



Human papillomavirus vaccination status among university students in Southern Thailand: A cross-sectional study

Supinya Sono^{*}, Natthapong Sukhanonsawat, Nuttida Naknuan, Pitchaya Auttasongkroh, Rinrada Suwanno, Karunyapas Kiratikosol, Kanatad Sookpong, Nichakarn Sukpornsinchai, Ladapa Sirikornpinyo, Witchaya Nakarae, Suchawadee Laomanachareon

Department of Family and Preventive Medicine, Faculty of Medicine, Prince of Songkla University, 15 Kanchanavanit Road, Hat Yai, Songkhla, 90110, Thailand

ARTICLE INFO

Keywords:
HPV
HPV vaccine
Coverage
Prevention
University
Student
Young adult

ABSTRACT

Objective: Human papillomavirus (HPV) commonly causes transmissible diseases worldwide; however, HPV vaccines are not available among some at-risk populations. Since 2017, HPV vaccination has been recommended for females aged 11–12 years in Thailand. However, studies on the coverage and HPV vaccination prevalence are limited. This study aimed to explore the prevalence and factors associated with HPV vaccination among Thai university students.

Methods: Data for this cross-sectional study were randomly collected using paper-based questionnaires from university students aged 18–26 years during October 17–27, 2023.

Results: Of 1,093 participants, 57.6 % were female, and 53.5 % were from non-urban areas. The median age was 20 years. One-third of the participants were from low-income families. The overall HPV vaccine coverage rates were 7.51 % and 0.87 % in female and male students, respectively. Female sex, being from a high-income family, studying in health science faculties, originating from an urban area, having one or both parents completing university educations, and having healthcare providers as family members increased the odds of receiving the HPV vaccine. The accuracy of HPV vaccine literacy among participants who reported that they “know about the HPV vaccine” was adequate, except for the fact that HPV vaccine was sex-neutral.

Conclusions: The HPV vaccine coverage rate among Thai university students was low owing to several factors. HPV and HPV vaccine education should be provided to populations that can still benefit from receiving the HPV vaccine.

1. Introduction

Human papillomavirus (HPV) infections, especially high-risk types, cause cervical cancer in females (Zhang et al., 2020; Burd, 2003). Currently, there are more than 40 types of HPV; however, the high-risk types associated with cancer include HPV types 16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, and 59 (Burd, 2003). Among the high-risk types, types 16 and 18 cause approximately 70 % of cervical cancers, while types 31, 33, 45, 52, and 58 cause the remaining 20 % (World Health Organization, 2022). HPV causes not only cervical cancer in females but also several diseases in both sexes, such as anogenital warts, oropharyngeal cancer, and congenital laryngeal papillomas, which are incurable (Dunne and Park, 2013). HPV infection is one of the most common

sexually transmitted infections (Plotzker et al., 2023). Several risk factors for HPV infection may lead to cervical cancer in the future, such as multiple sexual partners, early age at first sexual intercourse, non-monogamous male partners, high parity, and cigarette smoking (Chelimo et al., 2013; Plummer et al., 2012).

HPV vaccines can effectively prevent HPV infection before the first sexual intercourse (Onuki et al., 2022; Kamolratanakul and Pit-itsuttithum, 2021). Currently, three types of HPV vaccine are available worldwide: bivalent, quadrivalent, and nonavalent. The bivalent vaccine prevents HPV types 16 and 18 infections, which are the major causes of cervical cancer. The quadrivalent vaccine prevents HPV types 6, 11, 16, and 18 infections. The nonavalent vaccine prevents HPV types 6, 11, 16, 18, 31, 33, 45, 52, and 58 infections (Kamolratanakul and

Abbreviation: HPV, human papillomavirus.

** Corresponding author.*

E-mail address: supinya.so@psu.ac.th (S. Sono).

<https://doi.org/10.1016/j.pmedr.2024.102857>

Received 24 January 2024; Received in revised form 7 August 2024; Accepted 8 August 2024

Available online 13 August 2024

2211-3355/© 2024 Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Pituitthum, 2021). HPV vaccination is recommended for maximum benefit at ages 9–26 years to ensure protection against HPV infections before the first sexual intercourse (Rahangdale et al., 2022; Meites et al., 2019). For those aged 27–45 years, vaccination may still provide some benefits, but it is not recommended for those aged > 45 years (Meites et al., 2019).

Because cervical cancer is a serious public health concern, the World Health Organization (WHO) has launched a global strategy to reduce the number of cervical cancer cases to 4 per 100,000 in all populations and ensure that 90 % of females are fully vaccinated against HPV by the age of 15 years by 2030 (World Health Organization, 2022). Even with the recommendations for HPV vaccination since 2006 (Wethington et al., 2008), these vaccines are still not available among some at-risk populations. In 2020, only 55 % of the member countries recommended the HPV vaccine, with varying vaccination coverage rates owing to different public health policies. In 2011, the Centers for Disease Control and Prevention recommended routine sex-neutral HPV vaccination for the prevention of genital warts caused by HPV (Meites et al., 2019). In 2010, only 15 % of females worldwide received adequate vaccination protection (Rahangdale et al., 2022; Bruni et al., 2021). In Thailand, there are no official data on HPV vaccine coverage among the population (Chanprasertpinyo and Rerkswattavorn, 2020). Although the WHO recommendations for HPV vaccination suggest vaccination in males and females, almost 70 % of the 141 global vaccination programs are provided only for females (Dykens et al., 2023). In Thailand, as a public policy, two free doses of the HPV vaccine have been provided to all females aged 11–12 years since 2017 (Ngamphaiboon, 2022). The remaining data show that the coverage is still limited (Ngamphaiboon, 2022). However, previous studies from other geographic areas have shown that many factors, such as health literacy levels, education levels, socioeconomic statuses, HPV vaccine hesitancy, and healthcare provider involvement, were associated with HPV vaccine reception (Lelliott et al., 2023; Chanprasertpinyo and Rerkswattavorn, 2020; Alhusayn et al., 2022; Fiks et al., 2013).

This study aimed to evaluate the status of the HPV vaccine, including its coverage rate, factors associated with vaccine reception, health literacy regarding the HPV vaccine, and HPV vaccine hesitancy among the university students who belong to the young adult group in Thailand.

2. Materials and Methods

2.1. Study design and setting

This cross-sectional study was conducted at the largest of 14 universities in Southern Thailand, representing approximately 12 % of students in the region. During October 17–27, 2023, students aged 18–26 years were included in this study. The survey was conducted in public areas of the university, such as the university's common areas, canteens, dormitories, and each faculty's common area, using a paper-based questionnaire. In total, 1,200 questionnaires were distributed together with information and consent documents. Students interested in participating could sign the consent form, complete the questionnaire, and then return it to the distributors or put it in the return box in certain common areas. The participants were not required to provide personal information, such as student identification numbers, because the researcher kept the responses anonymous. The questionnaire distribution was assigned to reach all common areas in the university. Neither gift nor monetary compensation were provided for the participants.

The sample size was calculated using the infinite population proportion formula, using 0.15 as the proportion of HPV vaccine coverage (Bruni et al., 2021). The estimated sample size ranged from 196 to 4,989, depending on the margin of error of 0.01–0.05. However, a margin of error of 0.04–0.08 at the 95 % confidence level is usually considered acceptable. We first set the margin of error at 0.03 + 10 % of incomplete data, resulting in a sample size of 600. However, we aimed to collect the highest number of responses possible to increase the

confidence level of the analysis. Finally, the total number of students who participated in this study was 1,093.

This study was approved by the Research Ethics Committee of the Faculty of Medicine, Prince of Songkhla University (REC. 66–404–9–1).

2.2. Questionnaire and data collection

This study collected data using a recently developed Thai language paper-based questionnaire. The questionnaire consisted of four parts. The first part included respondents' demographics, including biological sex, age, faculty, religion, hometown, family income, paternal and maternal highest level of education, siblings, family history of cervical cancer, and having healthcare providers as family members. The second part consisted of 13 questions regarding the HPV vaccine. The third part consisted of eight questions regarding HPV literacy. The final part included questions about the decision to receive the HPV vaccine and the reasons for the decision in the unvaccinated group (Tables 3 and 4). The content validity index was tested by three experts, two family doctors, and one gynecologist. Internal consistency was tested using a pilot study of 30 students from another campus, resulting in Cronbach's alpha of 0.8.

2.3. Data analysis

Data were collected in a paper-based format, transformed into electronic data using KoboToolbox, and exported to Microsoft Excel. Jupyter version 3.4.2 and R version 4.1.3. were used for two-sided statistical analyses. Data distribution was tested using the Shapiro–Wilk test. Categorical data are presented as numbers and percentages. Continuous data are presented as medians (Q1 and Q3). Categorical data were compared using the Pearson's chi-squared and Fisher's exact tests. Demographic data associated with HPV vaccination were analyzed using multivariable logistic regression analysis. Statistical significance was set at $p < 0.05$. Univariate analysis was performed first to determine the significant factors that were used in a multivariable regression analysis.

3. Results

3.1. Demographic data

In total, 1,093 out of 1,200 questionnaires were returned, resulting in a 91.1 % response rate. The median age of the participants was 20 years (Q1, Q3 = 19, 21). Most were females (57.6 %) with a monthly family income of 850–1,420 USD/month (37.0 %). More than half of the participants had hometowns in non-urban areas (53.5 %). Most participants had no family history of cervical cancer (98.6 %) and did not have healthcare providers as family members (88.1 %) (Table 1).

4. Factors associated with HPV vaccination

Among all participants, 48 (4.4 %) reported receiving at least one dose of the HPV vaccine. Of these, 44 (7.51 %) were female, and four (0.87 %) were male. Univariate regression analysis showed that the statistically significant factors associated with HPV vaccination were biological sex, monthly family income, faculty group, hometown, the highest level of parental education, and having healthcare providers as family members.

Being female was the most important factor in receiving HPV vaccines (odds ratio [OR], 8.62; 95 % confidence interval [CI], 3.07–24.15). Other significant factors included family incomes of > 2,270 USD/month (OR, 5.5; 95 % CI, 2.41–12.57), having at least one parent achieving master's degrees or higher (OR, 4.11; 95 % CI, 1.13–14.89), having healthcare providers as family members (OR, 2.95; 95 % CI, 1.52–5.73), and having hometowns in urban areas (OR, 1.74; 95 % CI, 1.29–2.35). When compared among faculty groups, the medical science faculty had the highest HPV vaccination rate, followed by the social (OR,

Table 1
Demographic data of the participants from one university in Southern Thailand, 2023.

Factors	Number (N=1093)	%
Biological sex		
Male	463	42.4
Female	630	57.6
Age, median (Q1, Q3)	20 (19,21)	
Religion		
Buddhism	848	77.6
Christ	4	0.3
Islam	215	19.7
Other	26	2.4
Family income (US Dollar: USD/month)		
<850	353	32.3
850–1,420	404	37.0
1,420–2,270	193	17.6
>2,270	143	13.1
Faculty Group		
Pure and Applied science	435	39.8
Medical science	323	29.6
Social	335	30.6
Hometown		
Urban area	508	46.5
Non-urban area	585	53.5
Highest level of parental education		
Primary school	96	8.78
High school	264	24.1
Diploma	151	13.8
Bachelor's degree	471	43.1
Master's degree or more	111	10.2
Family history of cervical cancer		
Yes	15	1.4
No	1078	98.6
Having healthcare providers as family members		
Yes	130	11.9
No	963	88.1

0.34; 95 % CI, 0.16–0.71) and pure and applied sciences (OR, 0.28; 95 % CI, 0.14–0.58) faculties. However, the multivariable regression analysis showed that only three factors were associated with receiving HPV vaccines, including being female (adjusted OR, 13.37; 95 % CI, 4.58–39.01), having a hometown in an urban area (adjusted OR, 2.61; 95 % CI, 1.29–5.21), and having a healthcare provider as a family member (adjusted OR, 2.35; 95 % CI, 1.08–5.12) (Table 2).

4.1. Knowledge about HPV infection

In one part of the questionnaire, the participants were instructed to answer questions about HPV and its vaccine. In total, 567 (52.7 %) participants reported themselves as “Knowing about human papillomavirus.” The first three questions that most participants answered incorrectly were regarding knowledge about HPV-related diseases and HPV transmission. In total, 13.7 % did not know that HPV causes genital warts, 13.5 % did not know that HPV infection can be prevented by using condoms during sexual intercourse, and 9.5 % did not know that HPV infection causes cancer of organs other than the cervix (anal, penile, vaginal, and pharyngeal cancers) (Table 3).

4.2. Knowledge about HPV vaccine

Of all the participants, 670 (61.3 %) reported themselves as “Knowing about the human papillomavirus vaccine.” The participants were then instructed to answer each question about the HPV vaccine to evaluate the contents' accuracy. Regarding the knowledge about HPV vaccination, most participants (99.4 %) knew that it was essential to receive the HPV vaccine. A total of 93.4 % knew that the HPV vaccine was the most effective way of preventing HPV infection when administered at ages 9–26 years. Moreover, 86.1 % knew that the HPV vaccine was most effective in preventing HPV infection if they received the vaccine before their first sexual intercourse. However, only 80 % of the

participants were aware that the HPV vaccine can be administered to both males and females (Table 3).

4.3. Knowledge and perceptions of HPV and its vaccine

Of all the participants, 551 (50.4 %) received information about HPV or cervical cancer vaccines. Only 15.9 % of the participants were advised by healthcare providers regarding HPV or cervical cancer vaccinations. More than half of the participants (52.7 %) knew about HPV, and 61.3 % knew about the HPV vaccine. Three-quarters of the participants (74.6 %) knew the term “cervical cancer vaccine.” The median price of the HPV vaccine per injection that the participants thought all people could afford was USD 15 (Q1, Q3 = 7, 29). However, only half of the participants (50.0 %) realized that the HPV and cervical cancer vaccines were similar (Table 3).

4.4. Opinions among the unvaccinated group

The last part of the questionnaire comprised multiple-choice questions. Only unvaccinated respondents were required to answer this part. More than half (52.9 %) of the participants in the unvaccinated group stated that they wanted to be vaccinated. Most provided the reason that prevention is better than cure. The remaining unvaccinated respondents did not desire to be vaccinated or were uncertain because they did not get sufficient information about the HPV vaccine and thought that they had no risk of HPV infection (Table 4).

5. Discussion

This study evaluated HPV vaccine coverage in students belonging to the population who would benefit from receiving the HPV vaccine (aged 9–26 years) at one university in Southern Thailand, as well as the affecting factors, knowledge about HPV and its vaccine, opinion on

Table 2
Factors associated with HPV vaccine reception among university students in Southern Thailand, 2023.

Factors	N=1,093 (%)	Vaccinated, N (%)	Crude OR (95 % CI)	p-value	Adjusted OR** (95 % CI)	Adjusted p-value
Biological sex						
Male	463 (42.4)	4 (0.9)	–	<0.001*	13.37 (4.58–39.01)	0.01*
Female	630 (57.6)	44 (7.0)	8.62 (3.07–24.15)			
Religion						
Buddhism	848 (77.6)	44 (5.2)	1.37 (0.18–10.33)	0.76		
Christ	4 (0.3)	0 (0.0)	0.00 (0.00–0.00)	0.99		
Islam	215 (19.7)	3 (1.4)	0.35 (0.04–3.53)	0.38		
Other	26 (2.4)	1 (3.7)	–	–		
Family income (USD/month)						
<850	353 (32.3)	9 (2.5)	–	<0.001*	2.03 (0.74–5.55)	0.17
850–1,420	404 (37.0)	10 (2.5)	0.97 (0.39–2.42)			
1,420–2,270	193 (17.6)	11 (5.7)	2.31 (0.94–5.68)			
>2,270	143 (13.1)	18 (12.6)	5.50 (2.41–12.57)			
Faculty Group						
Medical science	435 (39.8)	27 (8.4)	–	<0.001*	2.82 (1.26–6.32)	0.12
Pure and applied science	323 (29.6)	11 (2.5)	0.28 (0.14–0.58)			
Social	335 (30.6)	10 (3.0)	0.34 (0.16–0.71)			
Hometown						
Non-urban area	585 (53.5)	14 (2.4)	–	<0.001*	2.61 (1.29–5.27)	0.01*
Urban area	508 (46.5)	34 (6.7)	1.74 (1.29–2.35)			
Highest level of parental education						
Primary school	96 (8.8)	3 (3.1)	–	0.001*	1.78 (0.41–7.69)	0.44
High school	264 (24.1)	2 (0.8)	0.24 (0.04–1.44)			
Diploma	151 (13.8)	8 (5.3)	1.73 (0.45–6.71)			
Bachelor's degree	471 (43.1)	22 (4.6)	1.52 (0.44–5.18)			
Master's degree or more	111 (10.2)	13(11.7)	4.11 (1.13–14.89)			
Having healthcare providers as family members						
Yes	130 (11.9)	13 (10.0)	2.95 (1.52–5.73)	0.001*	2.35 (1.08–5.12)	0.05*
No	963 (88.1)	35 (3.6)	–			

*Statistical significance, **Adjusted odds ratios by multivariable regression analysis, controlling for Sex, Family income, Faculty group, Hometown, the highest level of parental education, and Having Healthcare providers as family members. CI, confidence interval.

affordable costs per injection, and attitude toward HPV vaccination in the future. In this study, the coverage of at least one dose of the HPV vaccine among university students was 4.4 %, which was higher than that in Chanprasertpinyo and Rerkswattavorn's study conducted in rural Thailand, who reported an HPV vaccine coverage of 1.9 % (Chanprasertpinyo and Rerkswattavorn, 2020). However, our study's vaccine coverage was lower than the global coverage; according to Bruni et al. (Bruni et al., 2021) who reported a coverage rate of at least one dose of HPV vaccine of 15 %, as well as 49 % in one American university (Mathewson et al., 2021) and 39.1 % in a university in Italy (Di Giuseppe et al., 2023). However, when we grouped the vaccine recipients by sex, female coverage was 7.0 %, and male coverage was 0.9 %, which was higher than those reported by Chanprasertpinyo and Rerkswattavorn (males = 0.0 % and females = 2.5 %) (Chanprasertpinyo and Rerkswattavorn, 2020). Similarly, our study revealed higher vaccine coverage among females than that reported in universities in Morocco (females < 1 %) (Yacouti et al., 2022). However, the coverage in our setting was lower than that in one university in Brazil, where 42.4 % of female students had received at least one dose of the HPV vaccine (Oliveira et al., 2021). Although the WHO recommendations for HPV vaccination suggest vaccination for both sexes, more than one study has reported that vaccine coverage in males is significantly lower than that in females (Dykens et al., 2023). Several factors minimize male HPV vaccine coverage, such as inadequate recommendations from healthcare providers, high vaccine costs, lack of knowledge about HPV and its vaccine, lower parental education, lack of awareness, living in a non-urban area, and no public policy providing free or affordable HPV vaccines (Shin et al., 2022; Chen et al., 2021). As our study showed, only approximately 16 % of the participants stated that they had received information about the vaccine from healthcare providers.

Economic status is a significant factor in HPV vaccine distribution. According to our study results, a family income of more than USD 2,270 per month, considered a high income in Thailand, was statistically

significant, with an OR of 5.50 (95 % CI, 2.41–12.57) compared with a family income of < 850 USD. Similar to several other studies, this result found that a higher family income tended to lead to more vaccinations (Shin et al., 2022; Chen et al., 2021; Oliveira et al., 2021). Therefore, the high cost of vaccines may explain the lower vaccine coverage rates in low-income families (Pourat and Jones, 2012). According to Thailand's public policy for free bivalent HPV vaccines in females aged 11–12 years beginning in 2017 (Ngamphaiboon, 2022), our survey participants were not included in the policy when it was implemented. Therefore, had they wished to be vaccinated, they would have had to pay the full price without government support. Accordingly, in our study, the median affordable cost per injection of the HPV vaccine was suggested to be USD 15 per dose (USD 45 per course consisting of three injections). The minimum wage in Thailand is approximately USD 10 per day, whereas the actual prices of the HPV vaccine are approximately 70–90 USD per dose for quadrivalent vaccines and 200 USD per dose for nonavalent vaccines.

The medical science group had significantly higher HPV vaccine reception rates than the social and pure and applied science groups. The OR of the pure and applied science and social science groups were 0.28 (95 % CI, 0.14–0.58) and 0.34 (95 % CI, 0.16–0.71), respectively, compared with the medical science group. This result was similar to that of a study from Brazil and previous studies conducted in Thailand (Oliveira et al., 2021; Chanprasertpinyo and Rerkswattavorn, 2020). Although students in the healthcare field are likely to obtain more information about the vaccine, getting vaccinated in this age group is more dependent on parental decisions. This could be explained by the fact that healthcare students are likely to be from families with higher incomes. (AAMC, 2018).

Our study found that originating from different hometowns led to significant differences in vaccination rates. The OR of receiving an HPV vaccine when coming from urban areas was 1.74 (95 % CI, 1.29–2.35) compared with rural areas, similar to the results of studies conducted in

Table 3

The HPV and its vaccine literacy among participants from one university in Southern Thailand, 2023.

Content accuracy of HPV literacy among participants who responded as “know human papillomavirus” (n = 576)			
	Yes	No	% INCORRECT
1. Is HPV a sexually transmitted infection?	540	36	6.3
2. Does HPV cause genital warts?	497	79	13.7
3. Can HPV infection develop into cancer?	546	30	5.2
4. Does HPV infection play a significant role in causing cervical cancer?	546	30	5.2
5. Apart from cervical cancer, can HPV cause anal cancer, penile cancer, vaginal cancer, oral cancer, or neck cancer?	521	55	9.5
6. Can HPV infection be prevented by using condoms during sexual intercourse?	498	78	13.5
7. Can the HPV vaccine prevent HPV infection?	545	31	5.4
Content accuracy of HPV vaccine literacy among participants who responded as “know the HPV Vaccine” (n = 670)			
			% Yes
1. Can the HPV vaccine be administered to both males and females?			79.9
2. Is it essential to receive the HPV vaccine?			99.4
3. Is the HPV vaccine the most effective for preventing HPV infection if the vaccine is administered before the first sexual intercourse?			86.1
4. Is the HPV vaccine the most effective for preventing HPV infection if the vaccine is administered at 9–26 years of age?			93.4
Participants' knowledge and perceptions of HPV and its vaccine (N=1,093)			
	Yes (%)	No (%)	
1. Do you know about the human papillomavirus (HPV)?	576 (52.7)	517 (47.3)	
2. Do you know about the human papillomavirus (HPV) vaccine?	670 (61.3)	423 (38.7)	
3. Do you know about the cervical cancer vaccine?	815 (74.6)	278 (25.4)	
4. Are the HPV vaccine and cervical cancer vaccine similar?	546 (50.0)	547 (50.0)	
5. Have you ever received any information about the HPV vaccine or cervical cancer vaccine?	551 (50.4)	542 (49.6)	
6. Have you ever been advised about receiving the HPV vaccine or cervical cancer vaccine by a healthcare provider?	174 (15.9)	919 (84.1)	
7. In your opinion, to make the HPV vaccine affordable for all, what is the reasonable price of the HPV vaccine per dose?			Price in USD (Q1, Q3)
			15 (7,29)

HPV, human papillomavirus.

other geographic areas (Swiecki-Sikora et al., 2019; Mohammed et al., 2018; Tran et al., 2023; Osegueda et al., 2023). These results can be explained by easy access to healthcare providers and medical centers. Additionally, individuals living in rural areas have lower incomes, less knowledge about HPV and its vaccine, and less awareness of HPV-related diseases than those living in urban areas (Shin et al., 2022; Swiecki-Sikora et al., 2019).

Parental education plays a significant role in receiving HPV vaccines. The higher the level of parental education, the more willing individuals are likely to be vaccinated, especially if their parent's highest education level is equal to or higher than a master's degree, with an OR of 4.11 (95 % CI, 1.13–14.89). This result is similar to that in Sweden and may result from better education, which can reduce vaccine disinformation (Leval et al., 2013). However, a study from Saudi Arabia showed that higher parental education was not related to vaccine reception. Nevertheless, it increased the willingness to have or plan to have the HPV vaccine for their children (Alhusayn et al., 2022).

Having healthcare providers as family members led to an OR of 2.95 (95 % CI, 1.52–5.73) compared with those who did not. Healthcare provider recommendations are essential for individuals receiving HPV vaccination (Shin et al., 2022; Osaghae and Chido-Amajuoyi, 2022; Barnard et al., 2017; Miraglia del Giudice et al., 2023; Ebrahimi et al., 2023; Lelliott et al., 2023). In particular, if there is a healthcare provider in the family, there are several benefits for one's family members, not only their suggestions to receive the HPV vaccine but also the promotion of the entire vaccination course (Fiks et al., 2013).

HPV and its vaccine literacy may play an essential role in disease awareness and vaccine coverage. Because of the lack of HPV knowledge, our survey found that two of the top three incorrect answers were about non-cervical cancer-related diseases, such as genital warts and oral cancer, which is similar to the results of a previous study conducted in Thailand (Chanprasertpinyo and Rerkswattavorn, 2020). Moreover, our study indicated that another incorrect answer was that HPV could not be prevented by using condoms during sexual intercourse. Additionally, nearly half of the participants had not received any information about the HPV vaccine, which could mislead unvaccinated individuals to not get vaccinated due to a lack of HPV vaccine literacy, especially

regarding its adverse effects. In contrast, the reasons for individuals deciding to be vaccinated were believing that prevention is better than cure, being afraid of cancer in the future, and believing that they were at risk of HPV infection, which is similar to the results found in the study from Italy (Di Giuseppe et al., 2023).

5.1. Suggestions and limitations

Our study had several strengths. First, our study had a larger sample size than those in previous studies conducted in university settings. Moreover, this study's ratio of sexes and faculty groups was similar to the university's ratio. Second, we studied several factors affecting HPV vaccination and its coverage. Finally, we examined the knowledge on HPV and HPV vaccine.

However, this study had some limitations. First, this study was a cross-sectional study conducted in a single university using convenient sampling; therefore, the participants could not represent all young Thai adults because of demographic differences. Second, some questions in our survey, especially those regarding the history of HPV vaccination, were dependent on the participant's memories, which may have led to recall bias. Finally, HPV vaccine reception in this study referred to only a one-dose vaccination, which could not estimate the completion of two- or three-dose courses. Further studies should be conducted nationally or multicentrically to evaluate vaccine coverage in populations not included in the free HPV vaccination policy.

The affordable price and cost-effectiveness of the vaccine should be nationally surveyed to create an accessible HPV vaccine policy. Further studies should investigate other factors associated with HPV vaccination, especially the highest parental education level, owing to its controversy. Furthermore, it is important to evaluate techniques or interventions to publicize HPV and related disease knowledge to increase awareness and HPV vaccine coverage. Finally, authorized individuals should emphasize HPV-related diseases and the importance of vaccinations in Thailand's primary education curriculum.

Table 4

The numbers and percentages of the answers about the interest and decision in receiving the HPV vaccine and supported reasons among the unvaccinated group from one university in Southern Thailand, 2023 (n = 1,045).

Interest in receiving the HPV vaccine	N=1,045 (%)
Not interested in getting the HPV Vaccine	243 (23.3)
Not getting enough information about the HPV vaccine	110
Have no risk of HPV infection	92
Be afraid of the side effects of the HPV vaccine	87
Interested in getting the HPV Vaccine	802 (76.7)
Prevention is better than cure	568
Be afraid of cancer	261
May have risk of HPV infection	112
Decisions and supported reasons	N=1,045 (%)
Not willing to get the HPV Vaccine or Uncertain	492 (47.1)
Not getting enough information about the HPV vaccine	219
The HPV vaccine price is too high	203
Be afraid of the side effects of the HPV vaccine	159
Willing to get the HPV vaccine	553 (52.9)
Prevention is better than cure	511
Be afraid of cancer	241
May have risk of HPV infection	103

HPV, human papillomavirus.

6. Conclusions

The HPV vaccine coverage rate among young Thai adults was lower than that in Western countries, especially in males. Furthermore, several factors affect low HPV vaccination rates, such as male sex, low family income, and low parental education. HPV and HPV vaccine education should be provided to the population, especially to the young adults of both sexes, who still benefit from increasing awareness about its diseases and receiving the HPV vaccine. Finally, without any public policy for free HPV vaccination in our study group, a policy should be established to promote the HPV vaccination rate at an affordable price of USD 15 per injection, for a total of USD 45 per three-injection course.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

CRediT authorship contribution statement

Supinya Sono: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Project administration, Methodology, Formal analysis, Data curation, Conceptualization. **Natthapong Sukhanonsawat:** Investigation, Formal analysis, Data curation, Conceptualization. **Nuttida Naknuan:** Investigation, Data curation, Conceptualization. **Rinrada Suwanno:** Investigation, Data curation. **Karunyapas Kiratikosol:** Formal analysis, Data curation. **Kanadad Sookpong:** Investigation, Data curation, Conceptualization. **Nichakarn Sukpornsinchai:** Investigation, Data curation. **Ladapa Sirikornpinyo:** Investigation, Data curation, Conceptualization. **Witchaya Nakarae:** Investigation, Data curation. **Suchawadee Laomanachareon:** Investigation, Data curation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

References

- Aamc, 2018. An Updated Look at the Economic Diversity of U.S. Medical Students.
- Alhusayn, K.O., Alkhenizan, A., Abdulkarim, A., Sultana, H., Alsulaiman, T., Alendijani, Y., 2022. Attitude and hesitancy of human papillomavirus vaccine among Saudi parents. *J Family Med Prim Care* 11, 2909–2916.
- Barnard, M., George, P., Perryman, M.L., Wolff, L.A., 2017. Human papillomavirus (HPV) vaccine knowledge, attitudes, and uptake in college students: Implications from the Precaution Adoption Process Model. *PLoS One* 12, e0182266.
- Bruni, L., Saura-Lázaro, A., Montoliu, A., Brotons, M., Alemany, L., Diallo, M.S., Afsar, O. Z., LaMontagne, D.S., Mosina, L., Contreras, M., Velandia-González, M., Pastore, R., Gacic-Dobo, M., Bloem, P., 2021. HPV vaccination introduction worldwide and WHO and UNICEF estimates of national HPV immunization coverage 2010–2019. *Prev. Med.* 144, 106399.
- Burd, E.M., 2003. Human papillomavirus and cervical cancer. *Clin. Microbiol. Rev.* 16, 1–17.
- Chanprasertpinyo, W., Rerkswattavorn, C., 2020. Human papillomavirus (HPV) vaccine status and knowledge of students at a university in rural Thailand. *Heliyon* 6, e04625.
- Chelimo, C., Woules, T.A., Cameron, L.D., Elwood, J.M., 2013. Risk factors for and prevention of human papillomaviruses (HPV), genital warts and cervical cancer. *J. Infect.* 66, 207–217.
- Chen, G., Wu, B., Dai, X., Zhang, M., Liu, Y., Huang, H., Mei, K., Wu, Z., 2021. Gender Differences in Knowledge and Attitude towards HPV and HPV Vaccine among College Students in Wenzhou. *China. Vaccines* (Basel), p. 10.
- Miraglia del Giudice, Grazia, Sansone, Vincenza, Airoma, Francesca, Angelillo, Silvia, Licata, Francesca, Di Giuseppe, Gabriella. 2023. Respiratory Syncytial Virus: Willingness towards a Future Vaccine among Pregnant Women in Italy. *Vaccines* [Online], 11.
- Dunne, E.F., Park, I.U., 2013. HPV and HPV-associated diseases. *Infect. Dis. Clin. North Am.* 27, 765–778.
- Dykens, J.A., Peterson, C.E., Holt, H.K., Harper, D.M., 2023. Gender neutral HPV vaccination programs: Reconsidering policies to expand cancer prevention globally. *Front. Public Health* 11, 1067299.
- Ebrahimi, N., Yousefi, Z., Khosravi, G., Malayeri, F.E., Golabi, M., Askarzadeh, M., Shams, M.H., Ghezelbash, B., Eskandari, N., 2023. Human papillomavirus vaccination in low- and middle-income countries: progression, barriers, and future prospective. *Front. Immunol.* 14, 1150238.
- Fiks, A.G., Grundmeier, R.W., Mayne, S., Song, L., Feemster, K., Karavite, D., Hughes, C. C., Massey, J., Keren, R., Bell, L.M., Wasserman, R., Localio, A.R., 2013. Effectiveness of decision support for families, clinicians, or both on HPV vaccine receipt. *Pediatrics* 131, 1114–1124.
- Di Giuseppe, Gabriella, Angelillo, Silvia, Bianco, Aida, Gallè, Francesca, Licata, Francesca, Liguori, Giorgio, Napolitano, Francesco, Nobile, Carmelo G., Pavia, Maria, Pelullo, Concetta P., Angelillo, Italo F. 2023. Evaluating Knowledge, Attitudes, and Behaviors toward HPV Infection and Vaccination among University Students in Italy. *Vaccines* [Online], 11.
- Kamolratanakul, S., Pitisuttithum, P. 2021. Human Papillomavirus Vaccine Efficacy and Effectiveness against Cancer. *Vaccines* (Basel), 9.
- Lelliott, M., Sahker, E., Poudyal, H., 2023. A Review of Parental Vaccine Hesitancy for Human Papillomavirus in Japan. *J. Clin. Med.* 12.
- Leval, A., Herweijer, E., Ploner, A., Eloranta, S., Fridman Simard, J., Dillner, J., Young, C., Netterlid, E., Sparén, P., Arnheim-Dahlström, L., 2013. Quadrivalent human papillomavirus vaccine effectiveness: a Swedish national cohort study. *J. Natl Cancer Inst.* 105, 469–474.

- Mathewson, K., Sundaram, M., Bednarczyk, R.A., 2021. Young Adult Human Papillomavirus and Influenza Vaccine Coverage: A Comparison Across College Enrollment Status. *J. Community Health* 46, 13–21.
- Meites, E., Szilagyi, P.G., Chesson, H.W., Unger, E.R., Romero, J.R., Markowitz, L.E., 2019. Human Papillomavirus Vaccination for Adults: Updated Recommendations of the Advisory Committee on Immunization Practices. *MMWR Morb. Mortal. Wkly Rep.* 68, 698–702.
- Mohammed, K.A., Subramaniam, D.S., Geneus, C.J., Henderson, E.R., Dean, C.A., Subramaniam, D.P., Burroughs, T.E., 2018. Rural-urban differences in human papillomavirus knowledge and awareness among US adults. *Prev. Med.* 109, 39–43.
- Ngamphaiboon, N., 2022. PSY7-5 Current status of HPV vaccination and HPV-associated head and neck cancer in Thailand. *Ann. Oncol.* 33, S422.
- Oliveira, P.S., Gonçalves, C.V., Watte, G., Costa, J., 2021. Vaccination coverage against human papillomavirus (HPV) and associated factors in female academics from a university in southwestern Goiás. Brazil. *Rev Saude Publica* 55, 65.
- Onuki, M., Yamamoto, K., Yahata, H., Kanao, H., Yokota, H., Kato, H., Shimamoto, K., Takehara, K., Kamiura, S., Tsuda, N., Takei, Y., Shigeta, S., Matsumura, N., Yoshida, H., Motohara, T., Watari, H., Nakamura, K., Ueda, A., Tasaka, N., Ishikawa, M., Hirashima, Y., Kudaka, W., Taguchi, A., Iwata, T., Takahashi, F., Kukimoto, I., Yoshikawa, H., Yaegashi, N., Matsumoto, K., 2022. Human papillomavirus vaccine effectiveness by age at first vaccination among Japanese women. *Cancer Sci.* 113, 1428–1434.
- Osaghae, I., Chido-Amajuoyi, O. G., Shete, S., 2022. Healthcare Provider Recommendations and Observed Changes in HPV Vaccination Acceptance during the COVID-19 Pandemic. *Vaccines (Basel)*, 10.
- Osegueda, E.R., Chi, X., Hall, J.M., Vadaparampil, S.T., Christy, S.M., Staras, S.A.S., 2023. County-Level Factors Associated With HPV Vaccine Coverage Among 11-Year-Olds to 12-Year-Olds Living in Florida in 2019. *J. Adolesc. Health* 72, 130–137.
- Plotzker, R.E., Vaidya, A., Pokharel, U., Stier, E.A., 2023. Sexually Transmitted Human Papillomavirus: Update in Epidemiology, Prevention, and Management. *Infect. Dis. Clin. North Am.* 37, 289–310.
- Plummer, M., Peto, J., Franceschi, S., 2012. Time since first sexual intercourse and the risk of cervical cancer. *Int. J. Cancer* 130, 2638–2644.
- Pourat, N., Jones, J.M., 2012. Role of insurance, income, and affordability in human papillomavirus vaccination. *Am. J. Manag. Care* 18, 320–330.
- Rahangdale, L., Mungo, C., O'Connor, S., Chibwasha, C.J., Brewer, N.T., 2022. Human papillomavirus vaccination and cervical cancer risk. *BMJ* 379, e070115.
- Shin, H., Jeon, S., Cho, I., Park, H., 2022. Factors Affecting Human Papillomavirus Vaccination in Men: Systematic Review. *JMIR Public Health Surveill.* 8, e34070.
- Swiecki-Sikora, A.L., Henry, K.A., Kepka, D., 2019. HPV Vaccination Coverage Among US Teens Across the Rural-Urban Continuum. *J. Rural Health* 35, 506–517.
- Tran, N.T., Phan, T.N.T., Pham, T.T., Le, T.T., Le, H.M., Nguyen, D.T., Lam, A.N., Pham, T.T., Le, H.T., Dang, N.B., Tran, K.C., Tran, V.D., 2023. Urban-rural disparities in acceptance of human papillomavirus vaccination among women in Can Tho. Vietnam. *Ann Ig* 35, 641–659.
- Wethington, H.R., Hahn, R.A., Fuqua-Whitley, D.S., Sipe, T.A., Crosby, A.E., Johnson, R. L., Liberman, A.M., Mościcki, E., Price, L.N., Tuma, F.K., Kalra, G., Chattopadhyay, S. K., 2008. The effectiveness of interventions to reduce psychological harm from traumatic events among children and adolescents: a systematic review. *Am. J. Prev. Med.* 35, 287–313.
- World Health Organization. 2022. Cervical Cancer [Online]. Available: <https://www.who.int/news-room/fact-sheets/detail/cervical-cancer> [Accessed November 1st 2023].
- Yacouti, A., Elkhoudri, N., El Got, A., Benider, A., Hadrya, F., Baddou, R., Forster, A., Mouallif, M., 2022. Awareness, attitudes and acceptability of the HPV vaccine among female university students in Morocco. *PLoS One* 17, e0266081.
- Zhang, S., Xu, H., Zhang, L., Qiao, Y., 2020. Cervical cancer: Epidemiology, risk factors and screening. *Chin. J. Cancer Res.* 32, 720–728.