.040
<b>Religion</b>				
Buddhism	123 (77.8%)	281 (79.6%)	0.9 (0.6–1.5)	0.652
Muslim	34 (21.5%)	64 (18.1%)	1.2 (0.8–2.0)	0.369
Others	1 (0.6%)	8 (2.3%)	0.3 (0.0–2.1)	0.195
<b>Major</b>				
Health-related	77 (48.7%)	155 (43.9%)	1.2 (0.8–1.8)	0.311
Non-health related	81 (51.3%)	198 (56.1%)	0.8 (0.6–1.2)	0.311
<b>Year of study</b>				
1 <sup>st</sup> year	49 (31.0%)	166 (47.0%)	0.5 (0.3–0.8)	0.001
2 <sup>nd</sup> year	53 (33.5%)	97 (27.5%)	1.3 (0.9–2.0)	0.164
3 <sup>rd</sup> year	28 (17.7%)	44 (12.5%)	1.5 (0.9–2.6)	0.114
4 <sup>th</sup> year	25 (15.8%)	41 (11.6%)	1.4 (0.8–2.5)	0.190
5 <sup>th</sup> year or more	3 (1.9%)	5 (1.4%)	1.4 (0.2–7.0)	0.685
<b>Family's monthly income (USD)</b>				
<500	25 (15.8%)	73 (20.7%)	0.7 (0.4–1.2)	0.197
500–1000	69 (43.7%)	162 (45.9%)	0.9 (0.6–1.4)	0.641
1001–1500	32 (20.3%)	71 (20.1%)	1.0 (0.6–1.6)	0.971
1501–3000	21 (13.3%)	33 (9.3%)	1.5 (0.8–2.8)	0.180
>3000	8 (5.1%)	11 (3.1%)	1.7 (0.6–4.6)	0.282
<b>Ever had sex</b>				
No	137 (86.7%)	301 (85.3%)	1.1 (0.6–2.1)	0.667
Yes	14 (8.9%)	41 (11.6%)	0.7 (0.4–1.4)	0.353
Not answered	7 (4.4%)	11 (3.1%)	1.4 (0.5–4.2)	0.456
<b>Have heard of HPV infection</b>				
No/Not sure	79 (50.0%)	213 (60.3%)	0.7 (0.4–0.9)	0.029
Yes	79 (50.0%)	140 (39.7%)	1.5 (1.0–2.3)	0.029
<b>Have heard of HPV vaccine</b>				
No/Not sure	103 (65.2%)	284 (80.5%)	0.5 (0.3–0.7)	<0.001
Yes	55 (34.8%)	69 (19.5%)	2.2 (1.4–3.4)	<0.001
<b>HPV and its vaccine knowledge score (Total 18 score)</b>				
<7	53 (33.5%)	161 (45.6%)	0.6 (0.4–0.9)	0.011
≥7	105 (66.5%)	192 (54.4%)	1.7 (1.1–2.5)	0.011

OR = unadjusted odds ratio; CI = confidence interval.

Therefore, interventions aiming to increase HPV vaccination among the at-risk unvaccinated population who might not be covered by the government are still needed for preventing HPV-related diseases. The HPV vaccine works best when given before the onset of sexual activity. The sexually active people might receive less benefit because they might have already been exposed to one or more of the HPV types targeted by the vaccine [25].

Most of the participants (85.8%) in this study had never had sexual intercourse, and all of them were less than 26 years old, so catch up vaccination can provide unvaccinated participants with substantial benefits. However, only 30.3% of unvaccinated participants in this study had the intention to receive the vaccine. We found a significant association between the intention to receive the vaccine and the female gender, have heard about HPV infection, have heard about the HPV vaccine, and knowledge score of HPV infection and its vaccine  $\geq 7$ . Other studies among university students in other countries have reported similar findings, showing that women had a higher intention of receiving the vaccine than men [18, 26, 27]. The data reported here are consistent with earlier studies, which found an association between a higher knowledge of HPV and its vaccines and the intention to receive the vaccine [18, 28].

Due to a high prevalence of cervical cancer in Thailand, primary prevention (HPV vaccination) and secondary prevention (cervical cancer

screening and treatment of cervical precancerous lesions) are necessary strategies to reduce the incidence of cervical cancer effectively [29]. To date, there is no data on the nationwide HPV vaccination coverage rate in Thailand. The cervical cancer screening coverage was 60.2% among women aged 30–59 years [5]. The previous study found that people who reported ever screening cervical cancer had a higher rate of HPV knowledge [29]. Therefore, education aiming to enhance information level regarding HPV infection and HPV vaccination would increase the vaccination rate and cervical cancer screening rate. Consequently, cervical cancer incidence would reduce.

This study found that the cost of vaccines was the most common barrier to receiving HPV vaccines among unvaccinated participants. Logistic regression showed a trend of association of greater family's monthly income and intention to receive the vaccine, but the statistics were not significant.

Finally, perceiving no need for vaccination due to low-risk behavior was a significant barrier to receiving the vaccine that needs to be corrected. It is important to emphasize to the students that low-risk behavior does not mean zero possibility of becoming infected; they should always have consistent, safe sex along with HPV vaccination.

There were several limitations to this study. First, the samples were limited to university students from a single university located in a rural

Southern part of Thailand, which might not be generalized to other regions or populations. Second, the questionnaire was given to all participants at the same time. The participants might have copied the answer from the person sitting next to them, which can interfere with the total score of knowledge. The rate of sexual intercourse might also have been underestimated because of a fear of the response being seen by their friends; it is against the cultural norm to have sex before marriage. Finally, the HPV vaccination rate might be inaccurate due to recall bias.

## 5. Conclusion

The results of this study demonstrate the need for education programs on HPV infection and vaccination. The programs should be incorporated into the curriculum for all levels of educations, i.e., higher education, secondary education, and primary education. Early education among primary school students and secondary school students is necessary because the HPV vaccine works best before the onset of sexual activity.

In addition, parental education is essential if national vaccination programs are implemented, as these usually target younger people. In university students, the education programs may encourage the sexually inexperienced students to receive the vaccines, as they are still the ideal group for catch-up vaccination. Education programs could also encourage the group of at-risk people who are ineligible for publicly funded immunization programs to receive the vaccines.

The students themselves can also play a vital role in sharing knowledge with their friends, families, and communities. Using social media wisely (by teachers, students, and either public or private health organizations) can help spread the information about the HPV infection and HPV vaccine.

Improving knowledge about HPV infection and its vaccine can increase awareness of primary prevention by vaccination and safe sex behavior, which will eventually decrease the incidence of HPV infection and HPV-related diseases, especially HPV-related cancers. Moreover, other sexually transmitted diseases (STD) would also be decreased due to an increase in awareness of the importance of safe sex behavior.

## Declarations

### Author contribution statement

W. Chanprasertpinyo and C. Rerkswattavorn: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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### Competing interest statement

The authors declare no conflict of interest.

### Additional information

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