



# Willingness to Accept Human Papillomavirus Vaccination and its Influencing Factors Using Information–Motivation–Behavior Skills Model: A Cross-Sectional Study of Female College Freshmen in Mainland China

Cancer Control  
Volume 28: 1–15  
© The Author(s) 2021  
Article reuse guidelines:  
[sagepub.com/journals-permissions](https://sagepub.com/journals-permissions)  
DOI: 10.1177/10732748211032899  
[journals.sagepub.com/home/ccx](https://journals.sagepub.com/home/ccx)  


Mingyu Si, MD<sup>1</sup> , Yu Jiang, PhD<sup>1</sup>, Xiaoyou Su, PhD<sup>1</sup>, Wenjun Wang, PhD<sup>2</sup>, Xi Zhang, PhD<sup>3</sup> , Xiaofen Gu, PhD<sup>4</sup>, Li Ma, PhD<sup>5</sup>, Jing Li, PhD<sup>6</sup>, Shaokai Zhang, PhD<sup>7</sup>, Zefang Ren, PhD<sup>8</sup>, Yuanli Liu, PhD<sup>9</sup>, and Youlin Qiao, PhD<sup>1,10</sup>

## Abstract

**Background:** This study aimed to assess the awareness and attitudes toward human papillomavirus (HPV) vaccination among female college freshmen and explore their willingness and associated factors to receive the HPV vaccine based on the information–motivation–behavior skills (IMB) model.

**Methods:** From February 21 to April 30, 2020, a cross-sectional survey was conducted among female freshmen in seven colleges in mainland China. Socio-demographic characteristics, health-related awareness, knowledge of HPV, motivation, and behavioral skills toward HPV vaccination were assessed using questionnaires. Univariate and multivariate logistic regression analyses were performed to identify the influencing factors of willingness to receive the HPV vaccine in the next 6 months.

**Results:** Among the 3867 students invited to participate in this study, 102 (2.64%) reported having taken the HPV vaccine. Among the unvaccinated participants, 59.89% had previously heard of HPV, and 32.08% were willing to take the HPV vaccine in the next 6 months. Willingness to get the HPV vaccine was associated with sexual experience(s) (AOR = 1.96, 95% CI: 1.25–3.08), family or friends with cancer (AOR = 1.24, 95% CI: 1.04–1.48), having heard of HPV (AOR = 1.23, 95% CI: 1.03–1.47), and having actively searched for or having consulted on issues concerning HPV vaccine (AOR = 1.22, 95% CI: 1.02–1.45). In the dimensions of the IMB model, “perceived susceptibility” (AOR = 1.20, 95% CI: 1.09–1.31), “perceived severity” (AOR = 1.24, 95% CI: 1.11–1.39), “subjective norms” (AOR = 2.09, 95% CI: 1.75–2.49), and “self-efficacy” (AOR: 2.95, 95% CI: 2.44–3.58) were positively associated with HPV vaccination acceptance, while “perceived barriers” (AOR = .60, 95% CI: .52–.69) negatively affected intention to get HPV vaccination.

**Conclusion:** HPV vaccination rates and willingness to receive the HPV vaccine in the next 6 months were found to be poor among female college freshmen in mainland China. Having a positive attitude toward HPV vaccination, creating vaccine-friendly social norms, and removing related barriers are important measures to promote HPV immunization.

## Keywords

human papillomavirus vaccine, willingness, information–motivation–behavior skills, college female freshmen, China

## Introduction

Cervical cancer has been a major public health problem for women for several decades. It is the fourth most diagnosed cancer among women worldwide, with 570 000 new cases and

311 000 deaths reported in 2018. In 2018, 106 000 new cases and 48 000 deaths due to cervical cancer were reported in China.<sup>1</sup> Similar to other sexually transmitted diseases, human papillomavirus (HPV) infection is a prerequisite for the development of cervical cancer.<sup>2,3</sup> Among the high-risk types of



Creative Commons Non Commercial CC BY-NC: This article is distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 License (<https://creativecommons.org/licenses/by-nc/4.0/>) which permits non-commercial use, reproduction and distribution of the work without further permission provided the original work is attributed as specified on the SAGE and Open Access pages (<https://us.sagepub.com/en-us/nam/open-access-at-sage>).

HPV, HPV-16 and -18 are considered to account for approximately 70% of cervical cancers worldwide.<sup>4,5</sup> The introduction of vaccines against high-risk HPV has proven to be an effective measure for the prevention and control of cervical cancer.<sup>6,7</sup>

As of October 2020, 110 countries around the world have introduced HPV vaccines into their national immunization programs.<sup>8</sup> The HPV vaccine was approved by the Chinese authorities in 2016, 10 years after the first HPV vaccine became available in the US.<sup>9</sup> As a public health prevention tool, the success of the HPV vaccine lies in its widespread use among the most appropriate target groups, such as teenage girls who have not had sex yet.<sup>10</sup> However, even though the efficacy and safety of vaccines have been widely recognized, the HPV vaccination rate among Chinese adolescents is still not satisfactory.<sup>11-13</sup>

Previous studies have found some reasons for HPV vaccine refusal in the ideal target population, including a comparatively conservative attitude toward sex, inability to afford the vaccine, lack of awareness due to low media coverage, low perceived susceptibility, and concerns about the safety, side effects, efficacy, and injection pain.<sup>11-15</sup> This study focused on exploring the predictors of HPV vaccine willingness based on the information–motivation–behavioral skills (IMB) model among female Chinese university students.<sup>16</sup> In the context of HPV vaccination, the IMB model suggests that acceptance of

HPV vaccines can be predicted by analyzing the respondents' personal knowledge of HPV, the perceived susceptibility to HPV infection (risk of infection), the perceived severity of HPV infection (eg, progression to cervical cancer or death), their beliefs about the benefits of HPV vaccination (eg, prevention of HPV infection), and the barriers to HPV vaccination (eg, affordability issues).<sup>17-19</sup> In addition, subjective norms (belief that people around them would support HPV vaccination and they would comply with their opinions), the ability to make decisions (individuals can make their own decisions to adopt healthy behaviors since health is valued), and self-efficacy (the belief that individual can overcome obstacles to get HPV vaccination) also influence the intention of HPV vaccination.<sup>17-19</sup>

In line with the need for knowledge about safe sex and the declining age of first sexual intercourse, female adolescents in China are vulnerable to sexually transmitted infections, especially HPV.<sup>20-22</sup> In response to the World Health Organization's initiative to eliminate cervical cancer by 2030,<sup>23</sup> the current cross-sectional study conducted in seven geographic regions in mainland China explored the predictors of willingness to receive the HPV vaccine among female college freshmen based on the IMB model. Our findings would be useful in identifying the key links to promote HPV vaccination among Chinese college girls, as well as target populations among neighboring Asian countries that share a similar cultural background.

<sup>1</sup>Department of Epidemiology and Biostatistics, School of Population Medicine and Public Health, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, China

<sup>2</sup>School of Nursing, Jining Medical University, Jining, Shandong, China

<sup>3</sup>Key Laboratory of Carcinogenesis and Translational Research (Ministry of Education), Beijing Office for Cancer Prevention and Control, Peking University Cancer Hospital & Institute, Beijing, China

<sup>4</sup>Affiliated Tumor Hospital, Xinjiang Medical University, Urumqi, China

<sup>5</sup>Public Health School, Dalian Medical University, Dalian, China

<sup>6</sup>West China School of Public Health, Sichuan University/West China Forth Hospital, Sichuan University, Chengdu, China

<sup>7</sup>Henan Cancer Hospital, Affiliate Cancer Hospital of Zhengzhou University, Zhengzhou, China

<sup>8</sup>School of Public Health, Sun Yat-sen University, Guangzhou, China

<sup>9</sup>School of Health Policy and Management, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, China

<sup>10</sup>Department of Cancer Epidemiology, National Cancer Center/National Clinical Research Center for Cancer/Cancer Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, China

Received: 6 January 2021; revised: 1 June 2021; accepted: 4 June 2021

#### Corresponding Authors:

Yu Jiang, Department of Epidemiology and Biostatistics, School of Population Medicine and Public Health, Chinese Academy of Medical Sciences and Peking Union Medical College, 5 DongDanSanTiao, Dongcheng, Beijing 100730, China.

Email: [jiangyu@pumc.edu.cn](mailto:jiangyu@pumc.edu.cn)

Xiaoyou Su, Department of Epidemiology and Biostatistics, School of Population Medicine and Public Health, Chinese Academy of Medical Sciences and Peking Union Medical College, 5 DongDanSanTiao, Dongcheng, Beijing 100730, China.

Email: [suxiaoyou@hotmail.com](mailto:suxiaoyou@hotmail.com)

## Methods

### Settings

The study participants were recruited from colleges from seven geographical territories in China, located in the eastern, southern, central, north, northwest, southwest, and northeast parts of China, namely, Jinan University, Sun Yat-sen University, Henan Institute of Engineering, Shanxi University of Finance and Economics, Xinjiang Agricultural University, Sichuan University, and Dalian University of Technology.

### Study Population and Quality Control

This cross-sectional study was conducted between February 21 and April 30, 2020. An online self-administered questionnaire was disseminated and administered by university staff in each geographical territory. Female freshmen older than 18 years who had no vaccination contraindications and had mobile phone or computer access were invited to participate in the study. Medical students or those who were pregnant or were breastfeeding were excluded from the study.

On November 15, 2019, we conducted a pilot study among 28 female students at the University of Jinan in Shandong Province, China. Among them, 10 (35.71%) of them reported their willingness to undergo the HPV vaccination in the

following 6 months. According to the minimum sample size formula,  $n = Z^2 \times P(1-P)/d^2$ , the calculated sample size was 353 using an expected willingness of HPV vaccination of 35.71%, considering a 95% confidence interval (CI) and a 5% allowable error. Allowing for a 15% rate of non-response, 416 cases were required in each university, and a total of 2912 cases were required for the cross-sectional survey. To ensure the representativeness of the cross-sectional survey, and to meet the required sample size (calculated to be at least 3360 subjects) for a subsequent randomized controlled intervention study in the same population aimed at improving HPV vaccination rates (see the published protocol article for details),<sup>19</sup> we ended up recruiting 3968 female freshmen for the whole project.

In addition, two basic pieces of information would be collected for quality control: (1) ID number should conform to the coding rules and (2) the vaccination date must be after 2016 for those who self-reported that they had been vaccinated against HPV in mainland China. Only questionnaires that passed the above quality control were included in the statistical analysis.

Among the 3968 participants recruited in the study, 3867 (97.45%) met the quality control requirements. At the end of the study, each participant was given a notebook and pen with the research logo as compensation for his or her time and participation.

## Ethics

Ethical approval for the study was obtained from the Institutional Review Board of the Chinese Center for Disease Control and Prevention on October 24, 2019. Before enrollment in the study, participants were well informed of the purposes, methods, expected risks, and benefits of this research. A consent form was presented on the first page of the questionnaire, and participants who agreed to participate in the study clicked on the consent button to jump to the questionnaire page.

## Data Collection

Data were collected using an anonymous questionnaire designed by a panel of the Peking Union Medical College. The structured questionnaire included demographic information, health-related perceptions, and the constructs of the IMB model, which included knowledge of HPV, motivation, behavioral skills, and willingness to take HPV vaccine.

## Measurements

*The intention of HPV vaccination* was measured by asking the participants if they were willing to receive the HPV vaccine in the next 6 months (“Yes” or “No”). All the independent variables are described below.

*Socio-demographic characteristics* included age, major in school, ethnicity, place of residence for more than 1 year, monthly living expenses, education level of parents, previous sexual experience, current relationship, and whether they had relatives and/or friends with cancer.

*Health-related variables* included “agree that vaccines can effectively prevent diseases,” having received sexual education, attitude toward premarital sex, having previously heard of HPV, and had actively searched for or consulted on issues concerning HPV vaccination (“Yes” or “No”).

*Knowledge concerning HPV* was measured by asking participants eleven information-related items about HPV used in previous studies. The answers were “Agree,” “Disagree,” or “Do not know” (Table 2).<sup>24-28</sup> Each correct answer was assigned one point, while incorrect or unknown answers were assigned zero points. The total score of the knowledge questions was derived by adding the number of correct responses. Higher scores indicate more information about HPV was known. Cronbach’s alpha for the 11 items was .78.

*Motivation for vaccination* was measured in five dimensions: perceived susceptibility (perceptions of likelihood that they may get HPV infection), perceived severity (perceptions of the seriousness of the consequences related to HPV infection), perceived benefits and barriers (potential advantages and obstacles to participation in HPV vaccination), and subjective norms (perceived support from significant others toward HPV vaccination and the motivation to follow their recommendations) (Table A1).

Perceived susceptibility toward HPV infection was assessed by two items published in former studies: Cronbach’s alpha of the two items in our study was .92.<sup>29</sup> Perceived severity regarding HPV infection was assessed using four items, and Cronbach’s alpha in the present study was .80.<sup>25,30</sup> Perceived benefits and barriers toward HPV vaccination were assessed using three and five items, respectively, and Cronbach’s alpha in the present study was .78 and .72, respectively.<sup>25,30,31</sup> In addition, subjective norms regarding HPV vaccination were assessed by five items from previous studies, and Cronbach’s alpha in our study was .73.<sup>27</sup> Each item was assessed using a 5-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = neither disagree nor agree, 4 = agree, and 5 = strongly agree). Except for the negative trend of perceived barriers, the higher scores of other items indicated stronger motivation of the participants to receive the HPV vaccine.

*Behavioral skills*: Two dimensions with a total of ten items were used to evaluate participants’ behavioral skills, including perceived control in decision-making about HPV vaccination, and perceived self-efficacy (beliefs that they can successfully take up the HPV vaccination).<sup>28,30</sup> Answers for these items were measured on a 5-point Likert scale (1 = strongly disagree and 5 = strongly agree). Further details are presented in the appendix.

The ability of making decisions independently was evaluated by two items, while perceived self-efficacy to uptake the

HPV vaccine was measured by eight items, and Cronbach's alpha in the present study was .89 and .88, respectively. An average score was obtained by summing the responses of the ten items, and higher scores indicated more effective adoption of HPV vaccination.

### Statistical Analysis

Statistical analysis was performed using SPSS 23.0. Descriptive analysis was performed to acquire socio-demographic characteristics, health awareness, and suitable understanding of HPV-related knowledge. To identify the different distribution of variables among groups that were willing and unwilling to take the vaccine, the chi-square test and Student's t-test were used for categorical and continuous variables, respectively. The influencing factors of the intention of HPV vaccination were determined by logistic multivariate regression, and significant variables in the univariate analysis were further entered into the multivariate logistic regression model, where adjusted odds ratios (AORs) and their corresponding 95% CIs were calculated. Statistical significance was set at  $P < .05$  (2-tailed test).

## Results

### Participants' Background Characteristics

Of the 3867 verified respondents, 3765 were included in the final analysis as 102 respondents had been vaccinated before the questionnaire survey (the vaccination rate was 2.64%). The mean age of the participants was 19 years (standard deviation [SD]  $\pm 8.2$ ). As shown in Table 1, only 1208 (32.08%) participants were willing to take the HPV vaccine in the next 6 months. Of these, 47.30% majored in science, and the majority (87.78%) were Han Chinese. 64.25% had lived in urban areas for more than 1 year, 71.16% had monthly living expenses ranging from 1000 to 2000 yuan, and 25.21% of the participants' parents had educational qualifications equaling a college degree or higher. Only 2.87% of the participants had prior sexual experience, 17.29% were in a romantic relationship, and 24.25% of the participants had relatives or friends with cancer.

In terms of health-related variables, 92.93% agreed that vaccination was effective in preventing disease. Among the participants, 79.07% had received sexual education previously, while 38.19% said they could accept premarital sex. More than half of the participants (59.89%) had heard of HPV previously, while only 32.54% had actively searched for or consulted on issues concerning HPV vaccination. A statistically significant difference between groups that were willing and unwilling to undergo vaccination was identified using the chi-square test. The results showed that in addition to age, major in school, and ethnicity, other variables were related to the willingness to receive HPV vaccination ( $P < .05$ ).

### Knowledge of HPV

There were 11 questions about HPV, HPV-associated diseases, and HPV vaccine. About 70% of participants knew that "HPV is related to the development of cervical cancer" (69.99%) and "Males can be infected with HPV" (64.65%). In addition, 76.28% and 72.16% of respondents knew that the statements "Regular cervical cancer screening is unnecessary after HPV vaccination" and "The HPV vaccine protects against all types of cervical cancer" were false, respectively. However, less than 10% of the study participants correctly answered the questions "HPV is almost asymptomatic" (8.42%) and "A majority of HPV infections will disappear on their own" (9.40%). In addition, 52.96% and 58.80% of the students correctly answered the questions that "HPV is related to sexual contact" and "HPV infection may cause condyloma acuminatum, oral cancer, and other diseases," respectively. Furthermore, 45.07%, 37.40%, and 27.22% of the participants correctly answered the questions that "The best time for HPV vaccination is before any experience of sexual contact," "Condoms prevent HPV infection," and "HPV infection is very common." As shown in Table 2, a statistically significant difference between the groups that were willing and unwilling to receive the HPV vaccine was observed using the chi-square test. Further, greater awareness concerning HPV-related knowledge was observed in the group willing to receive the HPV vaccine ( $P < .05$ ).

### Dimensions of the IMB Model

As shown in Table 3, the mean score of HPV-related information was  $5.22 \pm 2.74$ . For the motivation of HPV vaccination, the average perceived susceptibility score was  $2.44 \pm .89$ , the average perceived severity score was  $3.45 \pm .74$ , the mean perceived benefits level was  $3.93 \pm .60$ , the mean perceived barriers level was  $2.94 \pm .61$ , and the average score of perceived norms was  $3.15 \pm .51$ . In terms of objective skills for HPV vaccination, the average score of perceived decision-making was  $4.27 \pm .57$ , and the mean self-efficacy level was  $3.50 \pm .59$ . A statistically significant difference between the groups that were willing and unwilling to receive the HPV vaccine was observed using the Student's t-test, with a higher level of information, motivation, and behavioral skills toward HPV vaccination observed in the group willing to receive the HPV vaccine ( $P < .05$ ).

### Multivariate Correlates of HPV Vaccination Intention

Table 4 presents the univariate and multivariate correlates of HPV vaccination intention with significant variables ( $P < .05$ ) in Tables 1 and 3. After adjusting for all other covariates, participants who had prior sexual intercourse (AOR = 1.96, 95% CI: 1.25–3.08) and had family or friends with cancer (AOR = 1.24, 95% CI: 1.04–1.48) were more likely to be vaccinated. Also, individuals who had heard of HPV (AOR = 1.23,

**Table 1.** Socio-demographics, health-related characteristics, and willingness to be vaccinated among participants (N = 3765).

Variables	All	Willing to receive HPV vaccine		Chi-square	P
	N (%)	Yes (%)	No (%)		
Socio-demographic					
Age (years)					
18	693(18.41)	206(17.05)	487(19.05)	2.74	.26
19	2231(59.26)	719(59.52)	1512(59.13)		
≥20	841(22.34)	283(23.43)	558(21.82)		
Mean ± SD	19.12±.82	19.14±.72	19.11±.86		
Major in school					
Science	1781(47.30)	563(46.61)	1218(47.63)	.35	.56
Liberal art	1984(52.70)	645(53.39)	1339(52.37)		
Ethnicity					
Han	3305(87.78)	1050(86.92)	2255(88.19)	1.23	.27
Other	460(12.22)	158(13.08)	302(11.81)		
Permanent residence (for more than one year)					
Rural	1346(35.75)	350(28.97)	996(38.95)	35.56	.00
Urban	2419(64.25)	858(71.03)	1561(61.05)		
Living Expenses (RMB/month)					
<1000 yuan	771(20.48)	196(16.23)	575(22.49)	59.38	.00
1000–2000 yuan	2679(71.16)	859(71.11)	1820(71.18)		
2001–3000 yuan	279(7.41)	130(10.76)	149(5.83)		
>3000 yuan	36(.96)	23(1.90)	13(.51)		
Education level of parents					
Junior high school or below	1694(44.99)	464(38.41)	1230(48.1)	38.18	.00
Senior high school ( including vocational high school)	1122(29.80)	375(31.04)	747(29.21)		
College (including technical college) and above	949(25.21)	369(30.55)	580(22.68)		
Previous sexual experience					
No	3657(97.13)	1149(95.12)	2508(98.08)	25.94	.00
Yes	108(2.87)	59(4.88)	49(1.92)		
Currently relationship					
No	3114(82.71)	956(79.14)	2158(84.40)	15.85	.00
Yes	651(17.29)	252(20.86)	399(15.60)		
Family/friends with any cancer (including cervical cancer)					
No	2852(75.75)	850(70.36)	2002(78.29)	28.09	.00
Yes	913(24.25)	358(29.64)	555(21.71)		
Health-related variables					
Believe vaccination is effective in preventing disease					
No	266(7.07)	68(5.63)	198(7.74)	5.59	.02
Yes	3499(92.93)	1140(94.37)	2359(92.26)		
Ever received sexual education					
No	788(20.93)	184(15.23)	604(23.62)	34.89	.00
Yes	2977(79.07)	1024(84.77)	1953(76.38)		
Attitude toward premarital sex					
Con	2327(61.81)	662(54.80)	1665(65.12)	36.97	.00
Pro	1438(38.19)	546(45.20)	892(34.88)		
Ever heard of HPV					
No	1510(40.11)	349(28.89)	1161(45.40)	93.14	.00
Yes	2255(59.89)	859(71.11)	1396(54.60)		
Ever actively searched for or consulted on HPV vaccine					
No	2540(67.46)	660(54.64)	1880(73.52)	133.34	.00
Yes	1225(32.54)	548(45.36)	677(26.48)		

Abbreviation: HPV, human papillomavirus.



**Table 2.** HPV-related knowledge and willingness to be vaccinated among participants (N = 3765).

Question items	All	Willing to receive HPV vaccine		Chi-square <sup>a</sup>	P
	N (%)	Yes (%)	No (%)		
HPV is related to the development of cervical cancer					
Agree <sup>b</sup>	2635(69.99)	906(75.00)	1729(67.62)	21.28	.00
Disagree	73(1.94)	23(1.90)	50(1.96)		
Do not know	1057(28.07)	279(23.10)	778(30.43)		
Males can be infected with HPV					
Agree <sup>b</sup>	2434(64.65)	93(7.70)	194(7.59)	9.43	.00
Disagree	287(7.62)	823(68.13)	1611(63.00)		
Do not know	1044(27.73)	292(24.17)	752(29.41)		
HPV is related to sexual behavior					
Agree <sup>b</sup>	1994(52.96)	696(57.62)	1298(50.76)	15.47	.00
Disagree	351(9.32)	121(10.02)	230(8.99)		
Do not know	1420(37.72)	391(32.37)	1029(40.24)		
Condoms can prevent HPV infection					
Agree <sup>b</sup>	1408(37.40)	534(44.21)	874(34.18)	35.22	.00
Disagree	774(20.65)	242(20.03)	532(20.81)		
Do not know	1583(42.05)	432(35.76)	1151(45.01)		
HPV is almost asymptomatic					
Agree <sup>b</sup>	317(8.42)	126(10.43)	191(7.47)	9.33	.00
Disagree	2275(60.42)	778(64.40)	1497(58.55)		
Do not know	1173(31.16)	304(25.17)	869(33.99)		
The HPV vaccine protects against all types of cervical cancer					
Agree	140(3.72)	64(5.30)	76(2.97)	4.18	.04
Disagree <sup>b</sup>	2717(72.16)	898(74.34)	1819(71.14)		
Do not know	908(24.12)	246(20.36)	662(25.89)		
HPV infection may result in oral cancer, condyloma acuminatum, and anal cancer					
Agree <sup>b</sup>	2214(58.80)	775(64.16)	1439(56.28)	21.02	.00
Disagree	292(7.76)	88(7.28)	204(7.98)		
Do not know	1259(33.44)	345(28.56)	914(35.75)		
Most HPV infections will disappear on their own					
Agree <sup>b</sup>	354(9.40)	143(11.84)	211(8.25)	12.38	.00
Disagree	1652(43.88)	578(47.85)	1074(42.00)		
Do not know	1759(46.72)	487(40.31)	1272(49.75)		
HPV infection is very common					
Agree <sup>b</sup>	1025(27.22)	405(33.53)	620(24.25)	35.66	.00
Disagree	947(25.15)	304(25.17)	643(25.15)		
Do not know	1793(47.62)	499(41.31)	1294(50.61)		
Regular cervical cancer screening is unnecessary after HPV vaccination					
Agree	33(.88)	16(1.32)	17(.66)	20.77	.00
Disagree <sup>b</sup>	2872(76.28)	977(80.88)	1895(74.11)		
Do not know	860(22.84)	215(17.8)	645(25.22)		
The best time for HPV vaccination is before any experience of sexual contact					
Agree <sup>b</sup>	1697(45.07)	690(57.12)	1007(39.38)	104.26	.00
Disagree	191(5.07)	62(5.13)	129(5.04)		
Do not know	1877(49.85)	456(37.75)	1421(55.57)		

Abbreviation: HPV, human papillomavirus.

<sup>a</sup>Chi-square test was used to test the difference of the distribution of "correct answer" and "incorrect answer or do not know" in the two groups of participants who were willing and not willing to receive HPV vaccine.

<sup>b</sup>Appropriate response.

**Table 3.** Dimensions of the IMB model and willingness to be vaccinated among participants (N = 3765).

Dimensions of the IMB model	All	Willing to receive HPV vaccine		t-value	P
	Mean(SD)	Yes (mean[SD])	No (mean[SD])		
Information (knowledge of HPV)	5.22(2.74)	5.77(2.65)	4.96(2.74)	8.53	.00
Motivation					
Perceived susceptibility	2.44(.89)	2.59(.91)	2.38(.87)	6.91	.00
Perceived severity	3.45(.74)	3.49(.76)	3.43(.73)	2.11	.04
Perceived benefits	3.93(.60)	4.07(.60)	3.86(.59)	9.89	.00
Perceived barriers	2.94(.61)	2.75(.63)	3.03(.58)	-12.97	.00
Subjective norms	3.15(.51)	3.37(.52)	3.05(.47)	17.71	.00
Behavioral skills					
Decision-making	4.27(.57)	4.36(.57)	4.22(.56)	7.05	.00
Self-efficacy	3.50(.59)	3.81(.57)	3.35(.53)	23.55	.00

Abbreviations: HPV, human papillomavirus; IMB, information–motivation–behavior.

95% CI: 1.03–1.47) and had ever actively searched for or consulted on HPV vaccine issues (AOR = 1.22, 95% CI: 1.02–1.45) were more likely to be vaccinated.

Among the dimensions of the IMB model, participants who had high scores of “perceived susceptibility” (AOR = 1.20, 95% CI: 1.09–1.31), “perceived severity” (AOR = 1.24, 95% CI: 1.11–1.39), “subjective norms” (AOR = 2.09, 95% CI: 1.75–2.49), and “self-efficacy” (AOR: 2.95, 95% CI: 2.44–3.58) were more likely to be vaccinated. On the other hand, those who had a high score of “perceived barriers” (AOR = .60, 95% CI: .52–.69) were less likely to receive the HPV vaccine in the next 6 months.

### Reasons for Unwilling to Get HPV Vaccine

Among the students unwilling to get the HPV vaccine in the following 6 months, the top three common reasons reported were as follows: “HPV vaccination is expensive” (47.48%), “Worry about the possible side effects of the HPV vaccine” (44.51%), and “No sexual activity” (43.37%). In addition, 7.67% of participants chose the “other” option, and the reasons for self-reported group that was unwilling to receive the HPV vaccine in the near future included “Not enough information to make a decision about HPV vaccination,” “Not yet, preferring to wait until I’m a little older or after college,” “Family conditions do not support vaccination in the short term, I should be vaccinated in the future,” “Parents do not know about the HPV vaccine, and my friends aren’t vaccinated yet,” and “Hesitation to get vaccinated in general, not specifically for HPV” (Figure 1).

### Discussion

In China, cervical cancer remains one of the most common cancers among women despite advances in HPV vaccines and cancer screening. The HPV vaccination rate was 2.64% among female freshmen in our study, which was lower than that of the three previous studies with all “female college

students,” which were 3.57%, 11.00%, and 9.50%, respectively.<sup>11–13</sup> In addition, only 32.08% of participants were willing to receive the HPV vaccine in the next 6 months, and few had in-depth knowledge of HPV-related diseases and the corresponding prevention and control measures. It is worth noting that participants with sexual experience were more willing to take the HPV vaccine. Since HPV infection is a common sexually transmitted disease and people are concerned about the risk of infection from existing sexual behaviors, those who had prior sexual experience were more willing to take preventive measures such as HPV vaccination.<sup>22</sup> Additionally, only 2.87% of participants in our study had sexual experience(s), which may be a major reason for the low vaccination rate and willingness to be vaccinated against HPV. With a decrease in the age of individuals at their first sexual intercourse and the greater odds of sexual intercourse as their age increases, it is particularly important to improve vaccination rates and intention for vaccination among populations who have not yet had sex.<sup>20,22</sup>

The reasons behind low vaccination rates and willingness to receive HPV vaccines are worth considering. First, the health education provided by the government and schools is not sufficient in terms of both content and frequency, leading to a lack of in-depth understanding of the vaccine among the target population. Second, HPV vaccination is relatively expensive for most university students, which results in various affordability issues with the increasing demand for HIV vaccination.<sup>11–13,32</sup> Students with better social and economic status (SES) have a higher chance of being vaccinated, and the accessibility of the HPV vaccine is reduced to a certain population in China. In addition, there is a need to consider the supply and accessibility issues of HPV vaccines since HPV vaccines are not yet available in many rural areas in China.<sup>33</sup> However, most of the burden of cervical cancer comes from low- and middle-income countries and populations with lower SES; hence, it is essential to provide HPV immunization among these vulnerable populations.<sup>1</sup>

**Table 4.** Influencing factors of HPV vaccination intention among participants (N = 3765).

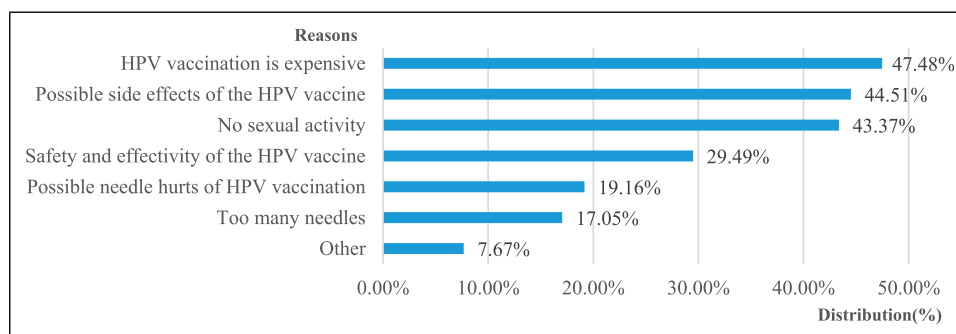
Variables	Willing to receive HPV vaccine		P
	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	
Permanent residence (for more than one year)			
Rural			
Urban	1.56(1.35–1.81)	1.08(.89–1.30)	.44
Living expenses (RMB/month)			
<1000 yuan			
1000–2000 yuan	1.39(1.16–1.66)	.90(.73–1.11)	.32
2001–3000 yuan	2.56(1.92–3.41)	.93(.66–1.32)	.70
>3000 yuan	5.19(2.58–10.44)	2.18(.97–4.92)	.06
Education level of parents			
Junior high school or below			
Senior high school ( including vocational high school)	1.33(1.13–1.57)	.96(.79–1.16)	.66
College (including technical college) and above	1.69(1.43–2.00)	.87(.69–1.09)	.21
Previous sexual experience			
No			
Yes	2.63(1.79–3.86)	1.96(1.25–3.08)	.00**
Currently relationship			
No			
Yes	1.43(1.20–1.70)	1.10(.90–1.35)	.35
Family or friends with any cancer (including cervical cancer)			
No			
Yes	1.52(1.30–1.77)	1.24(1.04–1.48)	.02*
Vaccination is effective in preventing disease			
No			
Yes	1.41(1.06–1.87)	.91(.66–1.25)	.55
Ever received sexual education			
No			
Yes	1.72(1.44–2.06)	1.14(.93–1.39)	.22
Attitude toward premarital sex			
Con			
Pro	1.54(1.34–1.77)	1.06(.90–1.25)	.51
Ever heard of HPV			
No			
Yes	2.05(1.77–2.37)	1.23(1.03–1.47)	.03*
Ever actively searched for or consulted on HPV vaccination			
No			
Yes	2.31(2.00–2.66)	1.22(1.02–1.45)	.03*
Information	1.12(1.09–1.15)	1.01(.97–1.04)	.73
Motivation		1.01(.97–1.04)	.73
Perceived susceptibility	1.31(1.22–1.42)	1.20(1.09–1.31)	.00**
Perceived severity	1.11(1.01–1.21)	1.24(1.11–1.39)	.00**
Perceived benefits	1.82(1.61–2.06)	.86(.73–1.00)	.05
Perceived barriers	.46(.41–.52)	.60(.52–.69)	.00**
Subjective norms	3.90(3.32–4.57)	2.09(1.75–2.49)	.00**
Behavioral skills			
Decision-making	1.56(1.38–1.77)	.86(.74–1.01)	.06
Self-efficacy	4.54(3.94–5.24)	2.95(2.44–3.58)	.00**

\*P &lt; .05; \*\*P &lt; .01. Abbreviation: HPV, human papillomavirus.

Traditional health education focuses on knowledge, believing that enhanced knowledge will lead to behavioral action. However, it is worth noting that the relationship between

knowledge scores and HPV vaccination intention is controversial. While significant positive correlations were found in some previous studies, some others, including the current





**Figure 1.** Reasons for unwilling to get human papillomavirus vaccine.

study, showed that knowledge concerning HPV infection, HPV-associated diseases, and vaccines was not a predictor of HPV vaccine acceptance.<sup>12,13,34,35</sup> It is not rare to find people with a medical background who believe that they are at a low risk of HPV infection and are hence reluctant to get vaccinated. On the contrary, people tend to rely heavily on their own or experience and knowledge from those close to them to make health decisions.<sup>36</sup> When a person realizes the health benefits of the vaccine, even though she may have only heard of the HPV vaccine, she will actively search for information about the HPV vaccine and consult professionals about making an appointment for vaccination. This scenario suggests a possible way of guiding health interventions to improve HPV vaccination among female freshmen, and the benefit of receiving the HPV vaccination should be specially addressed, rather than focusing only on HPV-related knowledge.

In line with other studies, in this study, participants who believed they were at risk for HPV infection and had a higher perceived severity of developing cervical cancer were more likely to receive the HPV vaccine.<sup>12,30,31</sup> However, the low percentage of premarital sex among freshman women leads to insufficient awareness of the risk of HPV infection among them and their families. The cognitive gap between the actual age group at the peak of HPV infection and the belief that there is no risk warrants considerable attention.<sup>37</sup> This misconception about HPV prevention may come from cultural beliefs about sexuality and result in widespread vaccine hesitancy and rejection among Chinese individuals.<sup>38,39</sup> Therefore, comprehensive understanding of the actual risks and possible consequences of HPV infection will help increase the willingness of the target population to receive HPV vaccination. Furthermore, subjective norms were also a significant predictor of vaccine acceptance, as has been discussed in other similar studies.<sup>40,41</sup> While the influence of self-made decisions was small in magnitude, it would lose significance when subjective norms were considered.<sup>40,41</sup> University youngsters are in the process of forming their own thoughts and identity as well as developing a sense of direction in their life. Compared to their own decisions, they are sometimes more likely to comply with the social norms surrounding them. Moreover, young people are mostly in good health and usually ignore the

role of disease prevention as a whole. In such circumstances, advice from family, friends, and their schools, together with their own positive attitude toward HPV vaccination, would be an effective way to promote HPV vaccination.

Similar to other studies, in this study, “perceived barriers” played a key negative role in young female students’ willingness for HPV vaccination.<sup>13,30,31</sup> There were three main barriers that hindered vaccination. The first was the vaccine itself. Some participants refused to be vaccinated because of concerns about safety and effectiveness. The second was the vaccination process, such as the possibility that the needle might hurt and the occurrence of adverse reactions due to HPV vaccination. Furthermore, in terms of the realistic conditions necessary for vaccination, some were unwilling to be vaccinated because they could not make their own decisions or afford the relatively high price of the vaccination. In the meantime, positive associations have been found between self-efficacy and performance of health behaviors (eg, vaccination) through engagement and motivation, and this always resulted in persistence.<sup>17</sup> Although self-efficacy beliefs can be developed by creating positive experience of success, it needs professional guidance and skills.<sup>42</sup> Therefore, reducing the target population’s concerns about vaccine safety, possible needle injuries, and vaccination costs would be a cost-effective and practical way to promote HPV vaccination in Chinese youth. In addition, exploring the gap of willingness toward HPV vaccination and acceptance of the HPV vaccine and formulating targeted measures to remove this gap should be prioritized.<sup>43</sup> Recently, as the first Chinese domestic-made 2-valent HPV vaccine (Cecolin, Inovax, Xiamen, China) was approved by Chinese FDA, additional efforts should be taken to relieve hesitation regarding the vaccine and use the opportunity to expand vaccine supply and reduce vaccine prices.<sup>44,45</sup> If feasible, HPV vaccines for young girls should be guaranteed initially, followed by a “catch-up” vaccination program for young women, and the government should finally integrate HPV vaccination into the national immunization program.

A number of studies around the world have explored the factors influencing HPV vaccination among female college students.<sup>12,13,27,30,31,34,35,40</sup> However, it is important to understand

the factors that affect or improve HPV vaccination rates among female college students in China as this population remains an important target group for HPV vaccination, especially after the vaccine is officially approved. Our research had some strengths. First, it was a multi-center study with a representative sample size. In addition, we used the IMB model to comprehensively analyze the factors influencing HPV vaccination, including personal background information, health-related awareness, and knowledge of HPV and HPV vaccines, to obtain persuasive results. Finally, the items in the IMB model were obtained from relevant high-quality research to ensure study quality.

This study examined women who had just entered college and were old enough to provide informed consent. Although the questionnaire survey was conducted in seven universities over the country and had certain representativeness, it was convenience sampling and the number of recruits might not be sufficient to cover heterogeneity in the target populations. In addition, most of the participants who volunteered to join the study may have been those who demonstrated greater interest in the HPV vaccination. Further, the proportion of students from urban areas and those with Han ethnicity was large. Hence, the study results might not be suitable to be generalized for all-age women or the whole “college female” population. Therefore, when applying the results and conclusions of this study, we should be careful in expanding representativeness. In addition, this was a cross-sectional survey based on self-reported information; hence, causality inference can hardly be drawn, and the possible overestimated influence of personal perceptions should be taken into consideration. In addition, 83 potential participants did not participate in the research, even after invitation and eligibility screening. Without the right to obtain the information of these non-respondents, it was difficult for us to understand whether the information provided by the respondents and non-respondents was balanced, and whether the research results can be inferred to the non-respondents. Furthermore, conclusions about the intention of HPV vaccination and associated factors should be interpreted with caution since these factors may have changed due to different research backgrounds. Finally, the study was conducted during a Public Health Emergency of International Concern, the COVID-19 pandemic. There might have been an increase in the perceived barriers reported by participants in the study due to the overlapping period, and hence, there is scope for further research concerning this issue.<sup>46</sup>

## Conclusion

This study was based on the IMB model with a large sample size to explore factors influencing female college students' intention to receive the HPV vaccine since the vaccine became available in mainland China. Only a small proportion of the female freshmen had been vaccinated against HPV about three

years after the HPV vaccines were approved in China, and the willingness of the vaccine among the unvaccinated remained low. Participants who had sex, had relatives or friends suffering from cancer, had heard of HPV, and actively consulted about HPV vaccines were more likely to receive the HPV vaccine in the next 6 months. Most importantly, our study found associations between vaccination acceptance and IMB constructs, such as perceived susceptibility, perceived severity, perceived barriers, subjective norms, and self-efficacy. The evaluation and strengthening of the positive attitude of female freshmen toward HPV vaccination, reducing barriers to vaccination, and creating vaccine-friendly social norms can be crucial for the promotion of HPV vaccination among college freshmen in mainland China.

## Abbreviations

AOR, adjusted odds ratio; CI, confidence interval; COVID-19, coronavirus disease 2019; HPV, human papillomavirus; IMB, information–motivation–behavior skills; OR, odds ratio; P, probability; SD, standard deviation; SES, socioeconomic status; WHO, World Health Organization.

## Author Contributions

Mingyu Si and Xiaoyou Su prepared the first draft. Yu Jiang, Xiaoyou Su, and Ming-Yu Si managed the overall project. Xi Zhang, Wenjun Wang, Xiaofen Gu, Li Ma, Jing Li, Shaokai Zhang, and Zefang Ren were responsible for the questionnaire survey in seven geographical regions of China. Yu Jiang and Yuanli Liu finalized the manuscript on the basis of comments from other authors. Youlin Qiao provided overall guidance.

## Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: Asian Regional Special Cooperation Fund of National Health Commission of the People's Republic of China (BLXM01) and Innovation Fund for Medical Sciences sponsored by Chinese Academy of Medical Sciences (2019-I2M-2-005, 2017-I2M-B&R-17).

## Ethical Approval and Consent to Participate

This study has been approved by the Institutional Review Board of Chinese Center for Disease Control and Prevention on October 24, 2019 (approval number: 201918-01).

## Availability of Data and Materials

The original data generated from this study and the analyzed results will be available from the corresponding author upon reasonable request.

## ORCID iDs

Mingyu Si  <https://orcid.org/0000-0002-8372-9301>

Xi Zhang  <https://orcid.org/0000-0001-7402-6981>

## References

- Arbyn M, Weiderpass E, Bruni L, et al. Estimates of incidence and mortality of cervical cancer in 2018: a worldwide analysis. *Lancet Glob Health*. 2020;8(2):e191-e203. doi:10.1016/S2214-109X(19)30482-6
- Walboomers JMM, Jacobs MV, Manos MM, et al. Human papillomavirus is a necessary cause of invasive cervical cancer worldwide. *J Pathol*. 1999;189(1):12-19. doi:10.1002/(SICI)1096-9896(199909)189:1<12::AID-PATH431>3.0.CO;2-F
- Schiffman MH, Bauer HM, Hoover RN, et al. Epidemiologic evidence showing that human papillomavirus infection causes most cervical intraepithelial neoplasia. *J Natl Cancer Inst*. 1993;85(12):958-964. doi:10.1093/jnci/85.12.958
- Clifford G, Franceschi S, Diaz M, Muñoz N, Villa LL. HPV type-distribution in women with and without cervical neoplastic diseases. *Vaccine*. 2006;24(suppl 3):S26-S34. doi:10.1016/j.vaccine.2006.05.026
- Sotlar K, Stubner A, Diemer D, et al. Detection of high-risk human papillomavirus E6 and E7 oncogene transcripts in cervical scrapes by nested RT-polymerase chain reaction. *J Med Virol*. 2004;74(1):107-116. doi:10.1002/jmv.20153
- Villa LL, Costa RL, Petta CA, et al. Prophylactic quadrivalent human papillomavirus (types 6, 11, 16, and 18) L1 virus-like particle vaccine in young women: a randomised double-blind placebo-controlled multicentre phase II efficacy trial. *Lancet Oncol*. 2005;6(5):271-278. doi:10.1016/S1470-2045(05)70101-7
- Harper DM, Franco EL, Wheeler C, et al. Efficacy of a bivalent L1 virus-like particle vaccine in prevention of infection with human papillomavirus types 16 and 18 in young women: a randomised controlled trial. *Lancet*. 2004;364(9447):1757-1765. doi:10.1016/S0140-6736(04)17398-4
- World Health Organization. Immunization, vaccines and biologicals-data, statistics and graphics, 2020. <https://www.who.int/teams/immunization-vaccines-and-biologicals/data-statistics-and-graphics>
- Markowitz LE, Dunne EF, Saraiya M, et al. Quadrivalent human papillomavirus vaccine: recommendations of the Advisory Committee on Immunization practices (ACIP). *MMWR Recomm Rep*. 2007;56(RR-2):1-24.
- World Health Organization. Human papillomavirus (HPV) position paper. [https://www.who.int/immunization/policy/position\\_papers/hpv/en/](https://www.who.int/immunization/policy/position_papers/hpv/en/)
- Deng C, Chen X, Liu Y. Human papillomavirus vaccination: coverage rate, knowledge, acceptance, and associated factors in college students in mainland China. *Hum Vaccines Immunother*. 2021;17(3):828-835. doi:10.1080/21645515.2020.1797368
- Liu Y, Di N, Tao X. Knowledge, practice and attitude towards HPV vaccination among college students in Beijing, China. *Hum Vaccines Immunother*. 2020;16(1):116-123. doi:10.1080/21645515.2019.1638727
- You D, Han L, Li L, et al. Human papillomavirus (HPV) vaccine uptake and the willingness to receive the HPV vaccination among female college students in China: a multicenter study. *Vaccines*. 2020;8(1):31. doi:10.3390/vaccines8010031
- Zhang X, Wang Z, Ren Z, et al. HPV vaccine acceptability and willingness-related factors among Chinese adolescents: a nationwide study. *Hum Vaccines Immunother*. 2020;17:1025-1032. doi:10.1080/21645515.2020.1812314
- Zhang Y, Wang Y, Liu L, et al. Awareness and knowledge about human papillomavirus vaccination and its acceptance in China: a meta-analysis of 58 observational studies. *BMC Publ Health*. 2016;16:216. doi:10.1186/s12889-016-2873-8
- Fisher JD, Fisher WA. Changing AIDS-risk behavior. *Psychol Bull* 1992;111:455-474.
- Fisher WA. Understanding human papillomavirus vaccine uptake. *Vaccine*. 2012;30(suppl 5):F149-F156. doi:10.1016/j.vaccine.2012.04.107
- Perez G, Cruess DG, Strauss N. A brief information-motivation-behavioral skills intervention to promote human papillomavirus vaccination among college-aged women. *Psychol Res Behav Manag*. 2016;9:285-296. doi:10.2147/PRBM.S112504
- Si M, Su X, Jiang Y, Qiao Y, Liu Y. Interventions to improve human papillomavirus vaccination among Chinese female college students: study protocol for a randomized controlled trial. *BMC Publ Health*. 2019;19(1):1546. doi:10.1186/s12889-019-7903-x
- Wang R, Guo XL, Wisman GBA, et al. Nationwide prevalence of human papillomavirus infection and viral genotype distribution in 37 cities in China. *BMC Infect Dis*. 2015;15:257. doi:10.1186/s12879-015-0998-5
- Zhou HL, Zhang W, Zhang CJ, et al. Prevalence and distribution of human papillomavirus genotypes in Chinese women between 1991 and 2016: a systematic review. *J Infect*. 2018;76(6):522-528. doi:10.1016/j.jinf.2018.02.008
- Zhao FH, Tiggelaar SM, Hu SY, et al. A multi-center survey of age of sexual debut and sexual behavior in Chinese women: suggestions for optimal age of human papillomavirus vaccination in China. *Cancer Epidemiology*. 2012;36(4):384-390. doi:10.1016/j.canep.2012.01.009
- World Health Organization. Accelerate cervical cancer elimination initiative. <https://www.who.int/reproductivehealth/publications/update-screening-treatment-cervical-cancer/en/>
- Chen PU, Chun-rong LIU, Zhang X, Jing LI. Knowledge and attitudes toward HPV and its vaccines among parents of middle school students in Chengdu. *Mod Prev Med*. 2018;45(02):299-302.
- Kim HW. Knowledge about human papillomavirus (HPV), and health beliefs and intention to recommend HPV vaccination for girls and boys among Korean health teachers. *Vaccine*. 2012;30(36):5327-5334. doi:10.1016/j.vaccine.2012.06.040
- Kahn JA, Rosenthal SL, Hamann T, Bernstein DI. Attitudes about human papillomavirus vaccine in young women. *Int J STD & AIDS*. 2003;14(5):300-306. doi:10.1258/095646203321605486

27. Yun-xia C, Wu Ds, Shi-qun C, et al. Investigation on college students' knowledge of human papilloma virus and HPV vaccine. *Chinese J School Doctor*. 2018;32(06):401-404.
28. Forster AS, McBride KA, Davies C, et al. Development and validation of measures to evaluate adolescents' knowledge about human papillomavirus (HPV), involvement in HPV vaccine decision-making, self-efficacy to receive the vaccine and fear and anxiety. *Publ Health*. 2017;147:77-83. doi:10.1016/j.puhe.2017.02.006
29. DiClemente RJ, Murray CC, Graham T, Still J. Overcoming barriers to HPV vaccination: a randomized clinical trial of a culturally-tailored, media intervention among African American girls. *Hum Vaccines Immunother*. 2015;11(12):2883-2894. doi:10.1080/21645515.2015.1070996
30. Gerend MA, Shepherd JE. Predicting human papillomavirus vaccine uptake in young adult women: comparing the health belief model and theory of planned behavior. *Ann Behav Med*. 2012;44(2):171-180. doi:10.1007/s12160-012-9366-5
31. Guvenç G, Seven M, Akyuz A. Health belief model scale for human papilloma virus and its vaccination: adaptation and psychometric testing. *J Pediatr Adolesc Gynecol*. 2016;29(3):252-258. doi:10.1016/j.jpog.2015.09.007
32. Yin Y. HPV vaccination in China needs to be more cost-effective. *Lancet*. 2017;390(10104):1735-1736. doi:10.1016/S0140-6736(17)32606-5
33. Wong LP, Han L, Li H, Zhao J, Zhao Q, Zimet GD. Current issues facing the introduction of human papillomavirus vaccine in China and future prospects. *Hum Vaccines Immunother*. 2019;15(7-8):1533-1540. doi:10.1080/21645515.2019.1611157
34. Oz M, Cetinkaya N, Apaydin A, et al. Awareness and knowledge levels of Turkish College students about human papilloma virus infection and vaccine acceptance. *J Canc Educ*. 2018;33(2):260-268. doi:10.1007/s13187-016-1116-0
35. LaJoie AS, Kerr JC, Clover RD, Harper DM. Influencers and preference predictors of HPV vaccine uptake among US male and female young adult college students. *Papillomavirus Res*. 2018;5:114-121. doi:10.1016/j.pvr.2018.03.007
36. Bojar H, Silveira F, Rebelo M, Elżbieta C, Krzysztof C. Health behaviours in Scaffold use risk assessment model–SURAM. *Ann Agric Environ Med*. 2019;26(1):138-142. doi:10.26444/aaem/100534
37. Wang J, Tang D, Wang K, et al. HPV genotype prevalence and distribution during 2009-2018 in Xinjiang, China: baseline surveys prior to mass HPV vaccination. *BMC Wom Health*. 2019;19(1):90. doi:10.1186/s12905-019-0785-3
38. Li L, Ding YY, Ding YY, et al. Normative beliefs and sexual risk in China. *AIDS Behav*. 2011;15(6):1251-1258. doi:10.1007/s10461-010-9835-4
39. Wang X, Zhou X, Leesa L, Mantwill S. The effect of vaccine literacy on parental trust and intention to vaccinate after a major vaccine scandal. *J Health Commun*. 2018;23(5):413-421. doi:10.1080/10810730.2018.1455771
40. Li L, Li J. Factors affecting young Chinese women's intentions to uptake human papillomavirus vaccination: an extension of the theory of planned behavior model. *Hum Vaccines Immunother*. 2020;16:3123-3130. doi:10.1080/21645515.2020.1779518
41. Cheung T, Lau JTF, Wang JZ, Mo PKH, Ho YS. Acceptability of HPV vaccines and associations with perceptions related to HPV and HPV vaccines among male baccalaureate students in Hong Kong. *PLoS One*. 2018;13(6):e0198615. doi:10.1371/journal.pone.0198615
42. Jinks AM, Lawson V, Daniels R. A survey of the health needs of hospital staff: implications for health care managers. *J Nurs Manag*. 2003;11(5):343-350. doi:10.1046/j.1365-2834.2003.00387.x
43. Thanasis I, Lavranos G, Gkogkou P, Paraskevis D. Understanding of young adolescents about HPV infection: how health education can improve vaccination rate. *J Canc Educ*. 2020;35(5):850-859. doi:10.1007/s13187-019-01681-5
44. Wang Q, Zhang W, Cai H, Cao Y. Understanding the perceptions of Chinese women of the commercially available domestic and imported HPV vaccine: a semantic network analysis. *Vaccine*. 2020;38(52):8334-8342. doi:10.1016/j.vaccine.2020.11.016
45. Zou Z, Fairley CK, Ong JJ, et al. Domestic HPV vaccine price and economic returns for cervical cancer prevention in China: a cost-effectiveness analysis. *Lancet Glob Health*. 2020;8(10):e1335-e1344. doi:10.1016/S2214-109X(20)30277-1
46. Ogundele OA, Omotoso AA, Fagbemi AT. COVID-19 outbreak: a potential threat to routine vaccination programme activities in Nigeria. *Hum Vaccines Immunother*. 2020;17:661-663. doi:10.1080/21645515.2020.1815490

## Appendix A

Table A1. Items and distribution of perceptions based on the IMB model dimensions included in the questionnaire (N = 3765).

IMB dimensions	Items	Willing to receive HPV vaccine (%)					Unwilling to receive HPV vaccine (%)				
		Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
Perceived susceptibility	I believe I am at risk for getting HPV	201(16.64)	312(25.83)	525(43.46)	156(12.91)	14(1.16)	536(20.96)	832(32.54)	999(39.07)	165(6.45)	25(.98)
	I believe I am at risk for developing cervical cancer	180(14.90)	296(24.50)	553(45.78)	166(13.74)	13(1.08)	475(18.58)	773(30.23)	1111(43.45)	177(6.92)	21(.82)
Perceived severity	The thought of HPV infection scares me	38(3.15)	218(18.05)	341(28.23)	515(42.63)	96(7.95)	62(2.42)	470(18.38)	862(33.71)	993(38.83)	170(6.65)
	HPV infection is a serious disease that can disturb my school life	34(2.81)	172(14.24)	348(28.81)	509(42.14)	145(12.00)	51(1.99)	399(15.60)	799(31.25)	1039(40.63)	269(10.52)
Perceived benefits	Having cervical cancer would be devastating for me	37(3.06)	233(19.29)	375(31.04)	415(34.35)	148(12.25)	78(3.05)	486(19.01)	900(35.20)	838(32.77)	255(9.97)
	Having cervical cancer would have major consequences on my life	18(1.49)	81(6.71)	240(19.87)	650(53.81)	219(18.13)	35(1.37)	159(6.22)	617(24.13)	1372(53.66)	374(14.63)
Perceived benefits	It is necessary to vaccinate against HPV even if you are in a committed relationship	14(1.16)	8(.66)	250(20.70)	642(53.15)	294(24.34)	28(1.10)	39(1.53)	788(30.82)	1303(50.96)	399(15.60)
	Getting vaccinated for HPV will help protect me from HPV infection	9(.75)	27(2.24)	166(13.74)	668(55.30)	338(27.98)	19(.74)	64(2.50)	558(21.82)	1485(58.08)	431(16.86)
	If I get vaccinated for HPV, I can reduce my risk of cervical cancer	4(.33)	4(.33)	126(10.43)	758(62.75)	316(26.16)	9(.35)	25(.98)	508(19.87)	1616(63.2)	399(15.60)

(continued)

Table A1. (continued)

IMB dimensions	Items	Willing to receive HPV vaccine (%)				Unwilling to receive HPV vaccine (%)					
		Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
Perceived barriers	I doubt the safety and efficacy of the vaccine	105(8.69)	489(40.48)	450(37.25)	149(12.33)	15(1.24)	135(5.28)	817(31.95)	1150(44.97)	402(15.72)	53(2.07)
	I have difficulty deciding HPV vaccination	193(15.98)	527(43.63)	395(32.70)	82(6.79)	11(.91)	147(5.75)	702(27.45)	1289(50.41)	366(14.31)	53(2.07)
	Possible needle hurts of HPV vaccination make me worry	206(17.05)	463(38.33)	321(26.57)	183(15.15)	35(2.90)	224(8.76)	797(31.17)	910(35.59)	544(21.27)	82(3.21)
	HPV vaccination is expensive	58(4.80)	190(15.73)	534(44.21)	326(26.99)	100(8.28)	52(2.03)	195(7.63)	1329(51.97)	771(30.15)	210(8.21)
Social norms	Possible side effects of HPV vaccination make me worry	56(4.64)	188(15.56)	496(41.06)	415(34.35)	53(4.39)	35(1.37)	205(8.02)	1097(42.9)	1062(41.53)	158(6.18)
	Other girls like me are considering getting the HPV vaccine	9(.75)	45(3.73)	593(49.09)	447(37)	114(9.44)	41(1.60)	216(8.45)	1651(64.57)	580(22.68)	69(2.70)
	My family thinks I should get vaccinated against HPV	14(1.16)	61(5.05)	571(47.27)	423(35.02)	139(11.51)	63(2.46)	339(13.26)	1710(66.88)	391(15.29)	54(2.11)
	In general, I want to do what my family members think I should do	11(.91)	106(8.77)	447(37.00)	564(46.69)	80(6.62)	26(1.02)	279(10.91)	1108(43.33)	1090(42.63)	54(2.11)
Decision-making	My friends thinks I should get vaccinated against HPV	15(1.24)	78(6.46)	704(58.28)	351(29.06)	60(4.97)	78(3.05)	421(16.46)	1710(66.88)	314(12.28)	34(1.33)
	In general, I want to do what my FF thinks I should do	28(2.32)	228(18.87)	675(55.88)	243(20.12)	34(2.81)	71(2.78)	661(25.85)	1497(58.55)	306(11.97)	22(.86)
	I strongly value my health	1(.08)	3(.25)	65(5.38)	629(52.07)	510(42.22)	4(.16)	9(.35)	183(7.16)	1534(59.99)	827(32.34)
	Prevention of disease and infections is important to me	1(.08)	0(.00)	55(4.55)	651(53.89)	501(41.47)	3(.12)	4(.16)	198(7.74)	1602(62.65)	750(29.33)

(continued)



Table A1. (continued)

IMB dimensions	Items	Willing to receive HPV vaccine (%)				Unwilling to receive HPV vaccine (%)					
		Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree	Disagree	Neither disagree nor agree	Agree	Strongly agree	
Self-efficacy	I feel confident in my ability to get vaccinated for HPV, even if it is expensive	5(.41)	33(2.73)	379(31.37)	532(44.04)	259(21.44)	33(1.29)	187(7.31)	1488(58.19)	675(26.40)	174(6.80)
	I feel confident in my ability to get vaccinated for HPV, even if getting the shot hurts a little	3(.25)	4(.33)	195(16.14)	704(58.28)	302(25.00)	17(.66)	82(3.21)	997(38.99)	1215(47.52)	246(9.62)
	I feel confident in my ability to get vaccinated for HPV, even if you are worried about the possible side effects	3(.25)	26(2.15)	387(32.04)	590(48.84)	202(16.72)	30(1.17)	200(7.82)	1482(57.96)	725(28.35)	120(4.69)
	I feel confident in my ability to get vaccinated for HPV, even if it means finding the time to go to the doctor three times	3(.25)	7(.58)	279(23.10)	674(55.79)	245(20.28)	24(.94)	128(5.01)	1294(50.61)	937(36.64)	174(6.80)
	I can talk to my parents/guardians/nurses/doctors about whether to get HPV vaccine at will	10(.83)	48(3.97)	354(29.30)	552(45.7)	244(20.20)	26(1.02)	270(10.56)	1174(45.91)	927(36.25)	160(6.26)
	I know the location of vaccination, or I will find out the location through online search or telephone consultation	15(1.24)	144(11.92)	447(37.00)	455(37.67)	147(12.17)	51(1.99)	550(21.51)	1202(47.01)	663(25.93)	91(3.56)
	I know that the HPV vaccine is a self-funded vaccine and the price is affordable	11(.91)	105(8.69)	494(40.89)	461(38.16)	137(11.34)	63(2.46)	441(17.25)	1471(57.53)	514(20.1)	68(2.66)
	If I want to vaccinate, I will set a reminder calendar and so on to complete 3 shots regularly	1(.08)	4(.33)	213(17.63)	725(60.02)	265(21.94)	14(.55)	84(3.29)	839(32.81)	1361(53.23)	259(10.13)

Abbreviations: HPV, human papillomavirus; IMB, information–motivation–behavior skills.