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Knowledge, attitude, and behavior of human papillomavirus vaccination among undergraduate students in Shanghai, China

Original article

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Abstract: **Objective:** This study aimed to explore undergraduates' knowledge, attitude, and practice/behavior of human papillomavirus (HPV) vaccination, as well as the essential influencing factors for vaccination decision-making.

Methods: Through cluster and convenience sampling, 2000 undergraduates from the Nursing and Language department of a university in Shanghai were sent a self-designed questionnaire. Chi-square tests, independent sample *t*-test/ANOVE, and multiple linear regression were used to investigate participants' knowledge and attitude on HPV vaccination, as well as the factors that predicted potential action to receive and promote HPV vaccination in the future.

Results: The mean HPV knowledge score was 5.027 out of 10. Health science students showed a significantly higher knowledge mean score than the non-health science students ($P < 0.000$). There was a statistically difference in HPV vaccination attitude among undergraduates in different grades ($P < 0.05$). Awareness of cervical cancer and worries about the risk of cervical cancer were the significant predictors of willingness to receive and promote HPV vaccination in the future.

Conclusions: It would take time for a new health product to be aware, understood, accepted, and received. Education providing and information sharing are expected to break the dawn and make the procedure processed.

Keywords: *human papillomavirus • undergraduate • vaccination • knowledge • attitude • behavior*

1. Introduction

Cervical cancer is second to breast cancer in the overall cancer-related mortality among women all over the world. In China, cervical cancer mortality has steadily increased over the years and Chen et al.[1] reported that, in 2015, there were an estimated 98,900 new cervical cancer cases and 30,500 deaths. The discovery that persistent high-risk human papillomavirus (HPV) infection which is sexually transmitted, contributes to the development of cervical cancer[2–4] brings possibilities for preventing and controlling this disease. In June 2006, the first vaccine against HPV, bivalent, was licensed by the US Food and Drug Administration (FDA),[5] followed by 4-valent in 2009[6] and 9-valent in 2014.[7] Although national immunization policies for HPV have been adopted in many countries since 2006,[8] it was not until July 2016 that China Food and Drug

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Administration approved the bivalent vaccine in the mainland of China.[9] The comprehensive prevention and control guidelines for cervical cancer in China stated that the target population for HPV vaccination was 13–15 years old middle school adolescents.[9] On the other hand, as the HPV vaccine has only been recently introduced in China, the guidelines also suggested women under 45 years old to take the vaccine preventing HPV infection.[9] However, the women's perspectives on the HPV vaccine and whether they would take it or not have not been revealed. College students are active in their social life and their perception of the likelihood of HPV infection and perspective on HPV vaccination are to be understood. Therefore, this study is going to explore undergraduates' behavior regarding such a new vaccine, as well as the essential influencing factors for vaccination decision-making. The study is based on the Health Belief Model to explore the health-seeking behavior for HPV infection prevention[10] in Shanghai. The study result can provide advice for future HPV vaccine implementation programs in mainland China for young women.

2. Methods

2.1. Study design and participants

This cross-sectional study was undertaken from October 2022 to December 2022. A cluster and convenience sampling method was adopted. The inclusion criteria for the participants were as follows: (1) undergraduate student; (2) informed and voluntarily joined the study. In addition, the undergraduate students who were suspended from the university were excluded from this study. The participants were cluster sampled by class of health science and non-health science majors. Health science and non-health science classes were sampled conveniently as convenience sampling was effective to conduct and was well-suited to this short time frame study. The researcher distributed the survey questionnaires to participants and collected from the undergraduates by the assistant in self-study evening classes. The university Ethical Committee granted permission for this study to be conducted for undergraduates.

2.2. Study questionnaire

The self-designed questionnaire is designed to cover demographic information, knowledge, attitude, and behavior toward HPV vaccination for cervical cancer prevention. A total of 10 questions to measure factors that may influence the willingness to participate in HPV vaccination. Participants were also asked for their preferences and opinions about the vaccine price, etc. Five experts in the gynecology and research field with senior professional titles were invited to review and evaluate the content validity of a questionnaire. After modification, an expert validity of the questionnaire was 0.924. The Cronbach's α of the questionnaire was 0.753.

2.2.1. Demographics

Demographic data such as age, gender, major, study year, whether heard about cervical cancer, whether heard about HPV vaccine, etc., were collected in the first section of the questionnaire to collect related information.

2.2.2. Knowledge of cervical cancer and HPV

Ten questions (5 single choice questions and 5 True&False questions) were designed to evaluate participants' understanding of cervical cancer and HPV infection. A total score for knowledge was the number of the correct responses and the maximum possibility was 10 (Cronbach's $\alpha = 0.637$ by internal consistency). A higher score stands for a better understanding of cervical cancer and HPV infection. These questions were:

Q1: Who is not the high-risk cervical cancer population?
Q2: What is the typical cervical cancer symptom?
Q3: Which prevention level is the HPV vaccine for cervical cancer?
Q4: When is the best time for HPV vaccine vaccinated?
Q5: Which statement is correct?
Q6: It is unnecessary to do a Pap smear test after HPV vaccination
Q7: Elderly women who have no sexual activities won't have cervical cancer
Q8: Almost every woman or man who has sex experience has been infected by several HPV types in her/his lifetime.
Q9: HPV infections could result in cervical cancer, penile cancer, vaginal cancer, etc.
Q10: It is suggested that women should not have sexual activities 48 h before receiving the Pap smear test.

2.2.3. Attitude toward HPV vaccine

Five 5-level Likert (strongly disagree to strongly agree) scale questions have been designed to explore undergraduates' views toward HPV vaccine by its side effects, usefulness, price issue, marketing issue, and cervical prevalence rate (Cronbach's $\alpha = 0.712$ by internal

consistency). The higher score stands for a more positive attitude toward the HPV vaccine.

2.2.4. Behavior/action of HPV vaccination

Undergraduate students' behavior/action for HPV vaccination is explored by five 5-level Likert scale questions. The questions survived students' actions on whether or not they wish to know more about the HPV vaccine, whether would they recommend HPV vaccine information to friends and families, do they wish to be vaccinated in the future, do they wish their future partner to be vaccinated, and are they able to recommend friends and families to take the HPV vaccine. Participants who already received the HPV vaccine tick strongly agree to vaccinate in the future (Cronbach's α = 0.806 by internal consistency). All answers are designed on a 5-level Likert scale from 1 to 5, and a high score stands for more positive behavior/action toward HPV vaccination.

2.3. Statistical analysis

Chi-square tests were used to compare responses to each knowledge item between health science and non-health science major undergraduates. Independent sample *t*-test/ANOVA was used to compare total knowledge between two groups of students. Independent sample *t*-test/ANOVA was used to explore the factors that influence undergraduates' attitudes and behavior on HPV vaccine and vaccination. Spearman's correlation test was conducted to explore the relationships between demographic characteristics, HPV knowledge, attitude, and behavior. A multiple linear regression was carried out to investigate the factors that predicted potential action to receive and promote HPV vaccination in the future.

3. Results

3.1. Demographics

A total of 2000 questionnaires were distributed and 1773 were collected. After the exclusion of incomplete responses on the questionnaires, a total of 1448 questionnaires were analyzed. The participants in this study were from the Nursing (Health Science major) and the Language (non-Health Science major) departments where most of the students were female. Thus, a majority of the sample was female (84.7%, n = 1226). The average age of the sample is 20 years (range: 17–24). A total of 1258 (86.9%) of the participants heard about cervical cancer whereas only 126 (8.7%) students are aware that HPV vaccination is a preventive action for cervical cancer prevention (Table 1).

Social and demographic characteristics	N (%)
Gender	
Female	1226 (84.7)
Male	222 (15.3)
Age (year), mean ± SD: 19.76 ± 1.25	
Major	
Health science	712 (49.2)
Non-health science	736 (50.8)
Study year	
Freshman	442 (30.5)
Sophomore	465 (32.1)
Junior	360 (24.9)
Senior	181 (12.5)
Heard about cervical cancer	
Yes	1258 (86.9)
No	190 (13.1)
Worried about the risk of cervical cancer	
Yes	425 (29.4)
No	1023 (70.6)
Heard about HPV	
Yes	576 (39.8)
No	872 (60.2)
Heard about HPV vaccine	
Yes	126 (8.7)
No	1322 (91.3)
Receive pay-by-self vaccine before	
Yes	440 (30.4)
No	1008 (69.6)
Friends or families received HPV vaccines	
Yes	196 (13.5)
No	1252 (86.5)
Yourself received HPV vaccine	
Yes	33 (2.3)
No	1415 (97.7)

Note: HPV, human papillomavirus.

Table 1. Sample characteristics (N = 1448).

3.2. Awareness of HPV infection, prevention, and cervical cancer

Nursing background undergraduates had a better understanding of cervical cancer (P=0.000), the risk of cervical cancer (P=0.007), and heard about the HPV vaccine (P=0.016) than non-health science background students, however, there was no statistically significant difference between the two groups of students on heard about HPV and action to HPV vaccination (Table 2).

Questions	Overall (n = 1448), n (%)	Health science (n = 712), n (%)	Non-health science (n = 712), n (%)	χ^2 (P value)
Heard about cervical cancer				
Yes	1258 (86.9)	642 (90.2)	616 (83.7)	13.301 (0.000)
No	190 (13.1)	70 (9.8)	120 (16.3)	
Worried about the risk of cervical cancer				
Yes	425 (29.4)	258 (36.2)	318 (43.2)	7.340 (0.007)
No	1023 (70.6)	454 (63.8)	418 (56.8)	
Heard about HPV				
Yes	576 (39.8)	213 (29.9)	212 (28.8)	0.216 (0.642)
No	872 (60.2)	499 (70.1)	524 (71.2)	
Heard about HPV vaccines				
Yes	126 (8.7)	49 (6.9)	77 (10.5)	5.838 (0.016)
No	1322 (91.3)	663 (93.1)	659 (89.5)	
Yourself received HPV vaccine				
Yes	33 (2.3)	11 (1.5)	22 (3.0)	3.389 (0.066)
No	1415 (97.7)	701 (98.5)	714 (97.0)	

Note: HPV, human papillomavirus.

Table 2. Awareness rate of HPV and related questions among health science and non-health science undergraduates (N = 1448).

3.3. Knowledge of HPV

The overall accuracy rate for multiple choice questions was lower than the True&False questions. More than half of the participants understood the typical symptoms of cervical cancer, whereas the overall answer accuracy rate of multiple choice questions was <50%. Among True&False questions, correct rates were relatively >72%, however, the perception about the likelihood of being infected by HPV was low (32.7%) among participants. Nursing undergraduates showed better knowledge than language students on 7 items (P < 0.005). The mean HPV knowledge score was 5.027 out of 10. Health science students showed a significantly higher knowledge mean score than the non-health science students (P < 0.000). The proportion of correct respondents to each knowledge item is shown in Table 3.

3.4. Factors impact on undergraduates' attitude of HPV vaccination

Analysis of variance was used to reveal the factors that impacted undergraduates' attitude toward HPV vaccination (Table 4). Undergraduates who were aware of cervical cancer and HPV infection showed a significant positive attitude toward HPV vaccination. Furthermore, there was a statistical difference in HPV vaccination attitudes among undergraduates in different grades of undergraduates. On the other hand, college major background, personal HPV vaccination experience, etc., showed no significant difference in attitude.

3.5. Potential willingness to promote and receive HPV vaccine in the future

Willingness to receive HPV vaccine and recommend HPV vaccine to others in the future were significantly positively associated with age (r = 0.102, P < 0.05), year of study (r = 0.121, P < 0.01), awareness of cervical cancer (r = 0.132, P < 0.01), awareness of HPV (r = 0.190, P < 0.01), cervical cancer worries (r = 0.274, P < 0.01), awareness of HPV vaccine (r = 0.087, P < 0.01), friends/families' HPV vaccination experience (r = 0.112, P < 0.01), and HPV knowledge (r = 0.062, P < 0.01), see Table 5.

A multiple linear regression demonstrated that awareness of cervical cancer and worries about the risk of cervical cancer were significant predictors of willingness to receive and promote HPV vaccination in the future (Table 6).

Questions	Overall (n = 1448), n (%)	Health science (n = 712), n (%)	Non-health science (n = 712), n (%)	χ^2 (P value)
Q1	438 (30.2)	269 (37.8)	169 (23.0)	37.667 (0.000)
Q2	853 (58.9)	469 (65.9)	384 (52.2)	28.048 (0.000)
Q3	418 (28.9)	230 (32.3)	188 (25.5)	8.054 (0.005)
Q4	351 (24.2)	261 (36.7)	90 (12.2)	117.605 (0.000)
Q5	337 (23.3)	167 (23.5)	195 (26.5)	1.783 (0.183)
Q6	1115 (77.0)	611 (85.8)	504 (68.5)	61.422 (0.000)
Q7	1139 (78.7)	587 (82.4)	552 (75.0)	11.946 (0.001)
Q8	474 (32.7)	231 (32.4)	243 (33.3)	0.054 (0.816)
Q9	1111 (76.7)	567 (79.6)	544 (73.9)	6.635 (0.010)
Q10	1043 (72.0)	539 (75.7)	504 (68.5)	9.374 (0.002)
Total knowledge score (M ± SD)	5.027 ± 1.670	5.486 ± 1.631	4.583 ± 1.647	

Note: Independent-sample *T*-test: F (0.017) = 10.481, $P < 0.000$; HPV, human papillomavirus.

Table 3. Correct responses to knowledge of HPV among health science and non-health science undergraduates (N = 1448).

Factors	M ± SD	d.f.	*F*	*P*
Gender		286.799	7.613	0.13
Male	14.770 ± 2.553			
Female	14.455 ± 2.891			
Age group (years)		1446	0.033	0.119
>18	14.674 ± 2.609			
≤18	14.962 ± 2.560			
Major		1446	2.848	0.241
Health science	14.803 ± 2.602			
Non-health science	14.643 ± 2.615			
Year of study		3/1444	4.484	0.004
Year 1	15.048 ± 2.667			
Year 2	14.740 ± 2.600			
Year 3	14.411 ± 2.527			
Year 4	14.497 ± 2.575			
Heard of cervical cancer		1446	0.023	0
Yes	14.816 ± 2.607			
No	14.095 ± 2.541			
Heard of HPV		732.834	4.4	0.028
Yes	14.965 ± 2.771			
No	14.621 ± 2.522			
Worried about the risk of cervical cancer		1446	0.283	0.247
Yes	14.819 ± 2.608			
No	14.657 ± 2.609			
Heard of HPV vaccine		1446	1.228	0.913
Yes	14.746 ± 2.851			
No	14.719 ± 2.586			
Received pay-by-self vaccine before		1446	0.015	0.505
Yes	14.791 ± 2.586			
No	14.691 ± 2.620			
Friends or families received HPV vaccine		240.934	6.24	0.059
Yes	15.092 ± 2.994			
No	14.664 ± 2.540			
Yourself received HPV vaccine		1446	2.38	0.16
Yes	14.091 ± 3.126			
No	14.736 ± 2.595			

Note: HPV, human papillomavirus.

Table 4. Factors influencing undergraduates' attitude toward HPV vaccination.

Items	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Age (years)	1													
2. Gender	0.043	1												
3. Major	0.021	−0.218**	1											
4. Year of study	0.809**	−0.126**	0.123**	1										
5. Heard of cervical cancer	−0.081**	−0.158**	−0.096**	0.145**	1									
6. Heard of HPV	−0.095**	0.008	−0.012	0.190**	0.197**	1								
7. Worried about cervical cancer	−0.126**	−0.205**	0.071**	0.212**	0.186**	0.167**	1							
8. Heard of HPV vaccine	−0.058*	−0.057*	0.063*	0.103**	0.055*	0.221**	0.150**	1						
9. Received pay−by−self vaccine before	0.054*	−0.023	0.037	−0.086**	0.026	−0.086**	−0.003	0.073**	1					
10. Friends or families received the HPV vaccine	−0.013	0.005	0.094*	0.088**	0.064*	0.250**	0.124**	0.186**	0.077**	1				
11. Received HPV vaccine	−0.013	0.025	0.048	−0.057*	−0.037	0.064*	0.056*	0.150**	0.141**	0.264**	1			
12. HPV knowledge	−0.003	−0.038	−0.031	−0.100**	0.164**	0.122**	0.081**	−0.022	−0.014	−0.005	0.008	1		
13. HPV attitude	0.041	−0.044	−0.266**	0.212**	0.093**	0.060*	0.03	0.003	0.018	0.056*	−0.037	0.058*	1	
14. HPV behavior	0.102*	−0.093**	0.032	0.121**	0.132**	0.190**	0.274**	0.087**	0.022	0.112**	0.031	0.062*	−0.047	1

Note: *Correlation is significant at the 0.05 level (2−tailed); **Correlation is significant at the 0.01 level (2−tailed); Spearman rho was used to analyze the correlation between the year of study to other variables; HPV, human papillomavirus.

Table 5. Spearman's correlation coefficient for demographic characteristics, HPV vaccine knowledge, attitude, and behavior.

Factors	*B*	SE	β	*t*	*P*
Constant	15.403	1.962		7.851	0
Age (years)	0.097	0.111	0.036	0.872	0.383
Gender	−0.334	0.240	−0.036	−1.395	0.163
Year of study	0.014	0.140	0.004	0.098	0.922
Heard of cervical cancer	0.902	0.199	0.123	4.526	0
Heard of HPV	0.505	0.260	0.051	1.945	0.052
Worried about the risk of cervical cancer	1.511	0.181	0.221	8.332	0
Heard of HPV vaccine	0.130	0.309	0.011	0.422	0.673
Friends or families received HPV vaccine	0.456	0.255	0.047	1.787	0.074
Knowledge	0.021	0.051	0.011	0.404	0.687

Note: $F = 18.676$, $R = 0.324$, $R^2 = 0.105$, adjusted $R^2 = 0.100$, $P = 0.000$; HPV, human papillomavirus.

Table 6. Factors predicting willingness to receive and promote HPV vaccine in the future.

4. Discussion

In this study, we assessed awareness of cervical cancer, HPV prevention, and HPV vaccinations. The study identified that undergraduates had a high awareness (86.9%) of cervical cancer, with a significant difference between health science and non-health science majors. Malignant tumor is one of the life-threatening diseases. Undergraduates, especially those with health science backgrounds had more opportunities to study for it and would pay more attention to the disease compared with non-health science major students. However, the perception or understanding of the cause of cervical cancer (38.9%) and the way to prevent it (8.7%) remained low. The knowledge level of HPV prevention and HPV vaccination in study participants was lower than that of university students in other countries.[11–13] The reason could be that the HPV vaccine was introduced to China in

2016, later than many Western countries. On the other hand, the perception rates on HPV and HPV vaccines of undergraduates in this study were higher than the rates of a general group in mainland China.[14] Chinese undergraduates had lower awareness of HPV and HPV vaccines compared to their peers in other countries whereas higher than the general citizens within their same circumstance. This implied that the university students could be the more sensible population to health new issues and developments. Although health science students demonstrated statistically higher awareness of HPV vaccine than non-health science students, they had not shown an equivalent higher HPV vaccination rate. The barriers and gaps between perception and action were needed to be explored.

The present study found a moderate level of knowledge (5.027 ± 1.680 of a maximum of 10) associated with cervical cancer, HPV infection, and HPV vaccination. This result was similar to the knowledge level of colleague women in Yoda's study[12] and that of colleague students in Bertram and Niederhuaser's study.[11] Students had a good understanding of the possible consequences of HPV infection (77%), the necessity of a Pap smear after HPV vaccination (72%), the symptom of cervical, etc. (58.9%); whereas comparatively less understanding on the chances of HPV infection through a lifetime (32.7%), cervical cancer high-risk population (30.2%), the appropriate time for HPV vaccination (24.2%), etc. Health science students stated a significantly deeper understanding of most (8 of 10) and overall HPV-related questions than non-health science students. With increased exposure to the pathophysiological knowledge of cancer, nursing students were supposed to have more comprehensive knowledge of cervical cancer. The professional classes, speeches, and materials that nursing students could attend and reach were incomparable for language students. Therefore, it was reasonable to see that non-health science students were less familiar with cervical cancer and HPV.

Perceived effectiveness, negative consequence, and barriers associated with HPV vaccine were generally assessed by the Likert scale questions. Overall, participants' attitudes toward HPV vaccine were at a moderate level (14.722 ± 2.609 of range 5–25). Similar questions were asked to assess participants' attitudes on the HPV vaccine in other papers, and descriptive rate, such as 66.7% of women concerned about the side effects,[15] was used to analyze and present the results.[13,15–17] It seemed that like the findings from other studies, participants' attitudes toward HPV attitude were neutral or in a dilemma. They were positive about the necessity and benefits of the HPV vaccine, however, concerned about the side effects, price, and accessibility of the vaccine. Demographic characters had limited influence on attitude, whereas awareness of cervical cancer and its pathogen contributed to a more positive attitude toward HPV vaccine. Participants seemed to be concerned about the risk of cervical cancer and expected the prevention measure, however, not confident enough about the current measure.

The potential future behavior on receiving and promoting the HPV vaccine was correlated to many factors. Coincident with other studies, awareness, and knowledge lead to more likely future behavior on receiving HPV vaccine.[16,18,19] However, the impact of knowledge weakened in the multiple linear regression which indicated that knowledge was not the directed leading factor to health behavior. Zhang et al.[18] found that adolescents' mothers who had more knowledge than fathers showed a less willingness to vaccinate their children. Health behavior could be complicatedly influenced by many factors. A deeper understanding may lead to a person's belief of barriers overwhelming benefits and result in not taking health action.

The Health Belief Model[10] reveals that modifying variables, perceived susceptibility, severity, benefits, barriers, and cues to action could explain and predict health-related behavior, particularly in regard to the uptake of health services, for instance, HPV vaccination. Modifying variables consist of age, gender, race, and so on. Perceived susceptibility and severity, in this study, stood for individual's perceptions of the risk of contracting cervical cancer and the seriousness of leaving unprotected. Education by diverse approaches could be a meaningful intervention to increase awareness and knowledge of a health condition.[20] Nursing students possessed better knowledge than language students could also be evidence. Perceived benefits and barriers, in this study, are presented for individuals' perceptions of the effectiveness and impediments of vaccination to prevent cervical cancer. Again education should be a useful way to reveal and explain related health issues.[20] This would furthermore form individual's attitude and decide his/her final action of taking or not taking the action. Zhang et al.[18] found a negative relationship between knowledge and potential action. This study did not find an evident positive relationship between knowledge and happened or future potential action. The possible reason could be that the effectiveness of the HPV vaccine has not been proved and accepted because of the short implementation period. Diverse and multiple information from various countries, especially where the HPV vaccine was earlier introduced and progressed, with no limitation on potential side effects should be provided to offer a

comprehensive version. Furthermore, the public would need the time to observe, reflect, and make final actions.

5. Conclusions

It would take time for a new health product to be aware, understood, accepted, and received. Education providing and information sharing are expected to break the dawn and make the procedure processed. This large scale study selected undergraduate students who are the targeted age group for HPV vaccination as the participants. Their knowledge, attitude, and practice/behavior of HPV vaccination, as well as the essential influencing factors for vaccination decision-making, would innovate the future strategy on the promotion and application of the HPV vaccine. However, this study only recruited undergraduate students from one university, so the generalizability could be the limitation. In the future, students from diverse institutes could be researched to enrich the findings in this research field.

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Data availability statement

The datasets used and analyzed during the current study are available from the corresponding author upon reasonable request.

Ethical approval

Ethical issues are not involved in this paper.

Conflicts of interest

All contributing authors declare no conflicts of interest.

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