

RESEARCH ARTICLE

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A Cross-Sectional Study of Knowledge, Attitudes, and Perceptions toward HPV Vaccination Among Undergraduate Students Studying in Sarawak, Malaysia

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Abstract

Background: Cervical cancer remains a significant public health problem, particularly in low- and middle-income countries, and is mainly caused by persistent infection with high-risk human papillomavirus (HPV). Despite Malaysia's national HPV vaccination program, gaps in knowledge, misconceptions, and suboptimal vaccine uptake persist even among university students. **Objective:** This study aimed to assess HPV-related knowledge, attitudes and perceptions toward HPV vaccination among undergraduate students studying in Sarawak, and to identify sociodemographic factors associated with knowledge levels. **Results:** A total of 382 undergraduate students participated, of whom 55% were unvaccinated against HPV. Overall, HPV knowledge was moderate, with students from health faculties demonstrating higher HPV knowledge compared with those from non-health faculties ([aOR] = 2.0, 95% CI: 1.1-3.5; p = 0.016); Indian participants had significantly higher odds of high HPV-related knowledge compared with Malay participants (adjOR = 2.7, 95% CI: 1.0-7.0; p = 0.043). Vaccinated students have significantly higher HPV-related knowledge compared with unvaccinated students (adjOR = 1.9, 95% CI: 1.2-3.0; p=0.007). Attitudes toward HPV vaccination were generally positive, although concerns regarding cost, safety, and social stigma remained. **Conclusion:** Undergraduate students demonstrated moderate knowledge and positive attitudes toward HPV vaccination; however, notable knowledge gaps and misconceptions persist, particularly among non-health students and those who were unvaccinated. Targeted educational strategies and improved access to reliable information are essential to strengthen HPV prevention efforts.

Keywords: HPV vaccine, Human papillomavirus (HPV), cervical cancer prevention, undergraduate students

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Introduction

Cervical cancer ranks as the fourth most common cancer among women, with approximately 660,000 new cases and around 350,000 deaths reported in 2022. The highest incidence and mortality rates for cervical cancer are found in low and middle-income countries [1]. In Malaysia, cervical cancer ranks as the fourth most common cancer among women [2], with the highest incidence of 12.1 per 100,000 women recorded in the state of Sarawak [3, 4].

Generally, approximately 1.0% of women will harbor cervical HPV-16/18 infection at a given time. Persistent

infection with high-risk HPV types is responsible for 88.7% of invasive cervical cancer cases [2]. In Malaysia, the prevalence of HPV types 16/18 among women aged 18 to 24 dropped by 91%, from 4.0% in 2013-2015 to just 0.4% in 2019-2020 [5]. This is due to the national HPV vaccination program launched in 2010, offering free HPV vaccines to 13-year-old girls via a school-based immunization initiative. Pre-COVID, the HPV vaccination rate was 84.5% among girls age 13 (completed 2 doses), but there are no published data on vaccination uptake according to individual states [6]. This program was however, disrupted during the COVID-19 pandemic due to pandemic lockdowns and shortage of HPV vaccination

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supply, which the Ministry of Health (MOH) is currently addressing through catch up vaccinations [7].

The effectiveness of HPV vaccines depends on the specific HPV types they target, offering strong protection against high-risk strains linked to cervical cancer[8]. The MOH in Malaysia has implemented the use of Cervarix® and Gardasil 4® as part of its immunization program. Currently, four HPV vaccines have WHO pre-qualifications: Gardasil 9®, which protects against HPV type 6, 11, 16, 18, 31, 33, 45, 52 and 58, Gardasil 4®, targeting types 6, 11, 16, and 18, Cervarix® and Cecolin-2®, both of which cover HPV16 and HPV18, which efficacy and safety has been endorsed [9].

The WHO now recommends a one- or two-dose HPV vaccination schedule for girls aged 9-14 years, a one- or two-dose schedule for girls and women aged 15-20 years, and two doses with a 6-month interval for women over 21 years [10]. According to the MOH Action Plan Towards the Elimination of Cervical Cancer in Malaysia 2021-2030, the aims are to achieve 90% HPV vaccination coverage among girls aged 13 years, 70% HPV screening coverage for women aged 30 to 65 years, and 90% treatment of precancerous lesions, which aligns with the WHO global strategy [11].

Several studies have been conducted in Peninsular Malaysia that have shown barriers to HPV vaccination due to lack of awareness and knowledge, with varying intention to receive HPV vaccination [12–20]. Cost is also one of the most important barriers to receive vaccination [13, 15, 21, 22], with Gardasil 9® costing at RM 2040 (USD 500) for 3 complete doses. Nationwide, Sarawak contributed the highest proportion of HPV-positive cases, 31.7%, followed by Perak, 16.1% and Sabah, 14.8% (23). However, published data specifically examining HPV-related knowledge, attitudes, and perceptions among undergraduate students in Sarawak remain limited, despite the state's high cervical cancer burden and distinct rural and sociodemographic context [7, 23].

Sarawak is the largest state in Malaysia with almost half the population living in rural areas [24]. Children from some ethnic communities may leave school early due to socio-economic factors, potentially resulting in them missing out on the National vaccination program [7]. Universiti Malaysia Sarawak (UNIMAS), the main public university in the state, provides an important setting to examine HPV-related knowledge and perceptions among young adults from diverse ethnic and educational backgrounds. As future professionals, university students may also play an important role in influencing public awareness and acceptance of HPV vaccination. This study therefore aimed to assess knowledge, attitudes, and perceptions toward HPV vaccination among undergraduate students in Sarawak, and to identify sociodemographic factors associated with knowledge levels.

Materials and Methods

Study design and population

This cross-sectional survey was conducted among undergraduate students from UNIMAS which is the single public tertiary university in Sarawak. Ten

faculties participated in the study, including the Faculty of Economics and Business (FEB), Faculty of Social Sciences and Humanities (FSSH), Faculty of Cognitive Sciences and Human Development (FCSHD), Faculty of Engineering (FENG), Faculty of Resource Science and Technology (FRST), Faculty of Built Environment (FBE), Faculty of Medicine and Health Sciences (FMHS), Faculty of Language and Communication (FELC), Faculty of Applied and Creative Arts (FACA), and Faculty of Computer Science and Information Technology (FCSIT). The questionnaire link was disseminated through WhatsApp student groups across all years in the ten participating faculties using convenience sampling. As distribution occurred via group-based sharing, the exact number of students approached could not be ascertained. Recruitment continued until the required sample size was obtained.

The required sample size for the survey was calculated using a 95% confidence level, 5% margin of error, 50% estimated prevalence, and a target population of approximately 13,521 UNIMAS undergraduate students from the ten participating faculties, excluding postgraduate and inactive students. Based on these parameters, the minimum required sample size was 374 students. As this was an online survey, a non-response rate of 10% was anticipated, requiring an additional 37 participants. Therefore, the minimum target sample size was 382 respondents [25]. A total of 420 responses were received, of which 382 complete responses were included in the final analysis after exclusion of incomplete submissions.

For the second objective, which was to identify factors associated with high HPV knowledge, four independent variables were included in the logistic regression analysis. The sample size requirement for this analysis was estimated based on the rule of thumb proposed by Bujang et al. [26] for logistic regression in observational studies, using the formula $n = 100 + 50(i)$, where i represents the number of independent variables in the final model. Based on four independent variables, the minimum required sample size was 300 respondents [26]. Therefore, the achieved sample size was sufficient for both the descriptive analysis and the logistic regression analysis conducted in this study.

Data collection and quality control

The study followed a quantitative study design based on a questionnaire method, whereby the data was collected via Google Forms (<https://shorturl.at/ImK0X>) and distributed via WhatsApp. This questionnaire was completely anonymous. The respondents were required to agree to the informed consent form before answering the questionnaire. Personal information such as the email address or any other identifiable data was not collected in the survey. The responses were confidential and were only used for research purposes.

The questionnaire used in this study consisted of three sections: (1) demographic profile, (2) knowledge, and (3) perception. The knowledge and perception items were developed with reference to previous validated studies [27, 28]. The original version comprised 14 knowledge-related questions and 11 perception-related items. In this study,

knowledge referred to participants' factual understanding of HPV and its prevention, whereas perception referred to participants' views, beliefs, and interpretations regarding HPV and related preventive measures.

Therefore, a validation process was conducted in accordance with the guidelines proposed by Bujang et al. [29].

First, content validity was assessed by three subject matter experts. All items were deemed appropriate, with only minor amendments made to suit the local population. As a result, the final version contained 14 knowledge questions and 13 perception items. All questions were presented in English, and translation was deemed unnecessary, as all participants were proficient in English. Furthermore, all items were considered appropriate in terms of scientific content, lifestyle, and cultural relevance [29]. Subsequently, a pilot study was conducted with 30 participants using a self-administered approach. The results revealed no missing value and no additional comments from the participants. After completing all the necessary validation steps, the questionnaire was deemed ready and applied in the main field survey.

Statistical analysis

Statistical analyses were performed using IBM SPSS Statistics version 29.0. Questionnaire responses were initially entered into Microsoft Excel and subsequently coded numerically prior importing into SPSS for analysis. Descriptive statistics were used to summarize participant characteristics and response distributions. Categorical variables were presented as frequencies and percentages.

Associations between categorical variables were assessed using Pearson's chi-square test. A p-value of <0.05 was considered statistically significant. Each correct response to the HPV knowledge questions was awarded one point, yielding a total HPV-related knowledge score ranging from 0 to 14. Based on these scores, respondents were categorized into three knowledge levels: low (0–6), intermediate (7–10), and high (11–14).

Binary logistic regression analysis was conducted to identify factors independently associated with HPV knowledge levels, adjusting for potential confounders including faculty (health vs. non-health), year of study, ethnicity, and HPV vaccination status.

Results

Demographic characteristics

Table 1 depicts the demographic characteristics of the respondents. Most of them were aged between 21–23 years old (59.4%). Female students constituted a slightly higher proportion (56.3%) than males (43.7%). Malay students constituted the largest ethnic group (26.4%), followed by Iban (16.8%) and Chinese (14.1%). Students from all ten academic faculties were represented, with the highest participation from the FMHS (14.9%), followed by the FCSHD (12.6%). Most respondents were in Year 1 (36.6%) or Year 2 (40.3%) of study, and the majority were non-smokers (88.5%). More than half of the students (55.0%) reported not having received the HPV vaccine, where 44.3% and 69.5% of these consisted of female and

Table 1. Sociodemographic Profile of Respondents (n=382)

Characteristics	Frequency (n)	Percentage (%)
Age		
18-20	124	32.5
21-23	227	59.4
24-27	31	8.1
Gender		
Male	167	43.7
Female	215	56.3
Ethnicity		
Malay	101	26.4
Chinese	54	14.1
Indian	32	8.4
Iban	64	16.8
Bidayuh	40	10.5
Kadazan	23	6
Dusun	33	8.6
Others	35	9.2
Faculty		
FMHS	57	14.9
FCSHD	48	12.6
FRST	35	9.2
FSSH	37	9.7
FENG	36	9.4
FBE	21	5.5
FEB	46	12
FELC	26	6.8
FACA	31	8.1
FCSIT	45	11.8
Year of Study#		
Year 1	140	36.6
Year 2	154	40.3
Year 3	56	14.7
Year 4	25	6.5
Year 5	7	1.8
Smoking Habit*		
Non-Smoker	338	88.5
Active or ex-smoker	41	10.7
Unknown	3	0.8
HPV vaccination status*		
Vaccinated	168	44
Not vaccinated	210	55
Unknown	4	1
Have you tested HPV positive before?*		
Yes	5	1.3
No	371	97.1
Unknown	6	1.6
If yes, which strain? (n=5)*		
Unknown	5	100

*, Optional questions; #, They did not add up to 100% because the numbers were rounded up.

male students, respectively. Only 1.3% of respondents reported a previous HPV infection, and none were able to identify the HPV strain.

Table 2 summarizes the level of HPV-related knowledge among the respondents based on 14 questionnaire items. Overall, students demonstrated good awareness in several key domains: A large proportion correctly identified HPV as a sexually transmitted infection (80.6%), recognized that it can infect men (80.6%), understood that it is common among women (80.6%) and were aware that HPV can cause cervical cancer (82.2%) and genital warts (81.4%).

However, knowledge gaps were evident. Understanding of the asymptomatic nature of HPV infection was limited, with 74.6% of respondents incorrectly believing that most women infected with HPV would show symptoms. Nearly one-third (30.1%) were unaware of that HPV infection can be cleared by the immune system. Most respondents recognized that persistent HPV infection is a necessary cause of cervical cancer (76.4%) and that HPV vaccination can help prevent cervical cancer (77.5%).

Only approximately one-fifth of respondents correctly understood that HPV vaccination may still be administered to women who have already been infected with HPV. Although the majority recognized that the vaccine can be given to sexually active women (78.3%), 69.4% of respondents incorrectly believed that cervical screening is required prior to HPV vaccination. Notably, 70.4% of respondents also incorrectly agreed that it is safe to have multiple sexual partners after receiving the HPV vaccine.

Table 3 demonstrated students' perceptions, attitudes, and concerns regarding HPV vaccination. In general, respondents showed positive attitudes towards HPV vaccination, with approximately two third agreeing that vaccination should be given before sexual debut, and supporting vaccination for boys. Adolescence was most commonly identified as the appropriate age for vaccination. The internet and television were the most frequently reported sources of information, followed by school-based learning and informal social sources. A high proportion of students also expressed willingness to receive or recommend HPV vaccination.

Despite these positive attitudes, several barriers and concerns were reported. Inadequate information was the most frequently reported obstacle, particularly among female respondents, followed by concerns regarding vaccine accessibility, cost, potential complications, and doubts about vaccine efficacy. Additionally, misconceptions persisted, with approximately one-fifth of respondents believing that HPV vaccination is not possible after sexual intercourse.

Stigma and emotional concerns related to HPV infection and vaccination were also evident. Approximately one-third of respondents reported feeling embarrassed or ashamed to ask for the HPV vaccine due to its association with sexual transmission, and a similar proportion indicated they would feel embarrassed if others knew they had received the vaccine. Nearly half of respondents reported that they would feel devastated if diagnosed with HPV. Furthermore, around one-quarter of students believed that receiving the HPV vaccine after HPV

infection could be harmful to their health.

Univariate analysis of association of demographic

Table 2. HPV Related Knowledge among UNIMAS Undergraduate Students (n=382)

	Frequency (n)	Percentage (%)
Is HPV sexually transmitted?		
Yes*	308	80.6
No	74	19.4
Is HPV a common infection in women?		
Yes*	308	80.6
No	74	19.4
Most women infected with HPV infection show symptoms, right?		
Yes*	285	74.6
No*	97	25.4
Do you think HPV can infect a man?		
Yes*	308	80.6
No	74	19.4
Can HPV be cleared by immune system?		
Yes*	267	69.9
No	115	30.1
Can HPV cause cervical cancer?		
Yes*	314	82.2
No	68	17.8
Can HPV cause genital warts?		
Yes*	311	81.4
No	71	18.6
Is persistent HPV the necessary cause of cervical cancer?		
Yes*	292	76.4
No	90	23.6
Can cervical cancer be prevented by HPV vaccines?		
Yes*	296	77.5
No	86	22.5
Can HPV vaccines be given to a woman already having HPV infection?		
Yes*	94	24.6
No	288	75.4
Can HPV vaccines be given to a sexually active woman?		
Yes*	299	78.3
No	83	21.7
Do girls/women need to be screened for HPV before getting vaccinated?		
Yes*	265	69.4
No*	117	30.6
Do women who have already been vaccinated, require a cervical cancer screening?		
Yes*	298	88
No	84	22
Is it safe to have multiple sexual partners after full course of HPV vaccination?		
Yes*	269	70.4
No*	113	29.6

*They corresponded to correct answers to the knowledge questions

Table 3. Perceptions, Attitudes and Concerns on HPV Vaccination among UNIMAS Undergraduate Students (n=382)

	Male (n=167)		Female (n=215)	
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)
Which age group HPV vaccines should be given?				
0-12y	12	7.2	16	7.4
13-18y	89	53.3	125	58.1
19-25y	42	25.1	49	22.8
26y and above	24	14.4	25	11.6
Unknown	0	0	0	0
Which is the most appropriate stage for HPV vaccination?				
Before sexual debut	133	79.6	171	79.5
After sexual debut	34	20.4	44	20.5
Can HPV vaccines be given to boys?				
Yes	113	67.7	152	70.7
No	54	32.3	63	29.3
What are your sources of information about vaccine?#				
School course	30	18	55	25.6
Hospital	17	10.2	13	6
Family/Friends	29	17.4	28	13
Internet/Television	62	37.1	89	41.4
Publications	29	17.4	30	14
Has anybody (friends or family) asked your opinion on HPV vaccines?				
Yes	48	28.7	53	24.7
No	119	71.3	162	75.3
Would you like to receive/advise on HPV vaccination?				
Yes	140	83.8	165	76.7
No	27	16.2	50	23.3
What is your attitude toward current HPV vaccination program in Malaysia?				
Positive, since the vaccine can prevent cervical cancer/genital warts.	112	67.1	140	65.1
Negative, since the price will be high and the consumption capacity of ordinary Malaysian are low.	2	1.2	5	2.3
Neutral, since I don't know the long-term efficacy and side effects.	48	28.7	67	31.2
Negative, since it may lead to promiscuity.	5	3	3	1.4
What do you think will be the most important obstacle preventing yourself to receive/advise on HPV vaccination?				
High cost	33	19.8	41	19.1
Worry about complications	27	16.2	36	16.7
Worry about the efficacy of the vaccine	29	17.4	28	13
Inadequate information	44	26.3	72	33.5
Accessibility in obtaining the vaccine	34	20.4	38	17.7
I would be embarrassed in case other people knew that I got HPV infection				
Yes	57	34.1	85	39.5
No	110	65.9	130	60.5
I would feel ashamed to ask for HPV vaccine because it is a sexual transmittable disease				
Yes	51	30.5	70	32.6
No	116	69.5	145	67.4
If others knew I received HPV vaccination, I would be embarrassed				
Yes	50	29.9	61	28.4
No	117	70.1	154	71.6

Table 3. Continud

	Male (n=167)		Female (n=215)	
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)
If I were diagnosed with HPV, I would be devastated				
Yes	72	43.1	107	49.8
No	95	56.9	108	50.2
In case I were infected with HPV, receiving vaccine could be harmful for my health				
Yes	43	25.7	50	23.3
No	124	74.3	165	76.7
I cannot receive vaccine because I already had sexual intercourse				
Yes	30	18	38	17.7
No	137	82	177	82.3

#They did not add up to 100% because the numbers were rounded up.

factors and level of HPV related knowledge is described in Supplementary Table 1. The HPV-related knowledge was categorized as low (0–6 correct answers), intermediate (7–10), or high (11–14), based on the classification proposed by Fu et al [27]. Overall, more than half of the respondents demonstrated a high level of HPV-related knowledge.

Figure 1 illustrates the HPV-related knowledge across ethnic groups, dichotomised into low-to-intermediate and high categories. The highest prevalence of high HPV-related knowledge was observed among Indian participants (75.0%), followed by Chinese (61.1%) and Iban (59.4%). In contrast, Dusun participants demonstrated the highest prevalence of low-to-intermediate knowledge (66.7%), followed by Kadazan participants (52.2%) and Malay participants (43.6%).

Univariate analyses of association of sociodemographic factors and level of HPV related knowledge (as shown in

Appendix) demonstrated that age, ethnicity, faculty, year of study, and HPV vaccination status are significantly associated with HPV knowledge level. Variables that were significantly associated with HPV-related knowledge in univariate analysis ($p < 0.05$) were considered for inclusion in the multivariable logistic regression model. Age was not included in the multivariate analysis due to its strong correlation with year of study, and year of study was retained as the more relevant indicator of educational exposure. For multivariable analysis, HPV-related knowledge was dichotomised by combining the low and intermediate knowledge categories and comparing them against the high knowledge category.

Table 4 demonstrated the multivariate logistic regression analysis determining sociodemographic factors associated with high HPV-related knowledge. Students from health faculties were significantly more likely to demonstrate high HPV knowledge compared with those

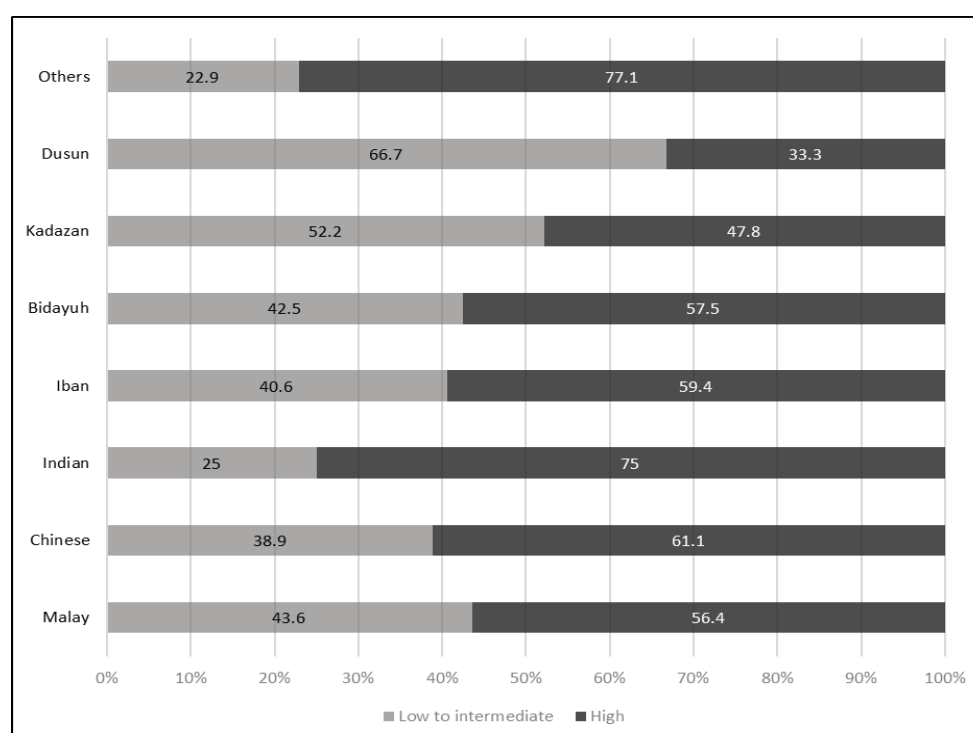


Figure 1. Prevalence of Low to Intermediate Level and High Level of Knowledge on HPV Vaccination According to Ethnic Groups

Table 4. Multivariate Logistic Regression of Sociodemographic Factors and Level of HPV Related Knowledge

	Low to intermediate (n=158)	High (n=224)	P value	Odd ratio	adjOR	P value
Faculty			0.004			0.016
Health	26 (16.5)	66 (29.5)				
Non-health (ref)	132 (83.5)	158 (70.5)		2.1 (1.3-3.5)	2.0 (1.1-3.5)	
Year			0.251			0.181
1 (ref)	63 (39.9)	77 (34.3)				
2	57 (36.1)	97 (43.3)	0.165	1.4 (0.9-2.2)	1.0 (0.6-1.7)	0.855
3	21 (13.3)	35 (15.6)	0.339	1.4 (0.7-2.6)	1.2 (0.6-2.3)	0.671
4 and above	17 (10.8)	15 (6.7)	0.407	0.7 (0.3-1.6)	0.5 (0.2-1.0)	0.055
Ethnicity			0.015			0.045
Malay (ref)	44 (27.8)	57 (25.4)				
Chinese	21 (13.3)	33 (14.7)	0.574	1.2 (0.6-2.4)	1.2 (0.6-2.3)	0.683
Indian	8 (5.1)	24 (10.7)	0.065	2.4 (1.0-5.6)	2.7 (1.0-7.0)	0.043
Iban	26 (16.5)	38 (17.0)	0.71	1.1 (0.5-2.2)	1.3 (0.6-2.4)	0.496
Bidayuh	17 (10.8)	23 (10.3)	0.908	1.0 (0.5-2.2)	0.9 (0.4-2.0)	0.838
Kadazan	12 (7.6)	11 (4.9)	0.455	0.7 (0.3-1.8)	0.8 (0.3-2.0)	0.605
Dusun	22 (13.9)	11 (4.9)	0.024	0.4 (0.2-0.9)	0.5 (0.2-1.1)	0.1
Others	8 (5.1)	27 (12.1)	0.033	2.6 (1.1-6.3)	2.6 (1.1-6.5)	0.035
HPV vaccination			<0.001			0.007
Vaccinated	53 (34.0)	115 (51.8)		2.1 (1.4-3.2)	1.9 (1.2-3.0)	
Not vaccinated (ref)	103 (66.0)	107 (48.2)				

from non-health faculties (adjusted odds ratio [aOR] = 2.0, 95% CI: 1.1-3.5; $p = 0.016$). Overall, Ethnicity was independently associated with HPV-related knowledge ($p = 0.045$). Indian participants had significantly higher odds of high HPV-related knowledge compared with Malay participants (adjOR = 2.7, 95% CI: 1.0-7.0; $p = 0.043$). HPV vaccination status was a strong independent predictor of HPV knowledge. Vaccinated students were significantly more likely to have high HPV-related knowledge compared with unvaccinated students (adjOR = 1.9, 95% CI: 1.2-3.0; $p = 0.007$). Year of study was not significantly associated with HPV-related knowledge after adjustment.

Discussion

This study demonstrated that undergraduate students studying in Sarawak had overall moderate to high knowledge and generally positive attitudes toward HPV vaccination. Students from health-related faculties and those who had received HPV vaccination were significantly more likely to have higher knowledge levels, highlighting the influence of academic exposure and prior health engagement. Ethnicity was also associated with knowledge differences, suggesting disparities in access to health information across population groups. Despite these encouraging findings, important misconceptions persist, particularly regarding the asymptomatic nature of HPV infection, vaccine eligibility after infection, and safe sexual practices following vaccination.

Although more than 80% of respondents correctly identified HPV as a sexually transmitted infection and its role in cervical cancer and genital warts, substantial

misconceptions remain. A large proportion believed that HPV infection is symptomatic, which is consistent with previous studies [27, 30, 31]. This misconception may reduce perceived susceptibility and delay preventive actions such as vaccination and screening [10, 32]. The lack of knowledge regarding asymptomatic HPV symptoms lead to an underestimation of personal risk and discouraged preventive strategies such as prompt vaccination and continued screening, which subsequently ended in late diagnosis [30, 31]. Misunderstandings regarding vaccine eligibility, particularly among individuals with prior infection or sexual activity, further indicate the gaps in translating knowledge into appropriate health behavior. These findings are consistent with previous studies reporting incomplete understanding of HPV natural history and vaccine function among university students. Most students are unaware that there are over 200 different HPV genotypes and that although vaccination does not treat existing infections, it can still provide prophylaxis against other high-risk HPV types that the individual has not yet acquired [10, 32]. The fact that almost three quarter of the respondents believed that it is safe to have multiple sexual partners post vaccination is a major concern, highlighting an overestimation of vaccine coverage. It is likely that these young adults are unaware of the 14-high risk HPV oncotypes [33], and that even the latest vaccine, Gardasil 9 could only cover half of these oncotypes. In addition, a recent increase in HIV cases especially among tertiary students [34], suggests that they may assume that HPV vaccine covers other sexually transmitted diseases as well. Hence, ongoing sexual education is needed to support consistent preventive behaviors among these undergraduates.

Interestingly, our study demonstrated that gender did not have a significant impact on knowledge, which is consistent with a few studies [12, 35]. This aligns with the emerging policies of gender-neutral HPV vaccination program to reduce HPV infections and related cancers via herd immunity as well as promoting gender equity [36]. This is supported by the fact that where 44.3% of male and 69.5% female students were vaccinated in this study. The proportion of male students who reported having received HPV vaccination is not unexpected, as HPV vaccination is also recommended for males and is not solely limited to females. In addition, vaccination status was also a predictor for higher knowledge levels, where those vaccinated participants showed better understanding, trust and less fear on HPV and HPV-related diseases [28]. However, several studies reported that health-related students are more willing to get vaccinated than non-health students [22,37], a finding similar in our study where almost 40% of those vaccinated were from health faculties (FMHS and FRST). This raises an important issue regarding the gap in HPV knowledge between health and non-health students. Naturally, students from health faculties also demonstrated significantly higher knowledge and awareness levels compared to non-health faculties, consistent with a previous local study [22]. This is likely to be due to an academic focus on medicine, health and biological sciences in these faculties, which increases their background knowledge of HPV.

Ethnic differences in knowledge levels were also observed, with highest knowledge recorded among Indian students, followed by Chinese and Iban. This finding is not surprising as Indian are a minority in Sarawak and hence, majority of them are from Peninsular Malaysia, where numerous past studies are conducted at [12–20]. In our study, both Iban and Chinese students portrayed greater knowledge about HPV, a result corroborated by existing evidences [19, 38]. This observation may be related to the higher reported cervical cancer prevalence among these ethnic groups in Sarawak [7], which could potentially contribute to increased awareness. On the other hand, Dusun, Kadazan and Malay students demonstrated lower knowledge, indicating gaps in public health outreach and inequality in resource distribution. The difference may relate to geographical and infrastructure as Dusun and Kadazan students are native to Sabah and are more likely to reside in less urbanized areas, where there are fewer health campaigns and limited access to the internet resulting in poor access to health-related materials, findings comparable to another local study in Penang rural region [13].

Students' perception of HPV vaccination was generally positive, with a high proportion expressing willingness to receive or recommend the vaccine and support for gender-neutral vaccination, which is comparable with previous studies [20, 39]. This aligns with the growing consensus that vaccinating both genders are essential in breaking the chain of HPV transmission, as male can also get HPV-related diseases such genital warts and oropharyngeal malignancies [2]. On the other hand, about a third of the respondents reported being embarrassed and devastated if they were found with HPV infection, and ashamed if

they are vaccinated because it is for sexual transmittable disease, highlighting the stigma surrounding HPV even after 15 years of implementing the free HPV vaccination program in Malaysia. Several studies corroborated this finding, where social stigma related to HPV vaccine and screening is one of the most recalcitrant barriers to cervical cancer elimination in the nation [14, 22, 31, 40]. Hence, culturally-sensitive public education campaign focusing on universal vaccine promotion may reduce the stigma surrounding HPV vaccination. This is important for university students, who may be particularly sensitive to peer perception, especially in societies where premarital sex is seen as a taboo [22].

The internet was identified as the primary source of HPV-related information, which is consistent with recent studies [21, 22]. While accessibility of the internet allows wide dissemination of health messages, the variability in content quality warrant the need for formal health education campaigns. Previous study indicated that the combination of social media and traditional media was effective in improving HPV vaccination practices among students by increasing their exposure to verified health information [41]. While more than half of the students expressed positive attitudes towards the HPV vaccination program, barriers such as cost, fear of side effects, and limited access to reliable information prevail. Another study in 2010 reflected similar findings, where 11.7% of the respondents were unvaccinated due to financial constraints [40]. However, in Malaysia, female who are 18 years old and above are also eligible up to age 26 years to get free vaccination at any of the government clinics according to the National Population and Family Development Board of Malaysia [15]. The respondents in this survey, being less than 26 years of age, may not be aware of this information. Hence, more extensive awareness on the availability of free HPV vaccinations until the age of 26 years should be conducted. In addition, authorities should disseminate the type, safety and efficacy of HPV vaccination provided to the public, a common pitfall where focus is always on the quantity and not the quality of the program conducted.

Several important implications arise from this study. Targeted educational interventions should be prioritized for non-health students and unvaccinated individuals with lower knowledge levels. Public health messaging should address key misconceptions regarding HPV infection and vaccination, particularly its asymptomatic nature and the need for continued preventive behaviors post-vaccination. Culturally sensitive strategies are also needed to reduce stigma and improve vaccine acceptability, alongside increasing awareness of vaccination programs and eligibility to enhance uptake among young adults.

Limitations

However, there are also some limitations to consider. Since the study was conducted only in UNIMAS, the results may not reflect the views or experiences of students in other institutions across Sarawak. Another limitation is the use of self-reported data, leading to recall bias. Given the cross-sectional design, this study could only identify associations and not causal relationships between

sociodemographic factors and HPV knowledge. Moreover, certain factors such as personal beliefs, socioeconomic, cultural background, or prior exposure to HPV information were not included in the questionnaire but may play an important role in the responses. Including these in future research could give a more complete picture of what influences vaccine acceptability.

In conclusion, undergraduate students demonstrated moderate knowledge and positive attitudes toward HPV vaccination. Undergraduate students who are from the health faculties faculty showed superior knowledge and positive attitudes toward HPV infection and vaccination compared to non-health faculties. However, misconceptions and gaps remain, especially among non-health students and the unvaccinated. Targeted, accurate and culturally appropriate education with better vaccine access is warranted to improve awareness and prevention efforts in a setting with high prevalence of cervical cancer. This study contributes region-specific evidence from Sarawak to inform culturally appropriate HPV prevention strategies in underserved and multi-ethnic populations.

Author Contribution Statement

MLSH and STSN contributed to the study conception and design. Data collection and analysis were performed by JFAS, NNBNA, SNIBMR, TMF, STSN and MAB. The first draft of the manuscript was written by MLSH, STSN, IBWM, VPJ and all authors commented on subsequent versions of the manuscript. All authors read and approved the final manuscript.

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Ethical Approval

This study was approved by the Medical Research Ethics Committee (MREC) of Universiti Malaysia Sarawak (FME/25/06) on 28 January 2025.

Data Availability Statement

The dataset generated and/or analyzed during the current study are available in the [HPV KAP UNIMAS] repository, [<https://www.kaggle.com/datasets/melissalimsiawhan/hpv-kap-unimas>].

Conflict of Interest

The authors declare no potential conflict of interest.

References

1. World Health Organization. Cervical cancer [Internet]. Geneva: World Health Organization; 2025 [cited 2025 Dec 23]. Available from: <https://www.who.int/news-room/fact-sheets/detail/cervical-cancer>
2. Bruni L, Albero G, Serrano B, Mena M, Collado JJ, Gómez D, et al. ICO/IARC Information Centre on HPV and Cancer (HPV Information Centre). Human papillomavirus and related diseases in the world. Summary report 10 March 2023 [Internet]. Barcelona: HPV Information Centre; 2023 [cited 2025 Dec 23]. Available from: <https://hpvcentre.net/statistics/reports/XWX.pdf>
3. Mustafa WA, Halim A, Nasrudin MW, Rahman KSA. Cervical cancer situation in Malaysia: A systematic literature review. *Biocell*. 2021;46(2):367-81. <https://doi.org/10.32604/biocell.2022.016814>.
4. Azizah AM, Hashimah B, Nirmal K, Siti Zubaidah AR, Puteri NA, Nabihah A, et al. Malaysia National Cancer Registry Report 2012-2016 [Internet]. Putrajaya: Ministry of Health Malaysia; 2019 [cited 2025 Nov 6]. Available from: [https://www.moh.gov.my/moh/resources/Penerbitan/Laporan/Umum/2012-2016\(MNCRR\)/MNCRR_2012-2016_FINAL_\(PUBLISHED_2019\).pdf](https://www.moh.gov.my/moh/resources/Penerbitan/Laporan/Umum/2012-2016(MNCRR)/MNCRR_2012-2016_FINAL_(PUBLISHED_2019).pdf)
5. Khoo SP, Muhammad Ridzuan Tan NA, Rajasuriar R, Nasir NH, Gravitt P, Ng CW, et al. Changes in genital human papillomavirus (HPV) prevalence among urban females a decade after the Malaysian hpv vaccination program. *PLoS One*. 2022;17(12):e0278477. <https://doi.org/10.1371/journal.pone.0278477>.
6. World Health Organization. Malaysian health indicators 2020 [Internet]. [cited 2023 May 9]. Available from: <https://data.humdata.org/dataset/who-data-for-malaysia>
7. Lim MSH, Tan SSN, Wan Maharuddin IB, Voon PJ, Abdul Rahim NKB, Tiong XT, et al. Survival rates of cervical cancer patients in Sarawak: A single-centre referral study. *BMC Cancer*. 2025;25(1):1381. <https://doi.org/10.1186/s12885-025-14678-9>.
8. Stanley M, Joura E, Yen GP, Kothari S, Luxembourg A, Saah A, et al. Systematic literature review of neutralizing antibody immune responses to non-vaccine targeted high-risk HPV types induced by the bivalent and the quadrivalent vaccines. *Vaccine*. 2021;39(16):2214-23. <https://doi.org/10.1016/j.vaccine.2021.01.060>.
9. Basu P, Banerjee D, Singh P, Bhattacharya C, Biswas J. Efficacy and safety of human papillomavirus vaccine for primary prevention of cervical cancer: A review of evidence from phase III trials and national programs. *South Asian J Cancer*. 2013;2(4):187-92. <https://doi.org/10.4103/2278-330x.119877>.
10. World Health Organization. One-dose human papillomavirus (HPV) vaccine offers solid protection against cervical cancer [Internet]. Geneva: World Health Organization; 2022 Apr 11 [cited 2025 Dec 23]. Available from: [https://www.who.int/news/item/11-04-2022-one-dose-human-papillomavirus-\(hpv\)-vaccine-offers-solid-protection-against-cervical-cancer](https://www.who.int/news/item/11-04-2022-one-dose-human-papillomavirus-(hpv)-vaccine-offers-solid-protection-against-cervical-cancer)
11. Ministry of Health Malaysia. Action plan towards the elimination of cervical cancer in Malaysia 2021-2030 [Internet]. Putrajaya: Family Health Development Division, Ministry of Health Malaysia; 2021 [cited 2025 Dec 23]. Available from: <https://www.moh.gov.my>
12. Rashwan HH, Saat NZ, Abd Manan DN. Knowledge, attitude and practice of Malaysian medical and pharmacy students towards human papillomavirus vaccination. *Asian Pac J Cancer Prev*. 2012;13(5):2279-83. <https://doi.org/10.7314/apjcp.2012.13.5.2279>.
13. Khoo CL, Teoh S, Rashid AK, Zakaria UU, Mansor S, Salleh FN, et al. Awareness of cervical cancer and HPV vaccination and its affordability among rural folks in Penang Malaysia. *Asian Pac J Cancer Prev*. 2011;12(6):1429-33.
14. Wong LP. Young multiethnic women's attitudes toward the HPV vaccine and HPV vaccination. *Int J Gynaecol Obstet*. 2008;103(2):131-5. <https://doi.org/10.1016/j.ijgo.2008.07.005>.

15. Rajiah K, Maharajan MK, Chin NS, Num KSF. Awareness and acceptance of human papillomavirus vaccination among health sciences students in Malaysia. *Virusdisease*. 2015;26(4):297-303. <https://doi.org/10.1007/s13337-015-0287-3>.
16. Wong LP, Alias H, Sam IC, Zimet GD. A nationwide study comparing knowledge and beliefs about HPV among female students before and after HPV vaccination. *J Pediatr Adolesc Gynecol*. 2019;32(2):158-64. <https://doi.org/10.1016/j.jpjg.2018.10.010>.
17. Wong LP, Raja Muhammad Yusoff RNA, Edib Z, Sam IC, Zimet GD. Nationwide survey of knowledge and health beliefs regarding human papillomavirus among HPV-vaccinated female students in Malaysia. *PLoS One*. 2016;11(9):e0163156. <https://doi.org/10.1371/journal.pone.0163156>.
18. Badgujar VB, Ahmad Fadzil FS, Balbir Singh HK, Sami F, Badgujar S, Ansari MT. Knowledge, understanding, attitude, perception and views on HPV infection and vaccination among health care students and professionals in Malaysia. *Hum Vaccin Immunother*. 2019;15(1):156-62. <https://doi.org/10.1080/21645515.2018.1518843>.
19. Yun-Vern AC, Mazlan NF, Nizaruddin MH, Dasrilsyah RA. Knowledge, awareness and perception of human papillomavirus testing among staff in a public university in Malaysia. *J Clin Health Sci*. 2024;9:35-45. <https://doi.org/10.24191/jchs.v9i1.21044>.
20. Shafei MN, Zainon N, Zulkifli N, Ibrahim MI. Knowledge and perception on human papilloma virus infection and vaccination among medical students of a university in Malaysia. *Procedia Soc Behav Sci*. 2014; 116:2707-10. <https://doi.org/10.1016/j.sbspro.2014.01.640>.
21. Chew KT, Kampan N, Shafiee MN. Perception and knowledge of human papillomavirus (HPV) vaccine for cervical cancer prevention among fully vaccinated female university students in the era of HPV vaccination: a cross-sectional study. *BMJ Open*. 2021;11(12):e047479. <https://doi.org/10.1136/bmjopen-2020-047479>.
22. Fahrni ML, Azni MZ, Rusdi NSM, Choo CY, Isa KAM, Babar ZU. Impact of university students' awareness and attitudes on vaccination practices for human papillomavirus, and perception on self-sampling for cervical cancer screening. *J Pharm Policy Pract*. 2022;15(1):73. <https://doi.org/10.1186/s40545-022-00471-7>.
23. Chee CSM, Tan SSN, Voon PJ, Augustin Y, Krishna S, Mat Ali N, et al. Human papillomavirus (HPV) genotype distribution in Malaysia: A systematic review. *BMC Infect Dis*. 2025;25(1):1010. <https://doi.org/10.1186/s12879-025-11441-0>.
24. Lim MSH, Tan SSN, Sulehan J, Jantan Z, Sharifah Ashrina Wan Ali SA, Mat Ali NA, et al. Breast cancer screening in Sarawak, Borneo: 10 years' community outreach program. *Asia Pac J Clin Oncol*. 2026;22(3):427-34. <https://doi.org/10.1111/ajco.70004>.
25. Bujang MA. A step-by-step process on sample size determination for medical research. *Malays J Med Sci*. 2021;28(2):15-27. <https://doi.org/10.21315/mjms2021.28.2.2>.
26. Bujang MA, Sa'at N, Sidik T, Joo LC. Sample size guidelines for logistic regression from observational studies with large population: Emphasis on the accuracy between statistics and parameters based on real life clinical data. *Malays J Med Sci*. 2018;25(4):122-30. <https://doi.org/10.21315/mjms2018.25.4.12>.
27. Fu CJ, Pan XF, Zhao ZM, Saheb-Kashaf M, Chen F, Wen Y, et al. Knowledge, perceptions and acceptability of HPV vaccination among medical students in Chongqing, China. *Asian Pac J Cancer Prev*. 2014;15(15):6187-93. <https://doi.org/10.7314/apjcp.2014.15.15.6187>.
28. Baldovin T, Bertoncello C, Cocchio S, Fonzo M, Gazzani D, Buja A, et al. Perception and knowledge of HPV-related and vaccine-related conditions among a large cohort of university students in Italy. *Hum Vaccin Immunother*. 2019;15(7-8):1641-9. <https://doi.org/10.1080/21645515.2018.1564432>.
29. Bujang MA, Yee LK, Khoo HY. A step-by-step guide to questionnaire validation research. Kuala Lumpur: Institute for Clinical Research, National Institutes of Health, Ministry of Health Malaysia; 2022.
30. Reza KA, Algamdi M, Alanazi R, Alanazi S, Alhujairy F, Albalawi R, et al. Knowledge, perception, and acceptance of HPV vaccination and screening for cervical cancer among Saudi females: A cross-sectional study. *Vaccines (Basel)*. 2023;11(7):1188. <https://doi.org/10.3390/vaccines11071188>.
31. Prisha P, Sin KT, Poo CL. What's stopping Malaysian women from uptaking HPV screening and vaccines?: a study on barriers. In: *Proceedings of the International Conference on Communication, Language, Education and Social Sciences (CLESS 2022)*. Paris: Atlantis Press SARL; 2023. p. 22-31. https://doi.org/10.2991/978-2-494069-61-9_4.
32. Centers for Disease Control and Prevention. HPV vaccination recommendations [Internet]. Atlanta (GA): Centers for Disease Control and Prevention; 2023 [cited 2025 Dec 23]. Available from: <https://www.cdc.gov/vaccines/vpd/hpv/hcp/recommendations.html>
33. Liverani CA, Di Giuseppe J, Giannella L, Delli Carpini G, Ciavattini A. Cervical cancer screening guidelines in the postvaccination era: Review of the literature. *J Oncol*. 2020;2020:8887672. <https://doi.org/10.1155/2020/8887672>.
34. Roslan S. Malaysian AIDS Council: increasing rate of HIV cases among students [Internet]. Kuala Lumpur: New Straits Times; 2025 Apr 26 [cited 2026 Jan 14]. Available from: <https://www.nst.com.my/news/nation/2025/04/1207807/malaysian-aids-council-increasing-rate-hiv-cases-among-students>
35. Sukrong M, Prapaisilp P, Juntamongkol T, Siranart N, Phoolcharoen N, Assavapokee N, et al. Knowledge regarding human papillomavirus and cervical cancer prevention among medical students from Chulalongkorn University in Thailand. *BMC Womens Health*. 2024;24(1):129. <https://doi.org/10.1186/s12905-024-02933-3>.
36. Dykens JA, Peterson CE, Holt HK, Harper DM. Gender neutral HPV vaccination programs: Reconsidering policies to expand cancer prevention globally. *Front Public Health*. 2023;11:1067299. <https://doi.org/10.3389/fpubh.2023.1067299>.
37. Yacouti A, Elkhoudri N, El Got A, Benider A, Hadrya F, Baddou R, et al. Awareness, attitudes and acceptability of the HPV vaccine among female university students in Morocco. *PLoS One*. 2022;17(4):e0266081. <https://doi.org/10.1371/journal.pone.0266081>.
38. Ali AN, Ping NY, Prajapati SK, Chen Pheng LC, Iqbal MZ, Ahmed N. Effect of intervention in increasing knowledge and awareness of human papilloma virus (HPV) infection and HPV vaccination among graduate students in a private university, Kedah state, Malaysia. *MOJ Bioequiv Availab*. 2018;5:187-93. <https://doi.org/10.15406/mojbb.2018.05.00101>.
39. Al-Naggar RA, Bobryshev YV, Al-Jashamy K, Al-Musli M. Practice of HPV vaccine and associated factors among school girls in Melaka, Malaysia. *Asian Pac J Cancer Prev*. 2012;13(8):3835-40. <https://doi.org/10.7314/apjcp.2012.13.8.3835>.
40. Al-Dubai SA, Alshagga MA, Al-Naggar RA, Al-Jashamy

- K, Baobaid MF, Tuang CP, et al. Knowledge, attitudes and barriers for human papilloma virus (HPV) vaccines among Malaysian women. *Asian Pac J Cancer Prev*. 2010;11(4):887-92.
41. Tusimin M, Yee CL, Razak NZSA, Zainol MI, Minhat HS, Rejali Z. Sociodemographic determinants of knowledge and attitude in the primary prevention of cervical cancer among University Tunku Abdul Rahman (UTAR) students in Malaysia: Preliminary study of HPV vaccination. *BMC Public Health*. 2019;19(1):1454. <https://doi.org/10.1186/s12889-019-7764-3>.



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