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Knowledge and Awareness of Human Papillomavirus Infection and Vaccination in Thai Male Youth, Including Men Who Have Sex with Men

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ABSTRACT

OBJECTIVE There is currently a lack of human papillomavirus (HPV) vaccination policy and education for male youth in Thailand. This study aimed to evaluate Thai male youth's knowledge and awareness of HPV infection and vaccination, determine their HPV vaccination rate, and factors related to the vaccination rate and the level of awareness of HPV.

METHODS A questionnaire survey on HPV vaccination was distributed to educational institutions across different regions of Thailand. Inclusion criteria included Thai male youth aged between 15 and 24 years, regardless of sexual orientation. Exclusion criteria were inability to access the internet, individuals whose responses were unintelligible, and those who did not complete the questionnaire. The trends of the association between participant characteristics and their HPV knowledge/awareness scores was analyzed using linear regression.

RESULTS A total of 594 individuals responded to the questionnaire. The median score for knowledge was 11 out of 18 and the awareness level was 80%. Higher education level, higher family income, bisexuality, and prior receipt of HPV information were statistically significantly linked to higher HPV knowledge scores. However, only previous receipt of HPV information was associated with an increased awareness level.

CONCLUSIONS Although the level of HPV knowledge and awareness among Thai males was acceptable, less than 50% of participants expressed an intention to get vaccinated. This indicates there is a need to improve the promotion of the HPV vaccine in order to achieve herd immunity.

KEYWORDS HPV knowledge, HPV vaccines, men who have sex with men, vaccination intention

INTRODUCTION

Human papillomavirus (HPV) infection is one of the most common sexually transmitted diseases (STDs) in both males and females (1). In fact, as many as 62.5% of men have been found to have asymptomatic HPV infections in their genitalia. Most of these cases are caused by HPV type 16 (2). High-risk HPV, particularly types 16 and 18, is the primary cause of HPV-related cancers, e.g., anal, penile, head and neck, and oropharyngeal cancers, which are transmitted primarily through sexual activity. Although cervical cancer screening programs can help detect HPV-related gynecologic cancer in women, there are currently no comparable screening methods available for detecting HPV-related cancer in men. Approximately 75%

of women with HPV-positive sexual partners have HPV DNA in their cervix (3). It's worth noting that males who engage in sexual activities with men (MSM) are at increased risk of contracting HPV. Studies have shown that anal HPV infection has a prevalence of 58.5% among MSM, and high-risk HPV infection has a prevalence of 36.6%. Therefore, it's important to take preventive measures and follow safe sex practices to reduce the risk of HPV transmission (4). According to the latest data, a staggering 86.6% of high-risk HPV-infected MSM in Northern Thailand have developed cancerous lesions. This highlights the urgent need for more effective prevention and early detection measures to tackle this important issue (5).

It is known that HPV vaccines are equally safe and effective for both males and females (6). According to available data, HPV vaccines are effective in preventing HPV-associated diseases in men, including MSM. Studies have shown that in males who have received the vaccine, there is an 86% reduction in persistent genital HPV infection and a 90% decrease in the incidence of external genital lesions (7). After HPV vaccination, a significant drop in anogenital warts was reported in both men and women in a country where vaccination coverage was at least 50% in women aged 13-19 years, suggesting herd immunity (8). In the US, the HPV vaccine results in $1.8 billion in direct medical costs annually (9). The incidence of HPV-related anal and oropharyngeal cancers has been increasing recently among men, and is remarkably high (20 times higher) among MSM in the US (9). The rates are lower among MSM who have received prophylactic HPV vaccination. According to a recent study, after an HPV vaccination program for men was introduced in the US in 2011, vaccine coverage has grown to 17.2%. However, despite this progress, the vaccination rate is still considered low (10).

In Thailand, the Ministry of Public Health has subsidized HPV vaccines for all fifth-grade female students in a national vaccination program since 2017 (11). However, health care benefits provided by the Civil Servant Medical Benefit Scheme (CSMBS), Social Security scheme (SSS), and the Universal Coverage program (UC) do not currently include men in the HPV vaccine program. In order to achieve maximum protection for the population, it is recommended that men as well as women receive the HPV vaccine. This could aid in reaching the necessary herd immunity level of 70-80% coverage, which, in turn, would help reduce the spread of the virus and decrease the occurrence of related health issues (12).

CDC guidelines recommend that females aged 9-14 i.e., those of adolescent age, receive HPV vaccine. In Thailand, the recommended age for vaccination is 9 to 26 years old. The number of antibodies produced after HPV vaccination decreases with age and significantly declines after first sexual intercourse (13). Although there is no national data, studies have found that Northern Thai teenagers have their first sexual intercourse on average at age 16.7 years, when they have the highest risk of getting HPV infection (14). Because this group is a non-obligatory population for HPV immunization even though they are a cog in the vicious disease cycle, they should be assessed regarding their knowledge and awareness of the topic.

This study is centered on Thai male youth between the ages of 15 and 24 years from various regions in Thailand. Its objective is to explore their awareness of HPV infection as well as their knowledge of HPV vaccination, which together reflect the effectiveness of public health promotion efforts. This study also seeks to identify factors that influence the decision of men to get HPV vaccination to help guide future promotion of HPV-related disease prevention efforts.

METHODS

Study design and participants

The design is a cross-sectional study of the Thai male youth population aged between 15 and 24 years, regardless of sexual orientation. The exclusion criteria are inability to access the internet, provision of illegible answers and failure to complete the questionnaire. The sample size calculation, based on the Thai male youth population aged 15-24 years from the National Statistical Office in 2019 (a total of 4,421,449), to gain 95% confidence interval and 5% margin of error, indicated a necessary sample size of 385.

The data on knowledge and awareness of HPV plus intention to be vaccinated against HPV infection was collected from August to October 2021 through a questionnaire. The survey was created using Google Form and sent to participants via

a QR code link. The QR code was distributed to educational institutions which had been selected based on the target population group in each region using stratified randomization. After selecting the institutions, direct letters containing advertising posters and QR codes were sent to each high school and vocational school, requesting their help in publicizing the survey. However, this method could not be used for university students due to the large number of students and the separation between student and faculty communities. For university students, project information and QR codes were posted on the main Facebook® group of each of the randomly selected institutions.

A Google form-based cross-sectional survey questionnaire consisting of 3 sections adapted from Dany et al. and Villanueva et al. (15, 16) was used. The questionnaire was translated into the Thai language, and was validated by Dr. Jatupol Srisomboon, a specialist in HPV in Thailand. The first section explored participants' demographics, including age, sexual orientation, sexual history, religion, family income, educational level, address region, and sources of receiving information. Section 2 contained 23 questions and investigated knowledge and awareness of HPV infection and vaccination. The first 18 questions of this section were true or false questions to determine the participants' general knowledge about HPV infection and vaccination. The remaining five questions were used to assess participants' agreement with specific statements using a 5-point Likert scale ("Strongly Disagree" to "Strongly Agree"). The last section asked both vaccinated and unvaccinated participants for their HPV vaccination status, their intention to receive HPV vaccination for those currently unvaccinated, and the rationale behind their decision. Each email account was allowed to respond only once to avoid repetitive responses.

Ethical considerations

At the outset of the questionnaire, the participants were informed that their involvement was completely voluntary. Certain questions, such as those pertaining to gender and sexual orientation, were sensitive, and the participants were told they had the right to choose not to answer them and that all raw data collected would be kept confidential and reported only as analyzed data. The participants' identities were not collected; however, a phone number was gathered for each participant solely as a means of contacting them at the end of the project. The phone number information was kept separate from the research data and to maintain confidentiality was only visible to the researchers.

Ethics approval and consent to participate

All subjects gave their informed consent for inclusion before they participated in the study. The study was conducted following the Declaration of Helsinki, and the protocol was approved by the Faculty of Medicine, Research Ethics Committee (OBG-2564-07878).

Data analysis

Our analysis indicated that the missing data in our study were missing at random (MAR), primarily because of the likelihood that missing data for certain variables was related to other observed data rather than to the missing data itself.

Given this MAR pattern, we chose to conduct a complete case analysis for each outcome. This decision was based on the nature of the missing data, which did not significantly skew our sample's representativeness. While we considered more complex methods such as multiple imputation, the MAR assumption and a subsequent sensitivity analysis confirmed that our approach did not compromise the study's findings.

Data are presented as percentages for categorical variables and median with IQR for non -normal distribution continuous variables. Linear regression was used for the trend of association between variables of interest (age, sexual orientation, sexual history, educational level, address region, religion, economic status, having heard of HPV infection and vaccination status before the survey) and HPV knowledge/awareness score. Multivariable analysis was performed using multiple linear regression using the enter method to identify significant factors associated with knowledge and awareness of HPV infection and vaccination. The respondent's rationale behind the decision in both the vaccinated and non-vaccinated groups was collected. Variables correlated with intention to get HPV vaccination in the future were investigated using the Chi-square test. Stata® version 15 and Jamovi® were used for statistical analysis in this study. $P < 0.05$ was considered statistically significant.

Knowledge score

For each question answered correctly, the participants were given one point, while incorrect answers and responses of "do not know" received zero points. The total number of points earned by each participant was calculated, and the average score was used to determine the level of knowledge demonstrated. Those with higher scores were considered to have a greater level of knowledge.

Awareness score

Participants' awareness scores were calculated based on their responses to five statements using a 5-point Likert scale (1=strongly disagree, 5= strongly agree). The scores are presented as a percentage, with higher scores indicating greater awareness.

RESULTS

A total of 614 participants participated in the survey of whom 20 did not complete the survey and were excluded from the analysis. Table 1 presents the participants' demographic data, including sexual history, as well as their level of knowledge and awareness of HPV infection and vaccination.

The median age of the participants was 19 years, with an interquartile range (IQR) of 16 to 21 years. Nearly half of the participants (49.8%) were university students. Regarding the participants' geographic location, almost 40% resided in the Central region. The survey also found that the majority of respondents (90.1%) identified as Buddhists, while the remaining 10% identified as atheists, Christians, or Muslims. In terms of family income, the majority (34.3%) fell within the range of 25,001 to 50,000 baht per month, with the second-highest group (21.4%) earning less than 25,001 baht per month. Almost 30% belonged to the upper-middle- to high-income group (earning more than 75,000 baht per month).

Regarding sexual orientation and behavior, a third of the participant had had sex; the median age of sexual debut was 18 (IQR 16-19). The majority of the Thai male youth were heterosexual (74.4%), while the rest were homosexual (14.1%), bisexual (8.8%), or others, e.g., asexual (1.4%). Regarding receipt of information about HPV infection or vaccination, 316 of 594 participants (53.2%) had heard about HPV or the HPV vaccine.

In the second part of the survey, participants were assessed regarding their knowledge and awareness about HPV infection and vaccination. The median score for knowledge was 11 out of 18 (IQR 7-13). The median awareness score for HPV infection was 80% (IQR 68-92). Finally, the participants were asked about their HPV vaccination status. Out of all the participants, only 25 (4.2%) had received the HPV vaccine, while the remaining 95.8% were unsure or had not yet received it.

HPV infection and vaccination knowledge

Details of questions in the questionnaire and participants' responses are shown in Supplementary Table 1 (Table S1). About 462 (77.8%) of the participants correctly answered that HPV could be transmitted to a sexual partner regardless whether they were male or female, and 434 participants (73.1%) knew that men could receive HPV vaccine. Although 376 (63.3%) and 275 (46.3%) of the participants correctly responded that HPV infection increases the risk of penile cancer and anorectal cancer, respectively, only 188 participants (31.6%) knew that HPV infection increases the risk of nasopharyngeal cancer.

Uni- and multivariable linear regression analysis was used to identify factors significantly associated with HPV infection and vaccination knowledge (Table 2). In univariable analysis, factors that tended to be associated with a higher knowledge score included older age ($p < 0.001$), university educational level ($p = 0.004$) and high vocational certificates ($p = 0.038$), and family income of more than 50,000 baht/month ($p < 0.05$). Also, bisexuals tended to have higher knowledge scores than heterosexuals ($p = 0.004$). In addition, participants who had heard about HPV tended to have a higher knowledge score than those who had not ($p < 0.001$).

In the multivariable analysis that considered age, education, family income, sexual orientation, and receipt of information regarding HPV, participants studying for high vocational certificates had significantly higher knowledge scores than those in junior high school. Family incomes of between 50,001-75,000 and more than 100,000 baht/month were significantly associated with higher knowledge scores compared with family incomes less than 25,000 baht/month. Participants with a family income of 75,001-100,000 tended to have

Table 1. Demographics, including sexual-related history, and HPV knowledge and awareness of participants

Characteristics	N (%) or Median (IQR)
Age (N=594)	19 (16-21)
Education (N=594)	
Junior high school	54 (9.1)
High school	170 (28.6)
University	296 (49.8)
Vocational certificate	44 (7.4)
High vocational certificate	29 (4.9)
Non-formal education	1 (0.2)
Region (N=594)	
Central	231 (38.9)
North	108 (18.2)
Northeast	177 (29.8)
South	62 (10.4)
East	13 (2.2)
West	3 (0.5)
Religion (N=594)	
Buddhism	535 (90.1)
Christianity	15 (2.5)
Islam	3 (0.5)
Atheist	41 (6.9)
Family income (baht per month) (N=505)	
Less than 25,000	108 (21.4)
25,000-50,000	173 (34.3)
50,001-75,000	75 (14.9)
75,001-100,000	61 (12.1)
More than 100,000	88 (17.4)
History of sexual intercourse (N=566)	
No	379 (67.0)
Yes	187 (33.0)
Age of first sexual intercourse (N=594)	18 (16-19)
Sexual orientation (N=563)	
Heterosexual	419 (74.4)
Homosexual	84 (14.9)
Bisexual	52 (9.2)
Others	8 (1.4)
People heard about HPV infection and vaccination before the survey (N=594)	
No	278 (46.8)
Yes	316 (53.2)
HPV infection and vaccination knowledge (full score 18) (N=594)	11 (8-13)
HPV infection and vaccination awareness (%) (N=594)	80 (68-92)
HPV vaccination status (N=594)	
Yes	25 (4.2)
No	490 (82.5)
Unsure	79 (13.3)

higher knowledge scores than those with incomes less than 25,000 baht/month, but the difference was just short of statistical significance (p = 0.053). Lastly, bisexuality and receipt of HPV information were significantly associated with both a higher incidence of HPV infection and higher vaccination knowledge scores than both heterosexuality and never having heard about HPV.

HPV infection and vaccination awareness

A total of 594 participants responded to the five questionnaire items related to their awareness of HPV and the HPV vaccine. Responses

Table 2. Association between characteristics of Thai male youth and HPV infection and vaccination knowledge

Characteristics	Univariable analysis				Multivariable analysis			
	Coefficient (β)	95% Confidence Interval		*p*-value	Coefficient (β)	95% Confidence Interval		*p*-value
		Lower	Upper			Lower	Upper	
Age (N=594)	0.31	0.18	0.44	< 0.01**				
Education (N=594)								
Junior high school (N=54)	Ref.				Ref.			
High school (N=170)	-0.02	-1.34	1.29	0.97	0.70	-0.67	2.07	0.32
University (N=296)	1.84	0.60	3.09	< 0.01**	1.42	-0.77	3.60	0.20
Vocational certificates (N=44)	-0.32	-2.03	1.39	0.71	-0.15	-2.03	1.72	0.87
High vocational certificates (N=29)	2.05	0.12	4.00	0.04*	3.06	0.74	5.37	0.01**
Non-formal education (N=1)	5.02	-3.46	13.50	0.25				
Region (N=594)								
Central (N=231)	Ref.							
North (N=108)	-0.21	-1.21	0.80	0.69				
Northeast (N=177)	-0.63	-1.49	0.23	0.15				
South (N=62)	-0.36	-1.59	0.87	0.56				
East (N=13)	-1.05	-3.50	1.40	0.40				
West (N=3)	-3.28	-8.28	1.71	0.20				
Religion (N=594)								
Buddhism (N=535)	Ref.							
Christianity (N=15)	0.28	-1.97	2.53	0.81				
Islam (N=3)	-0.26	-5.23	4.73	0.92				
Atheist (N=41)	0.74	-0.66	2.13	0.30				
Family income (bath per month) (N=505)								
Less than 25,000 (N=108)	Ref.				Ref.			
25,000-50,000 (N=173)	0.53	-0.49	1.56	0.31	0.42	-0.66	1.51	0.44
50,001-75,000 (N=75)	1.83	0.57	3.09	< 0.01**	1.44	0.14	2.74	0.03*
75,001-100,000 (N=61)	1.41	0.07	2.75	0.04*	1.36	-0.02	2.73	0.05*
More than 100,000 (N=88)	1.93	0.73	3.14	< 0.01**	1.49	0.23	2.75	0.02*
History of sexual intercourse (N=566)								
No (N=379)	Ref.							
Yes (N=187)	0.48	-0.29	1.25	0.22				
Age of first sexual intercourse (N=594)	0.05	-0.03	0.13	0.24				
Sexual orientation (N=563)								
Heterosexual (n=52)	Ref.				Ref.			
Homosexual (n=419)	1.00	-0.02	2.02	0.05	0.60	-0.39	1.60	
Bisexual (n=84)	1.83	0.58	3.09	< 0.01**	1.53	0.30	2.75	0.24
Others (n=8)	0.81	-2.23	3.86	0.60	-0.38	-3.12	2.37	0.01*
Previous receiving information about HPV infection and vaccination (N=594)								0.79
No (n=278)	Ref.				Ref.			
Yes (n=316)	3.72	3.08	4.36	< 0.01**	3.39	2.65	4.12	<0.01**

*, $p < 0.05$; **, $p < 0.01$

were rated on a 5-point Likert scale. The overall awareness score was found to be high, with a median of 80% and an interquartile range (IQR) between 68% and 92%. More detailed information about the individual questions, including participants' opinions about HPV infection and vaccinating males, is shown in Supplementary Table 2 (Table S2). Interestingly, approximately 28% of the Thai male youths did not believe that they were at risk of HPV infection or that they needed the HPV vaccine.

The study included an analysis of the factors associated with awareness of HPV infection and vaccination, similar to that for the knowledge

Table 3. Association between characteristics of Thai male youth and HPV infection and vaccination awareness

Characteristics	Univariable analysis				Multivariable analysis			
	Coefficient (β)	95% Confidence interval		*p*-value	Coefficient (β)	95% Confidence interval		*p*-value
		Lower	Upper			Lower	Upper	
Age (N=594)	0.84	0.42	1.26	< 0.01**				
Education (N=594)								
Junior High school (n=54)	Ref.							
High school (n=170)	2.25	-2.14	6.65	0.31				
University (n=296)	6.73	2.57	10.89	< 0.01**				
Vocational certificates (n=44)	3.89	-1.82	9.60	0.18				
High vocational certificates (n=29)	4.20	-2.27	10.67	0.20				
Non - formal Education (n=1)	12.89	-15.49	41.26	0.37				
Region (N=594)								
Central (n=231)	Ref.							
North (n=108)	0.38	-2.93	3.69	0.82				
Northeast (n=177)	-2.12	-4.95	0.72	0.14				
South (n=62)	1.18	-2.88	5.25	0.57				
East (n=13)	-4.48	-12.58	3.62	0.28				
West (n=3)	-2.84	-19.35	13.67	0.74				
Religion (N=594)								
Buddhism (n=535)	Ref.							
Christianity (n=15)	-2.11	-9.55	5.32	0.58				
Islam (n=3)	12.55	-3.88	28.99	0.13				
Atheist (n=41)	2.41	-2.19	7.01	0.31				
Family income (bath per month) (N=505)								
Less than 25,000 (n=108)	Ref.							
25,000-50,000 (n=173)	0.08	-3.33	3.47	0.97				
50,001-75,000 (n=75)	0.31	-3.86	4.48	0.88				
75,001-100,000 (n=61)	3.187	-1.25	7.63	0.16				
More than 100,000 (n=88)	1.63	-2.35	5.61	0.42				
History of sexual intercourse (N=566)								
No (n=379)	Ref.							
Yes (n=187)	2.94	0.40	5.48	0.02*				
Age of first sexual intercourse (N=187)	0.02	-0.22	0.26	0.89				
Sexual orientation (N=563)								
Heterosexual (n=52)	Ref.							
Homosexual (n=419)	4.08	0.67	7.49	0.02*				
Bisexual (n=84)	2.73	-1.47	6.93	0.20				
Others (n=8)	5.27	-4.92	15.46	0.31				
Previous receiving information about HPV infection and vaccination (N=594)								
No (n=278)	Ref.				Ref			
Yes (n=316)	6.43	4.15	8.71	< 0.01**	6.08	3.56	8.60	< 0.01**

*, $p < 0.05$; **, $p < 0.01$

scores (Table 3). The analysis was performed using both uni- and multivariable linear regression. The analysis identified several determinants that were statistically significant in the univariable analysis. For example, the analysis revealed that individuals who were older and had higher education levels, e.g., university education, had a greater awareness of HPV infection and vaccination than those who were younger and had lower education levels, e.g., a junior high school education. The study also found that participants who had already engaged in sexual intercourse or had heard about HPV were more aware of HPV infection. Furthermore, the study highlighted the importance of sexual orientation as a factor related to awareness, as individuals who identified

as homosexual tended to be more aware of HPV infection and vaccination compared to those who identified as heterosexual. The variables which showed statistical significance ($p < 0.05$) in the univariate analysis, e.g., age, education, history of sexual debut, and previous receipt of HPV information, were further assessed using multivariable linear regression analysis. However, only the variable related to previous receipt of HPV information maintained its significance ($p < 0.001$) in the multivariable analysis.

Rationale behind decisions regarding HPV vaccination

According to the survey, only 4.2% of young Thai males have received the HPV vaccination. Among those who had been vaccinated, most made the decision to do so on their own, followed by parental suggestions, healthcare worker recommendations, and encouragement from friends. The present study also explored reasons why some participants did not receive the HPV vaccine. The most common reason was that they were not aware that men could receive the HPV vaccine (48.2% of responses) (N = 236). About 25% reported that the vaccine was costly and they did not have the time to receive it. An additional 17.8% believed they were at low risk of HPV infection. Other reasons included inconvenient healthcare accessibility, fear of needles, and lack of knowledge about HPV. In the survey, 490 male youth who were not vaccinated against HPV were asked about their intention to get the vaccine in the future. Supplementary Table 3 (Table S3) Their responses showed that address region, sexual orientation, and prior receipt of information about HPV infection and vaccination were significantly associated with intention to get the vaccine. Most of the participants did not feel the need to get vaccinated, although more than 50% of Thai male youth from the South expressed their intention to get the vaccine, which was higher than any other region. In terms of sexual orientation, two-thirds of the heterosexual male youth were not willing to get the vaccine, while the proportion of homosexual and bisexual males willing to get the vaccine, 47.3% and 52.3%, respectively, was quite similar. Most participants who had heard about HPV but had not received the vaccine (58.3%) stated that they would not get vaccinated. However, the proportion of those who intended to receive the vaccine was higher in the group that had previously heard about HPV.

Previous receipt of information about HPV infection and vaccination

The aim of this study was to investigate the knowledge and awareness of HPV, the HPV vaccination rate, and reasons behind vaccination decisions of Thai male youth. The study found that previous receipt of information about HPV was a significant determinant in all aspects of the study. This suggests that providing accurate information is crucial for future clinical applications. Supplementary Table 4 (Table S4) displays the sources from which the participants learned about HPV. Social media was the most common source of information for Thai males, followed by healthcare providers who contributed more than half of the respondents' information. Two sources, friends and publications such as newspapers and magazines, both also had a strong effect in spreading information being cited in 42.1% and 35.7% of responses, respectively. Television, family, and other sources had only a minor influence.

DISCUSSION

This study, which included 594 participants, aimed to assess the knowledge and awareness of HPV and HPV vaccination among Thai male youth. In the study, the median score for knowledge was 11 (maximum score 18) (IQR 8-13). Several factors, including higher education level, higher family income, bisexuality, and prior receipt of information about HPV were associated with significantly higher knowledge of HPV scores. In terms of awareness (full scale 100%), the study found that the median awareness was 80% (IQR 68-92), and that previous receipt of HPV information was the only factor significantly associated with higher awareness. The study also found that the HPV vaccination rate among Thai male youth was 4.2%, and that most of the vaccinated individuals had decided to receive the vaccine by themselves. However, most participants who had not been vaccinated responded that they did not know that men could get HPV vaccination. Only 37.3% of the unvaccinated group expressed an intention to get vaccinated. Interestingly, unvaccinated males from the South region, those who were homosexual

or bisexual, and individuals who had previously received HPV information were significantly associated with a higher likelihood of getting vaccinated in the future. Participants indicated they had heard of HPV infection and vaccination mostly through social media, followed by healthcare providers, friends, and print media.

There was no difference observed in HPV knowledge between different age groups. However, recent evidence from Germany has shown that knowledge of HPV tends to increase with age (17). Some German schools now include sex education, including STD diseases, in their curriculum, which might have increased knowledge about HPV (17). In this study, male students pursuing high vocational certificates demonstrated significantly higher knowledge scores than those who completed only junior high school. This result suggests that the difference may be attributable to variations in the cultural norms of sexual education between academic and vocational education programs. We strongly advocate for sex education to be integrated into school curriculums, as there is a correlation between education level and higher knowledge scores.

Individuals with family incomes exceeding 50,000 baht per month tended to have a significantly higher score on knowledge of HPV. This finding could be attributable to the fact that higher income families have greater access to education and healthcare resources. Additionally, bisexual men displayed higher knowledge levels than heterosexual men, which is consistent with a study conducted among Australian women. In that study, bisexual women were found to have a greater awareness of HPV compared to heterosexual women (18). Individuals who identify as bisexual may be more knowledgeable and better prepared when it comes to engaging in sexual activities with partners of both genders. This could be due to their need to educate themselves on various sexual practices as well as on the risks of sexually transmitted infections and prevention strategies. As a result, they may have a better understanding of sexual health and safety practices than those who do not identify as bisexual.

Men who were better informed about HPV had higher scores for knowledge, awareness, and vaccination intention. This is because having prior knowledge about HPV infection and vaccination helps in understanding the potential risks and severity of diseases caused by this virus, its mode of transmission, and how to prevent it. In our study, over half of the men had heard of HPV (53.2%). This proportion is similar to a study among adolescent boys in England (19), but was considerably higher than in many countries where only 10-30% of people had heard of HPV (20-23). From the questionnaire, only a small number of participants indicated they had received information about HPV infection and vaccination in the classroom. Surprisingly, the majority of participants (70.6%) had learned about HPV and HPV vaccine from social media. This finding could have a significant impact on knowledge, awareness, and attitudes towards HPV infection and vaccination. It is crucial to note that helping individuals learn how easily HPV can be contracted can increase their awareness of the issue. According to our survey, only 4.2% of respondents reported that they had received the HPV vaccine. The exact number of HPV-vaccinated men in Thailand is unknown. Globally, only 4% of males have completed the entire course of the HPV vaccine (24). As shown in Table S5 of our study, there are two primary reasons why some participants did not receive the HPV vaccination. The first is lack of knowledge about HPV infection, including the misconceptions that men cannot receive the HPV vaccine and that there is only a low risk of getting infected, coupled with a lack of awareness of the vaccine. The second reason is the high cost of the vaccine, which is only provided free of charge for 11-12-year-old girls under Thailand's healthcare benefits system. Unfortunately, others must bear the cost of the vaccine themselves, which is a significant financial burden for many families, particularly amid the ongoing economic crisis. The survey found that 183 respondents (37.3%) intended to get vaccinated. This percentage is similar to the 41% vaccination intention rate found in England (19). Certain cultural beliefs and practices related to region or race have also been shown to affect awareness of HPV and the vaccine. In this study, participants residing in the Southern region were more likely to have received the HPV vaccine compared to other regions. A similar dichotomy was found in a study that reported Hispanics residing in the US were less aware of HPV and the HPV vaccine than non-Hispanic Whites. (25).

It's important to note that a person's sexual orientation can affect their decision to get vaccinated. Studies have shown that young gay men in the US and Thailand are more likely to consider getting vaccinated against HPV than are heterosexual men. This information can be useful for vaccination campaigns to help improve overall vaccination rates (26).

Strengths and limitations

The survey was conducted among Thai male youth from all major regions of the country using stratified random sampling, resulting in accurate and geographically inclusive data collection. The questionnaire system ensured that each email account was able to respond only once, thus avoiding repetitive answers. Additionally, the survey guaranteed respondents' confidentiality and anonymity, which encouraged them to provide truthful and realistic answers.

It is important to note that this study also has certain limitations. First, the survey did not include the levels of knowledge, awareness, and vaccination intention of female youth regarding HPV, which could have been used for comparison. The approach requiring internet access for participation in the questionnaire survey may have introduced potential selection bias, possibly contributing to the observation that nearly 40 percent of participants reside in the central region. Consequently, the results of this study may not be representative of the entire Thai male youth population. Additionally, the survey did not provide probable reasons to explain why education levels and geographic regions were associated with HPV knowledge and vaccination intention.

Clinical application and future direction

Based on the findings of this study, it appears that most of the participants lacked knowledge about HPV infection and vaccination, underlining the importance of raising awareness and encouraging young males to receive the vaccine and to better educate themselves about the disease. A previous study suggested that the HPV vaccine should be administered before the first sexual intercourse. Our data indicates that Thai men typically have their first sexual experience between the ages of 16 and 19. As a result, we recommend encouraging vaccination before that age. The Thai health education curriculum for school-aged children should include information on sexually transmitted infections and the importance of HPV vaccination. Social media can also be a valuable resource for promoting the HPV vaccine. Lastly, it is essential to gather more comprehensive, nationwide information on HPV vaccination among both males and females.

CONCLUSIONS

Although there is a high level of awareness of HPV infection and vaccination among Thai male youth, the current level of knowledge is still insufficient. Additionally, their acceptance rate of the HPV vaccine is still low and their attitudes are largely based on misconceptions. Therefore, it is important to develop improved education strategies, especially for this age group, to improve their understanding of HPV and increase their intention to get vaccinated. Such strategies could lead to a decrease in HPV-related diseases and help induce herd immunity in the future.

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CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

ADDITIONAL INFORMATION

Authors' contributions

All authors contributed to the study's conception and design. T.C., T.R.: performed material preparation and data collection. P.I.: reviewed Thai male population data. C.N., S.S., G.P.: analyzed and interpreted the patient data. C.N., S.S., G.P.: were major contributors in writing the manuscript. All authors read and approved the final manuscript.

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Table S1. Frequency distribution of knowledge of HPV and HPV vaccine knowledge (N = 594).

Questionaire items	Correct response	Yes (%)	No (%)	Unsure (%)
1. HPV can be transmitted to sexual partner regard-less male or female	Yes	462 (77.8)	22 (3.7)	110 (18.5)
2. Men can receive HPV vaccine	Yes	434 (73.1)	23 (3.9)	137 (23.1)
3. Even though receiving HPV vaccine, individuals still have risk of HPV infection	No	179 (30.1)	183 (30.8)	232 (39.1)
4. HPV vaccine is safe	Yes	361 (60.8)	41 (6.9)	192 (32.3)
5. HPV can cause herpes	No	215 (36.2)	153 (25.8)	226 (38.0)
6. Multiple sexual partners increase the risk of HPV infection	Yes	516 (86.9)	11 (1.9)	67 (11.3)
7. HPV infection increases the risk of penile cancer	Yes	376 (63.3)	50 (8.4)	168 (28.3)
8. HPV infection increases the risk of anorectal can-cer	Yes	275 (46.3)	81 (13.6)	238 (40.1)
9. HPV infection increases the risk of nasopharyn-geal cancer	Yes	188 (31.6)	118 (19.9)	288 (48.5)
10. Sexual intercourse at an early age increases risk of HPV infection	Yes	303 (51.0)	107 (18.0)	184 (31.0)
11. Using condom can reduces risk of the infection	Yes	532 (89.6)	9 (1.5)	53 (8.9)
12. Smoking is not a risk factor of HPV infection	No	91 (15.3)	330 (55.6)	173 (29.1)
13. For couples who received HPV vaccine, condom is not necessary	No	36 (6.1)	468 (78.8)	90 (15.2)
14. Sexual intercourse can increase risk of HPV in-fection, only if partner shows sign or symptom of HPV infection	No	108 (18.2)	355 (59.8)	131 (22.1)
15. HPV can be transmitted via contact or sharing common utensils	No	274 (46.1)	131 (22.1)	189 (31.8)
16. HPV vaccination in male youth requires 3 doses	Yes	224 (37.7)	56 (9.4)	314 (52.9)
17. Individuals who already have sexual intercourse have no necessity to get HPV vaccine because they were infected	No	32 (5.4)	408 (68.7)	154 (25.9)
18. Universal coverage scheme and social security fund cover the cost of HPV vaccination in Thai-land	No	224 (37.7)	85 (14.3)	285 (48.0)

Table S2. Frequency distribution of awareness of HPV knowledge and HPV vaccine (N = 594).

Questionnaire item	Strongly disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly agree (%)	Mean	S.D.
1. You believe that you are risky to be HPV in-fected and should receive HPV vaccine	75 (12.6)	91 (15.3)	178 (30.0)	108 (18.2)	142 (23.9)	3.3	1.3
2. You believe that being HPV infected are really caused life threatening disease	6 (1.0)	21 (3.6)	65 (10.9)	215 (36.2)	287 (48.3)	4.3	0.9
3. All students regardless of their gender should be received HPV vaccine	5 (0.8)	5 (0.8)	90 (15.2)	166 (27.9)	328 (55.3)	4.4	0.8
4. You would suggest your friend to receive HPV vaccine	7 (1.2)	8 (1.3)	143 (24.1)	187 (31.5)	249 (41.9)	4.1	0.9
5. You believe that HPV vaccine is capable to prevent other type of HPV-infected cancer	13 (2.2)	32 (5.4)	166 (27.9)	171 (28.8)	212 (35.7)	3.9	1

Table S3. Association between characteristics of unvaccinated Thai male youth and intention to get HPV vaccine (N = 490, Chi-square test)

Variables	Total	N (% within a row)		P-value
		Yes	No	
1. Education				0.48
Junior High school	46	17 (37.0)	29 (63.0)	
High school	139	53 (38.1)	86 (61.9)	
University	238	94 (39.5)	144 (60.5)	
Vocational certificate	39	9 (23.1)	30 (76.9)	
High vocational certificate	27	10 (37.0)	17 (63.0)	
Non - formal Education	1	0 (0.0)	1 (100.0)	
2. Region				0.02*
Central	185	58 (31.4)	127 (68.6)	
North	91	35 (38.5)	56 (61.5)	
Northeast	152	58 (38.2)	94 (61.8)	
South	50	29 (58.0)	21 (42.0)	
East	10	2 (20.0)	8 (80.0)	
West	2	1 (50.0)	1 (50.0)	
3. Religion				0.52
Buddhism	443	161 (36.3)	282 (63.7)	
Christianity	10	5 (50.0)	5 (50.0)	
Islam	3	1 (33.3)	2 (66.7)	
Atheist	34	16 (47.1)	18 (52.9)	
4. Family income (bath per month)				0.13
Less than 25,000	90	29 (32.2)	61 (67.8)	
25,000-50,000	146	57 (39.0)	89 (61.0)	
50,001-75,000	67	27 (40.3)	40 (59.7)	
75,001-100,000	49	26 (53.1)	23 (46.9)	
More than 100,000	68	22 (32.4)	46 (67.6)	
5. History of sexual intercourse				0.26
No	314	111 (35.4)	203 (64.6)	
Yes	152	62 (40.8)	90 (59.2)	
6. Sexual orientation				< 0.01**
Heterosexual	338	110 (32.5)	228 (67.5)	
Homosexual	74	35 (47.3)	39 (52.7)	
Bisexual	44	23 (52.3)	21 (47.7)	
Others	6	4 (66.7)	2 (33.3)	
7. Previous receiving information about HPV infection and vaccination				0.03*
No	226	73 (32.3)	153 (67.7)	
Yes	264	110 (41.7)	154 (58.3)	
Total	490	183 (37.3)	307 (62.7)	

*; P < 0.05, **; P < 0.01, statistically significant

Table S4. Sources of HPV infection and vaccination information (N = 316)

Sources	N (%)
Social media	223 (70.6)
Healthcare provider	162 (51.3)
Friends	133 (42.1)
Print media (e.g., Newspaper, magazine etc.)	113 (35.7)
Television	71 (22.5)
Family	57 (18.0)
Others	8 (0.03)

Table S5. Frequency distribution of rationales contributing to the decision-making of HPV vaccination (N = 515).

	N (%)
Yes (N = 25, 4.9%)	
Self-decision	17 (68.0)
Parents	14 (56.0)
Healthcare workers	9 (36.0)
Friends	1 (4.0)
No (N = 490, 95.1%)	
Unknowing that men can receive HPV vaccine	236 (48.2)
HPV vaccine is costly	125 (25.5)
Not enough time to get HPV vaccination	121 (24.7)
Self-perception that individual has low risk to HPV infection	87 (17.8)
Difficulty in transportation	76 (15.5)
Trypanophobia	63 (12.9)
Unknowing about HPV infection and vaccination	20 (4.1)
No history of sexual intercourse	6 (1.2)
Others	9 (1.8)