


RESEARCH ARTICLE

Willingness to human papillomavirus (HPV) vaccination and influencing factors among male and female university students in China

Zhenwei Dai¹  | Mingyu Si¹ | Xiaoyou Su¹ | Wenjun Wang² | Xi Zhang³ | Xiaofen Gu⁴ | Li Ma⁵ | Jing Li⁶ | Shaokai Zhang⁷ | Zefang Ren⁸ | Youlin Qiao^{1,9}

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

²School of Nursing, Jining Medical University, Jining, Shandong, China

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

⁴Affiliated Tumor Hospital, Xinjiang Medical University, Urumqi, China

⁵School of Public Health, Dalian Medical University, Dalian, China

⁶West China School of Public Health, West China Forth Hospital, Sichuan University, Chengdu, China

⁷Henan Cancer Hospital, Affiliated Cancer Hospital of Zhengzhou University, Zhengzhou, China

⁸School of Public Health, Sun Yat-sen University, Guangzhou, China

⁹Department of Epidemiology, National Cancer Center/Cancer Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, China

Correspondence

Xiao-You Su, Department of Epidemiology and Biostatistics, School of Population Medicine and Public Health, Chinese Academy of Medical Sciences and Peking Union Medical College, 9 DongDanSanTiao, Dongcheng District, Beijing, China.

Email: suxiaoyou@hotmail.com

You-Lin Qiao, Department of Epidemiology, National Cancer Center/Cancer Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, 17 South Panjiayuan, Chaoyang District, Beijing, China.

Email: qiaoy@cicams.ac.cn

Funding information

Innovation Fund for Medical Sciences sponsored by Chinese Academy of Medical Sciences; Asian Regional Special Cooperation Fund of National Health Commission of the People's Republic of China

Abstract

This study compared the willingness to receive human papillomavirus (HPV) vaccination and the influencing factors between male and female university students who had never been vaccinated against HPV in China. University students were recruited from seven universities in China. A self-administered questionnaire was used to collect information about demographic characteristics, willingness to HPV vaccination, and possible influencing factors including demographics, knowledge, and attitude toward HPV vaccination. The χ^2 test was used to test the difference between males and females' knowledge and attitudes to HPV vaccination. Multivariate logistic regression was employed to detect the factors associated with willingness to HPV vaccination. A total of 7335 university students participated in the survey (3570 males and 3765 females). Over 70% of the participants had previously received sex education and knowledge. The average age of sexual debut was 17.5 years old. More male students reported acceptance of premarital sex than female students did ($\chi^2 = 708.458$, $p < 0.001$). Female students had better knowledge and

Abbreviations: ACIP, Advisory Committee on Immunization Practices; HPV, human papillomavirus.

Mingyu Si is a Joint first author.

This is an open access article under the terms of the Creative Commons Attribution-NonCommercial License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited and is not used for commercial purposes.

© 2021 The Authors. *Journal of Medical Virology* published by Wiley Periodicals LLC

attitudes to HPV in general, while male students perceived a higher chance of being infected by HPV compared with female students ($\chi^2 = 6.047$, $p = 0.014$). The level of knowledge (male: adjusted odds ratio [AOR] = 1.935, 95% confidence interval [CI]: 1.516–2.470; female: AOR = 1.227, 95% CI: 1.055–1.428) and receiving sex education (male: AOR = 1.414, 95% CI: 1.109–1.804; female: AOR = 1.289, 95% CI: 1.064–1.562) were indicators of the HPV vaccination willingness for both genders. For male students, those who had ever inoculated optional self-paid vaccines were more likely to receive the HPV vaccine than those who had not (AOR = 1.567, 95% CI: 1.242–1.977). Female students were more willing to be vaccinated against HPV, if they had higher living expenses (AOR = 1.395 and 3.717, 95% CI: 1.071–1.426 and 1.776–7.752), relatives or friends had certain cancer (AOR = 1.290, 95% CI: 1.095–1.518), ever had sexual experiences (AOR = 2.628, 95% CI: 1.788–3.863), and had ever consulted on HPV vaccination issues (AOR = 1.612, 95% CI: 1.367–1.901). In China, more active education should be provided to improve university students' knowledge and attitudes on HPV and HPV vaccination. Including HPV vaccine uptake for both males and females at recommended ages in National Immunization Program would be the most cost-effective way to prevent HPV infection.

KEYWORDS

China, human papillomavirus, university students, vaccination

1 | INTRODUCTION

The human papillomavirus (HPV) is one of the most common sexually transmitted infections worldwide.¹ It is estimated that about 80% of sexually active women and men will be infected with certain HPV types during their lives.² While females have an overall high prevalence of HPV infection and some may develop into cervical cancer,³ previous studies proved that HPV infection can also result in cancers in men (e.g., penile cancer and anal cancer).^{4,5} The prevalence of HPV infection in males ranges from 5.3% to 42.2% worldwide and approximately 10.5% reported in China.^{6–8}

In the United States, the Advisory Committee on Immunization Practices (ACIP) recommended that HPV vaccination should be given to girls and boys at the age of 11 or 12 years old, and they urged catch-up HPV vaccination for all people up to the age of 26 years old in June 2019.^{9,10} However, although National Immunization Programs offering free or discounted mandatory HPV vaccination are available in over 110 countries as of October 2020, it is still yet to be covered by the Chinese government in a short period of time.^{11–13} In China, the cost-effective HPV vaccination has been suggested for males aged 9–15 years old and females aged 9–45 years old.¹⁴ The three-dose HPV vaccine series has been available for women with a total price of around \$ 300 since it was approved by the China Food and Drug Administration in 2016.¹⁵ Despite the emerging demand for HPV vaccination among males, it has not been approved for use in mainland China.¹⁶ Compared with many other countries, China faces

obstacles in effectively preventing HPV infection due to the accessibility and affordability issues of HPV vaccination. Furthermore, former studies indicated that awareness and knowledge of HPV vaccination among Chinese is still relatively low, especially among university students.¹⁷

Individuals aged 18–26 years old, who are most often university students, have the highest rate of new HPV infection.¹⁸ The average age of sexual debut varies in different countries and cultural contexts. In Europe, America, and China, it was 19, 16, and 17 years old, respectively.^{19–22} With the declining age of sexual debut and compromised condom use, young Chinese students are susceptible to sexually transmitted infections including HPV.^{23,24} A cross-sectional study aimed at university students in Jinan, China showed that gender was a significant factor of knowledge, attitude, and willingness toward HPV vaccination,²⁵ which indicated that males and females might have different levels of knowledge and attitude to HPV vaccination, as well as dissimilar willingness to receive it.²⁶ Compared with previous studies that aimed at students from specific regions in China, this study is a multicenter and school-based survey on knowledge, attitude, and willingness toward HPV vaccination among university students in China. It aims to explore and compare the willingness to HPV vaccination, as well as influencing factors such as knowledge and attitude between male and female university students in China who have not been vaccinated against HPV, and thus to provide evidence for the future intervention of HPV vaccination and relevant policy-making in China.

2 | MATERIAL AND METHODS

2.1 | Measures

This cross-sectional study used an online questionnaire containing 35 questions to measure the knowledge, attitude, and willingness to HPV vaccination. In the part of knowledge and attitude, we included two aspects of measures: (1) knowledge and attitude to health and sexual behavior (six items, e.g., "Vaccines can effectively prevent diseases," "I accept premarital sex"), and (2) knowledge and attitude to HPV-related issues (nine items, e.g., "I have ever heard of HPV related diseases, such as genital warts and cervical cancer," "HPV infection is very serious and will affect my life on campus").²⁷⁻³⁰ In the part of willingness, we chose a single item to measure whether one is willing to be vaccinated against HPV ("Yes" or "No"). For female students, the item was "Do you want to be vaccinated against HPV in the next 6 months?," while for male students was "Are you willing to receive HPV vaccine when it is approved among men in mainland in the future?". Additionally, we asked participants to provide their demographic information such as age, ethnicity, and living expenses (yuan/month).

2.2 | Study settings and recruitment

To guarantee the representativeness of the research findings, we recruited participants from seven comprehensive universities located in seven geographical territories of China: Shandong University in East China, Zhongshan University in South China, Zhengzhou University in Central China, Capital Normal University in North China, Sichuan University in Southwest China, Dalian University of Technology in Northeast China, and Xinjiang University in Northwest China by convenience sampling. The purposive selection of these universities resulted in good coverage of different geographic locations of the country. This study follows the regulations of Measures for the Ethical Review of Biomedical Research Involving Humans (implemented on December 1, 2016) of the National Health Commission of the People's Republic of China. Before the survey, all participants signed an informed consent after they agreed to attend the study.

Participants were screened at each university for their eligibility to participate in the study by their teachers. The inclusion criteria were as follows: (1) university students over 18 years old; (2) first- and second-year undergraduate students; (3) no vaccination contraindications; (4) had a mobile phone or computer access; and (5) had never been vaccinated against HPV before. The exclusion criteria were as follows: (1) under 18 years old; (2) nonundergraduate first- or second-year students; (3) previous history of vaccination contraindications; (4) medical students; and (5) current pregnant or breast-feeding women.

2.3 | Data analysis

Descriptive analyses were performed to examine the participants' demographic characteristics, as well as their knowledge and attitude

to health, sexual behavior, and HPV. χ^2 tests were used to test the differences between males and females based on these items. Univariate logistic regression analysis began with a full set of demographics, knowledge, and attitude toward health and sexual behavior, knowledge, and attitude toward HPV, and so on, to evaluate the associations of willingness to HPV vaccination. Significant variables ($p \leq 0.10$) in the univariate analysis were further incorporated into the multivariate logistic regression analysis. Adjusted odds ratio (AOR) and the corresponding 95% confidence intervals (CIs) were calculated to assess the results of the regression model. All analyses were conducted using SPSS 26.0, with level of significance determined at a 0.05 p value.

3 | RESULTS

3.1 | Demographic characteristics

A total of 7440 university students participated in the survey. One hundred and five people were excluded from our analysis because they had previously been vaccinated against HPV. As a result, the analysis employed data of 7335 university students (3570 male and 3765 female).

Table 1 shows the sociodemographics of the participants. The average age of participants was 19.22 years old. Among the participants, 48.7% were males, 46.9% majored in Art, 89.2% were Han ethnicity, 1.2% had a religious belief, 64.4% lived in a city as their residence place, and 24.4% had parents with an undergraduate or above educational level. A total of 70.9% spent 1000–2000 yuan per month on their living expenses and 23.4% had relatives or friends with cancer. The age gap between male students and female students was statistically significant ($\chi^2 = 104.215$, $p < 0.001$). Specifically, female students were younger than male students in this study. Significantly more male students majored in science than female students ($\chi^2 = 105.593$, $p < 0.001$) and more male students were Han than female students ($\chi^2 = 16.513$, $p < 0.001$).

3.2 | Knowledge and attitude to HPV vaccine

Table 2 shows participants' knowledge and attitude to health and sexual behavior. The majority of male and female students equally believed that vaccines can effectively prevent diseases ($\chi^2 = 0.350$, $p = 0.554$). There is no statistically significant difference between male and female students in having ever inoculated the optional self-paid vaccines ($\chi^2 = 0.927$, $p = 0.336$). Female students were more likely than male students to receive sexual education and knowledge ($\chi^2 = 29.387$, $p < 0.001$). Female students reported the same age of sexual debut as male students ($\chi^2 = 0.358$, $p = 0.550$). The mean age of the sexual debut of the participants was 17.5 years old, and less than 5% of the participants had previously had sexual intercourse. Compared with male students, female students were more likely to be single (without a boyfriend/girlfriend) ($\chi^2 = 11.953$, $p = 0.001$).

TABLE 1 Demographic characteristics of participants

Variable	Gender		Total (%)	χ^2	p
	Male (%)	Female (%)			
Age (year)					
18	435 (12.2)	693 (18.4)	1128 (15.3)	104.215	<0.001
19	2016 (56.5)	2231 (59.3)	4247 (57.9)		
≥20	1119 (31.3)	841 (22.3)	1960 (26.8)		
Major					
Art	1454 (40.7)	1984 (52.7)	3428 (46.9)	105.393	<0.001
Science	2116 (59.3)	1781 (47.3)	3897 (53.1)		
Ethnicity					
Han	3239 (90.7)	3305 (87.8)	6544 (89.2)	16.531	<0.001
Other	331 (9.3)	460 (12.2)	791 (10.8)		
Religion					
Yes	44 (1.4)	34 (1.1)	78 (1.2)	1.513	0.219
No	3068 (98.6)	3142 (98.9)	6210 (98.9)		
Missing value	458 (12.8)	589 (15.6)	1047 (14.3)		
Residence					
City	2304 (64.5)	2419 (64.2)	4723 (64.4)	0.066	0.797
Village	1266 (35.5)	1346 (35.8)	2612 (35.6)		
Residence of parents					
City	2322 (65.0)	2399 (63.7)	4721 (64.4)	1.400	0.237
Village	1248 (35.0)	1366 (36.3)	2614 (35.6)		
Education level of parents					
Secondary school or below	1582 (44.3)	1694 (45.0)	3276 (44.7)	5.441	0.066
Senior and vocational high school	1147 (32.1)	1122 (29.8)	2269 (30.9)		
Undergraduate or above	841 (23.6)	949 (25.2)	1790 (24.4)		
Living expenses (Yuan/Month)					
<1000	728 (20.4)	771 (20.5)	1499 (20.4)	1.819	0.611
1000–2000	2522 (70.6)	2679 (71.2)	5201 (70.9)		
2001–3000	275 (7.7)	279 (7.4)	554 (7.6)		
>3000	45 (1.3)	36 (1.0)	81 (1.1)		
Relatives or friends have cancer					
Yes	801 (22.4)	913 (24.2)	1714 (23.4)	3.362	0.067
No	2769 (77.6)	2852 (75.8)	5621 (76.6)		

Male students were more likely to agree with and engage in pre-marital sex than female students ($\chi^2 = 708.458$, $p < 0.001$).

Table 3 shows participants' knowledge and attitude to HPV. Female students were more likely than male students to have ever heard of HPV ($\chi^2 = 239.532$, $p < 0.001$) and HPV-related diseases ($\chi^2 = 81.839$, $p < 0.001$). For questions regarding the HPV vaccine, female students were more likely to have ever heard of HPV vaccine ($\chi^2 = 231.593$, $p < 0.001$) and to have ever actively

consulted on HPV vaccination issues ($\chi^2 = 108.926$, $p < 0.001$). However, male students were more concerned about the risk of HPV infection than female students ($\chi^2 = 6.047$, $p = 0.014$). While female students were more likely than male students to believe in the protection of the HPV vaccine ($\chi^2 = 37.594$, $p < 0.001$), they were less willing to be vaccinated against HPV ($\chi^2 = 2533.642$, $p < 0.001$) and to encourage their friends to be vaccinated ($\chi^2 = 402.377$, $p < 0.001$).

TABLE 2 Participants' knowledge and attitude to health and sexual behavior (n = 7335)

Item	Gender		Total (%)	χ^2	p
	Male (%)	Female (%)			
Vaccines can effectively prevent diseases					
Yes	3305 (92.6)	3499 (92.9)	6804 (92.8)	0.350	0.554
No	265 (7.4)	266 (7.1)	531 (7.2)		
Ever paid for optional self-paid vaccines					
Yes	2333 (65.4)	2420 (64.3)	4753 (64.8)	0.927	0.336
No	1237 (34.6)	1345 (35.7)	2582 (35.2)		
Ever received sex education and knowledge					
Yes	2631 (73.7)	2977 (79.1)	5608 (76.5)	29.387	<0.001
No	939 (26.3)	788 (20.9)	1727 (23.3)		
Age of first sexual behavior					
<18	100 (2.8)	45 (1.2)	145 (2.0)	0.358	0.550
≥18	151 (4.2)	59 (1.6)	210 (2.9)		
None	3319 (93.0)	3661 (97.2)	6980 (95.2)		
Mean ± SD	17.552 ± 1.5329	min:10	max:22		
Single					
Yes	2840 (79.6)	3114 (82.7)	5954 (81.2)	11.953	0.001
No	730 (20.4)	651 (17.3)	1381 (18.8)		
Acceptance of premarital sex					
Yes	2471 (69.2)	1438 (38.2)	3909 (53.3)	708.458	<0.001
No	1099 (30.8)	2327 (61.8)	3426 (46.7)		

3.3 | Variables associated with willingness to vaccination

Table 4 shows the results of the factors associated with willingness to be vaccinated with the HPV vaccine. In univariate logistic regression, it was indicated that for male students, the 16 predictor variables "Ethnicity," "Residence," "Residence of parents," "Education level of parents," "Living expenses," "Relative or friends have cancer," "Ever heard of HPV," "Ever heard of HPV related diseases," "Ever heard of HPV vaccine," "Level of knowledge," "Vaccines can effectively prevent diseases," "Ever had optional self-paid vaccinations," "Ever received sex education and knowledge," "ever actively consulted on HPV vaccination issues," "Ever had sexual behavior," "Acceptance of premarital sex" were statistically significant and were later employed in multivariate logistic regression to predict male students' willingness to the HPV vaccine among male students. A similar procedure was also applied to female students.

In the multivariate analysis, among the male students, students with higher HPV knowledge scores were almost twice more likely to take the HPV vaccine than those with lower knowledge levels (AOR = 1.935, 95% CI: 1.516–2.470). Students who believed vaccines can effectively prevent diseases were over twice more likely to take the vaccine than those who did not (AOR = 2.492, 95% CI: 1.813–3.425). Students who ever had optional self-paid vaccinations were more likely to take the

HPV vaccine than those who did not (AOR = 1.567, 95% CI: 1.242–1.977). Students who ever received sex education were more willing to vaccination (AOR = 1.414, 95% CI: 1.109–1.804). Students who accepted premarital sex were more willing to be vaccinated (AOR = 1.429, 95% CI: 1.131–1.805). Among female students, the probability of willingness to HPV vaccine significantly increased as the living expenses increased (AOR = 1.395, 95% CI: 1.071–1.426; and AOR = 3.717, 95% CI: 1.776–7.752). Students whose relatives or friends had certain types of cancer were more likely to receive the vaccine (AOR = 1.290, 95% CI: 1.095–1.518). Students who had high knowledge scores (AOR = 1.227, 95% CI: 1.055–1.428), ever received sex education (AOR = 1.289, 95% CI: 1.064–1.562), and ever actively consulted on HPV vaccination issues (AOR = 1.612, 95% CI: 1.367–1.901) were more willing to be vaccinated against HPV. Additionally, students who ever had sexual experience were almost three times more likely to take the vaccine than those who had not (AOR = 2.628, 95% CI: 1.788–3.863) (Table 4).

4 | DISCUSSION

The average age of participants in this study was 19.22 years old, which is around the first peak age of HPV infection in China.³¹ In this study, up to 89.7% of male students indicated that they would be

TABLE 3 Participants' knowledge and attitude to HPV (*n* = 7335)

Item	Gender		Total (%)	χ^2	<i>p</i>
	Male (%)	Female (%)			
I have ever heard of HPV					
Yes	1493 (41.8)	2255 (59.9)	3748 (51.1)	239.532	<0.001
No	2077 (58.2)	1510 (40.1)	3587 (48.9)		
I have ever heard of HPV-related diseases, such as genital warts and cervical cancer					
Yes	1754 (49.1)	2246 (59.7)	4000 (54.4)	81.839	<0.001
No	1816 (50.9)	1519 (40.3)	3335 (45.5)		
I have ever heard of HPV vaccine					
Yes	1410 (39.5)	2156 (57.3)	3566 (48.6)	231.593	<0.001
No	2160 (60.5)	1609 (42.7)	3769 (51.4)		
I have ever actively consulted on HPV vaccination					
Yes	774 (21.7)	1225 (32.5)	1999 (27.3)	108.926	<0.001
No	2796 (78.3)	2540 (67.5)	5336 (72.7)		
HPV infection is very serious and will affect my life in campus					
Yes	1924 (53.9)	1962 (52.1)	3886 (53.0)	2.336	0.126
No/Uncertain	1646 (46.1)	1803 (47.9)	3449 (47.0)		
I think I have risk of infecting HPV					
Yes	404 (11.3)	360 (9.6)	764 (10.4)	6.047	0.014
No/Uncertain	3166 (88.7)	3405 (90.4)	6571 (89.6)		
Vaccination against HPV helps protect me from HPV infection					
Yes	2548 (71.4)	2922 (77.6)	5470 (74.6)	37.594	<0.001
No/Uncertain	1022 (28.6)	843 (22.4)	1865 (25.4)		
I am willing to be vaccinated with HPV vaccine					
Yes	3201 (89.7)	1208 (32.1)	4409 (60.1)	2533.642	<0.001
No	369 (10.3)	2557 (67.9)	2926 (39.9)		
I am willing to encourage my friends to be vaccinated with HPV vaccine					
Yes	3212 (90.0)	2689 (71.4)	5902 (80.5)	402.377	<0.001
No	357 (10.0)	1076 (28.6)	1433 (19.5)		

Abbreviation: HPV, human papillomavirus.

willing to be vaccinated against HPV if it became available in mainland China, while only 32.1% of the female students, the target population of HPV vaccination, indicated that they would be willing to get vaccinated in the following 6 months. Therefore, it is very important to explore the willingness to HPV vaccination and its influencing factors among male and female university students in China.

In this study, over 70% of female and male students had ever received sex education and knowledge. However, a considerable proportion of male students had never heard about HPV (58.2%), HPV-related diseases (50.9%), or HPV vaccine (60.5%). Despite the fact that sex education curriculum has been introduced to China for more than 30 years, it is still inadequate in terms of content and frequency of its delivery. This might result from the traditional Chinese cultural context, which fosters a conservative attitude toward

sex issues. However, it is concerning that there also exists the trend of earlier sexual intercourse among youngsters than decades ago.³² Under this circumstance, it is worthwhile to explore effective ways to help university students avoid sexually transmitted diseases. In some western countries like Britain, the average age of sexual debut is around 19 years old, while in America, the average age is around 16 years old.^{19,21} While in our study, apart from 95.2% of the participants who still had no sexual debut yet, the average age of sexual debut was 17.5 years old for both male and female students, indicating that they normally began their active sexual life when they were freshmen in university. In China, 70% of people had premarital sex in 2012, up from 15% in 1989.³³ The increasing rate of premarital sex urged us to address the related health issues caused by sexual behaviors. Consistent with a previous study,²⁵ we found that more

TABLE 4 Univariate and multivariate analysis on participants' willingness to vaccinate against HPV

Item	Willing to vaccinate with HPV vaccine											
	Male						Female					
	Yes	OR	<i>p</i>	AOR	95% CI	<i>p</i>	Yes	OR	<i>p</i>	AOR	95% CI	<i>p</i>
Age (year)												
18	390 (89.7%)	1					206 (29.7%)	1				
19	1830 (90.7%)	0.881	0.469				719 (32.2%)	0.890	0.216			
≥20	981 (87.7%)	1.219	0.276				283 (33.7%)	0.834	0.101			
Ethnicity												
Han	2919 (90.1%)	1		1			1050 (31.8%)	1				
Other	282 (85.2%)	0.631	0.005	0.813	0.573–1.153	0.245	158 (34.3%)	1.124	0.267			
Religion												
No	2762 (90.0%)	1					952 (30.3%)	1				
Yes	41 (93.2%)	1.514	0.490				11 (32.4%)	1.1	0.796			
Residence												
City	2108 (91.5%)	1		1			858 (35.5%)	1		1		
Village	1093 (86.3%)	0.587	<0.001	0.710	0.409–1.235	0.225	350 (26.0%)	0.639	<0.001	0.961	0.629–1.466	0.851
Residence of parents												
City	2120 (91.3%)	1		1			850 (35.4%)	1		1		
Village	1081 (86.6%)	0.617	<0.001	0.929	0.536–1.611	0.793	358 (26.2%)	0.647	<0.001	0.900	0.591–1.370	0.622
Education level of parents												
Secondary school or below	1386 (87.6%)	1		1			464 (27.4%)	1		1		
Senior and vocational high school	1056 (92.1%)	0.609	<0.001	0.816	0.612–1.088	0.166	375 (33.4%)	0.751	0.001	0.946	0.788–1.137	0.554
Undergraduate or above	759 (90.2%)	0.764	0.053	1.373	0.980–1.925	0.066	369 (38.9%)	0.593	<0.001	0.953	0.775–1.173	0.651
Living expenses (Yuan/Month)												
<1000	622 (85.4%)	1	<0.001	1			196 (25.4%)	1		1		
1000–2000	2280 (90.4%)	0.623	<0.001	0.820	0.626–1.074	0.150	859 (32.1%)	1.385	<0.001	1.031	0.844–1.258	0.769
2001–3000	259 (94.2%)	0.362	<0.001	0.583	0.323–1.052	0.073	130 (46.6%)	2.558	<0.001	1.395	1.012–1.923	0.042
>3000	40 (88.9%)	0.733	0.524	1.525	0.560–4.150	0.409	23 (63.9%)	5.181	<0.001	3.717	1.776–7.752	<0.001
Relatives or friends have cancer												
No	2463 (88.9%)	1		1			850 (29.8%)	1		1		
Yes	738 (92.1%)	1.455	0.009	1.119	0.831–1.507	0.457	358 (39.2%)	1.519	<0.001	1.290	1.095–1.518	0.002
I have ever heard of HPV												
No	1808 (87.0%)	1		1			349 (23.1%)	1		1		
Yes	1393 (93.3%)	2.073	<0.001	1.335	0.931–1.914	0.117	859 (38.1%)	2.047	<0.001	1.192	0.951–1.495	0.128
I have ever heard of HPV-related diseases, such as genital warts and cervical cancer												
No	1567 (86.3%)	1		1			385 (25.3%)	1		1		
Yes	1634 (93.2%)	2.164	<0.001	1.291	0.980–1.700	0.069	823 (36.6%)	1.704	<0.001	1.027	0.867–1.216	0.759

TABLE 4 (Continued)

Item	Willing to vaccinate with HPV vaccine											
	Male						Female					
	Yes	OR	<i>p</i>	AOR	95% CI	<i>p</i>	Yes	OR	<i>p</i>	AOR	95% CI	<i>p</i>
I have ever heard of HPV vaccine												
No	1888 (87.4%)	1		1			370 (23.0%)	1		1		
Yes	1313 (93.1%)	1.95	<0.001	0.973	0.670–1.411	0.884	838 (38.9%)	2.129	<0.001	1.251	0.997–1.569	0.053
Level of knowledge												
Low	1276 (84.4%)	1		1			489 (26.3%)	1		1		
High	1925 (93.5%)	2.677	<0.001	1.935	1.516–2.470	<0.001	719 (37.7%)	1.692	<0.001	1.227	1.055–1.428	0.008
Vaccines can effectively prevent diseases												
No	196 (74.0%)	1		1			68 (25.6%)	1		1		
Yes	3005 (90.9%)	3.526	<0.001	2.492	1.813–3.425	<0.001	1140 (32.6%)	1.407	0.019	1.058	0.787–1.421	0.710
Ever paid for optional self-paid vaccines												
No	1052 (85.0%)	1		1			393 (29.2%)	1		1		
Yes	2149 (92.1%)	2.054	<0.001	1.567	1.242–1.977	<0.001	815 (33.7%)	1.23	0.005	1.08	0.928–1.258	0.321
Ever received sex education and knowledge												
No	788 (83.9%)	1		1			184 (32.1%)	1		1		
Yes	2413 (91.7%)	2.121	<0.001	1.414	1.109–1.804	<0.001	1024 (34.4%)	1.721	<0.001	1.289	1.064–1.562	0.009
Ever actively consulted on HPV vaccination												
No	2483 (88.8%)	1		1			660 (26.0%)	1		1		
Yes	718 (92.8%)	1.616	0.001	1.023	0.738–1.418	0.891	548 (44.7%)	2.306	<0.001	1.612	1.367–1.901	<0.001
Ever had sexual behavior												
No	2959 (89.3%)	1		1			1149 (31.4%)	1		1		
Yes	242 (94.5%)	2.074	0.009	1.558	0.878–2.763	0.129	59 (54.6%)	2.628	<0.001	1.646	1.088–2.490	0.018
Single												
No	658 (90.1%)	1					252 (38.7%)	1		1		
Yes	2543 (89.5%)	0.937	0.638				956 (30.7%)	0.701	<0.001	0.837	0.692–1.011	0.065
Acceptance of premarital sex												
No	943 (85.8%)	1		1			662 (28.4%)	1		1		
Yes	2258 (91.4%)	1.754	<0.001	1.429	1.131–1.805	0.003	546 (38.0%)	1.54	<0.001	1.12	0.960–1.306	0.149

Abbreviations: AOR, adjusted odds ratio; CI, confidence interval; HPV, human papillomavirus; OR, odds ratio.

male university students had more love affairs than female students (20.4% vs. 17.3%), male students were more likely to accept premarital sexual behavior (69.2% vs. 38.2%), and the rates of male and female students who ever had sexual behavior were 7.2% and 2.9%, respectively. Additionally, though anal sexual behavior between men had been historically regarded as a taboo, it is an emerging concern of contracting and spreading sexually transmitted diseases including genital warts among university students in China.³³ Therefore, given that the HPV vaccine is not yet available for males in mainland China even for men who have sex with men (MSM), and research has shown that the improvement of sex education in China can finally

enhance the intention of HPV vaccination in both sexes,¹⁷ the needs for appropriate, comprehensive and timely sex education among male students are of great urgency to prevent and control sexually transmitted diseases.^{16,34}

In addition, the affordability and accessibility of HPV vaccination should be addressed in China. Currently, the supply of HPV vaccine is insufficient to cover all recommended-age customers when they demand the vaccination, not to mention the relatively high price for university students to afford.³⁵ Sometimes, the HPV vaccination becomes a privilege for those with better social economic status. Since the HPV vaccine is accessible among female students in China,

the government should ensure that as many female students as possible should be vaccinated against HPV, while also considering policies that would allow male students to be inoculated with the HPV vaccine. Otherwise, the transmission of HPV would be unavoidable through both heterosexual and same-sex routes.

In our study, female students had better knowledge and attitude to HPV in general. While female students were more likely to consult on the HPV vaccine and believe its effectiveness, male students were more willing to be vaccinated with HPV vaccine than female students (89.7% vs. 32.1%). HPV infection is common in males in China,³⁶ while most studies concentrated on the topic of HPV infection in females because of the serious results of cervical cancer, and only a rare amount of the studies focused on an emerging epidemic of HPV-related cancers in males.^{36,37} Another research aimed at studying the knowledge of HPV among male university students in China also revealed that male university students lacked the knowledge about HPV and lacked sufficient information to decide whether or not to take HPV vaccination compared with their female counterparts.¹⁶ Considering the attitudes to HPV and its vaccination, more male students were afraid of their exposure to HPV infection than female students. This can further interpret the reason that more male students were willing to be vaccinated and encourage their friends to be vaccinated with the HPV vaccine. These findings suggested that only providing sex education and enhancing students' understanding of HPV infection are insufficient to promote the protection of students. Based on the present situation and results of this study, future research should pay more attention to interventions aimed at improving university students' perceptions of threat and severity of HPV and HPA-related diseases.

Among the variables affecting willingness to vaccination, the level of knowledge and having ever received sex education were both the indicators of the willingness of male and female students. According to the theory of planned behavior (TPB), one's behavior intention will be affected by his attitude, and further affects behavior.³⁸ This indicated that students who have a good knowledge or had ever received education in some aspects tend to pay more attention to potential sexually transmitted diseases and take measures to cope with these infections. This suggests that improving attitudes and knowledge of HPV, as well as relative education, is an effective way to enhance university students' willingness to be vaccinated with the HPV vaccine.

For male students, those who had ever inoculated optional self-paid vaccines were more willing to be vaccinated. Willingness to pay for the vaccines uncovered by the National Immunization Program indicated that they valued their health and were ready for taking action to prevent disease, making them more willing to be vaccinated against HPV.³⁹ For female students, living expense is an important factor in their willingness to be vaccinated. Some research indicate that China failed to promote the HPV vaccine mainly because of its high price.^{15,25} In China, the majority of the population who can get access to HPV vaccines are females, hence female students were more sensitive to the money it takes by evaluating their living expenses than males.⁴⁰ In America, 65% of university students were

willing to take the vaccination only if it was free.⁴¹ A pilot project among teenage girls in one of the counties in China on promoting free HPV vaccination also showed a high HPV vaccination rate and intention.⁴² In this case, to encourage more students to be vaccinated, policies aimed at including the HPV vaccine in the Expanded Program on Immunization and providing financial subsidies on vaccination could be helpful.⁴³

5 | LIMITATIONS

This study has certain limitations. First, the questionnaire was designed by our research team, its validity and reliability were not tested before the research. However, the questions used in this study were based on a thorough literature search which covered various issues in this area. Second, we should take caution when interpreting the findings of our study, because a drawback of the cross-sectional study is that we can not make any statements regarding causality.

6 | CONCLUSIONS

Sex education and awareness should be improved among both male and female university students in China. Including the HPV vaccine for both males and females of appropriate age in the Expanded Program on Immunization would be the most cost-effective way to prevent HPV infection.

ACKNOWLEDGMENTS

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).

CONFLICT OF INTERESTS

The authors declare that there are no conflict of interests.

ETHICS STATEMENT

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).

AUTHOR CONTRIBUTIONS

Xiaoyou Su, Zhenwei Dai prepared the first draft. Youlin Qiao provided overall guidance, managed the overall project. Mingyu Si, Wenjun Wang, Xi Zhang, Xiaofen Gu, Li Ma, Jing Li, Shaokai Zhang and Zefang Ren were responsible for the questionnaire survey in seven geographical regions of China. Xiaoyou Su, Zhenwei Dai and Mingyu Si analyzed data.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author, Xiaoyou Su, upon reasonable request.

ORCID

Zhenwei Dai  <http://orcid.org/0000-0002-7508-008X>

REFERENCES

- Satterwhite CL, Torrone E, Meites E, et al. Sexually transmitted infections among US women and men: prevalence and incidence estimates, 2008. *Sex Transm Dis*. 2013;40(3):187-193.
- Chesson HW, Dunne EF, Hariri S, Markowitz LE. The estimated lifetime probability of acquiring human papillomavirus in the United States. *Sex Transm Dis*. 2014;41(11):660-664.
- Cohen PA, Jhingran A, Oaknin A, Denny L. Cervical cancer. *Lancet*. 2019;393(10167):169-182.
- Pereira-Lourenço M, Vieira E Brito D, Eliseu M, et al. Prognostic value of p16INK4a overexpression in penile cancer. *Arch Ital Urol Androl*. 2020;92(1):11-16.
- Goddard SL, Templeton DJ, Petoumenos K, et al. Prevalence and association of perianal and intra-anal warts with composite high-grade squamous intraepithelial lesions among gay and bisexual men: baseline data from the study of the prevention of anal cancer. *AIDS Patient Care STDS*. 2020;34(10):436-443.
- Wei F, Yin K, Wu X, et al. Human papillomavirus prevalence and associated factors in women and men in south China: a population-based study. *Emerg Microbes Infect*. 2016;5(11):e119.
- Gargano JW, Unger ER, Liu G, et al. Prevalence of genital human papillomavirus in males, United States, 2013-2014. *J Infect Dis*. 2017;215(7):1070-1079.
- Lehtinen T, Söderlund-Strand A, Petäjä T, et al. Human papillomavirus (HPV) prevalence in male adolescents 4 years after HPV-16/18 vaccination. *J Infect Dis*. 2017;216(8):966-968.
- Markowitz LE, Dunne EF, Saraiya M, et al. Human papillomavirus vaccination: recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR Recomm Rep*. 2014;63(RR-05):1-30.
- Meites E, Szilagyi PG, Chesson HW, Unger ER, Romero JR, Markowitz LE. Human papillomavirus vaccination for adults: updated recommendations of the advisory committee on immunization practices. *MMWR Morb Mortal Wkly Rep*. 2019;68(32):698-702.
- Cuzick J, Castanon A, Sasieni P. Predicted impact of vaccination against human papillomavirus 16/18 on cancer incidence and cervical abnormalities in women aged 20-29 in the UK. *Br J Cancer*. 2010;102(5):933-939.
- Hu S, Xu X, Zhang Y, et al. A nationwide post-marketing survey of knowledge, attitude and practice toward human papillomavirus vaccine in general population: Implications for vaccine roll-out in mainland China. *Vaccine*. 2020;39:35-44.
- WHO Immunization, vaccines and biologicals. Data, statistics and graphics. 2020. <https://www.who.int/teams/immunization-vaccines-and-biologicals/data-statistics-and-graphics>
- Li R, Li Y, Radley D, et al. Safety and immunogenicity of a vaccine targeting human papillomavirus types 6, 11, 16 and 18: a randomized, double-blind, placebo-controlled trial in Chinese males and females. *Vaccine*. 2012;30(28):4284-4291.
- Zhang WJ, Li F, Wang YH, et al. The case for semi-mandatory HPV vaccination in China. *Nat Biotechnol*. 2013;31(7):590-591.
- Wang S, Han B, Wan Y, et al. Do male university students know enough about human papillomavirus (HPV) to make informed decisions about vaccination? *Med Sci Monit*. 2020;26:e924840.
- Xue L, Hu W, Zhang H, et al. Awareness of and willingness to be vaccinated by human papillomavirus vaccine among junior middle school students in Jinan, China. *Hum Vaccin Immunother*. 2018;14(2):404-411.
- Ragan KR, Bednarczyk RA, Butler SM, Omer SB. Missed opportunities for catch-up human papillomavirus vaccination among university undergraduates: Identifying health decision-making behaviors and uptake barriers. *Vaccine*. 2018;36(2):331-341.
- Lawn RB, Sallis HM, Wootton RE, et al. The effects of age at menarche and first sexual intercourse on reproductive and behavioural outcomes: a Mendelian randomization study. *PLOS One*. 2020;15(6):e0234488.
- Meites E, Kempe A, Markowitz LE. Use of a 2-dose schedule for human papillomavirus vaccination—updated recommendations of the advisory committee on immunization practices. *MMWR Morb Mortal Wkly Rep*. 2016;65(49):1405-1408.
- Mendez Rojas B, Beogo I, Owili PO, Adesanya O, Chen CY. Community social capital on the timing of sexual debut and teen birth in Nicaragua: a multilevel approach. *BMC Public Health*. 2016;16:991.
- 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 Epidemiol*. 2012;36(4):384-390.
- Tabora N, Zelaya A, Bakkers J, Melchers WJ, Ferrera A. Chlamydia trachomatis and genital human papillomavirus infections in female university students in Honduras. *Am J Trop Med Hyg*. 2005;73(1):50-53.
- Vivancos R, Abubakar I, Hunter PR. Sex, drugs and sexually transmitted infections in British university students. *Int J STD AIDS*. 2008;19(6):370-377.
- Zou H, Wang W, Ma Y, et al. How university students view human papillomavirus (HPV) vaccination: a cross-sectional study in Jinan, China. *Hum Vaccin Immunother*. 2016;12(1):39-46.
- Bettinghaus EP. Health promotion and the knowledge-attitude-behavior continuum. *Prev Med*. 1986;15(5):475-491.
- Si M, Jiang Y, Su X, et al. 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*. 2021;28:1073274 8211032899.
- 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.
- 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.
- 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. *Public Health*. 2017;147:77-83.
- Jing L, Zhong X, Zhong Z, et al. Prevalence of human papillomavirus infection in Guangdong Province, China: a population-based survey of 78,355 women. *Sex Transm Dis*. 2014;41(12):732-738.
- Huang D, Hu Y, Wu G, et al. HIV prevention services and testing utilization behaviors among men who have sex with men at elevated risk for HIV in Chongqing, China. *BioMed Res Int*. 2014;2014:174870.
- Burki T. Sex education in China leaves young vulnerable to infection. *Lancet Infect Dis*. 2016;16(1):26.
- Education EGoS. Sexuality education—what is it? *Sex Educ*. 2016;16(4):427-431.
- 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 Vaccin Immunother*. 2019;15(7-8):1533-1540.
- Xin HN, Li HJ, Li Z, et al. Genital HPV infection among heterosexual and homosexual male attendees of sexually transmitted diseases clinic in Beijing, China. *Epidemiol Infect*. 2017;145(13):2838-2847.

37. Ning YE, Liu Y, Xu XY, Zhang XY, Wang N, Zheng LQ. Knowledge of cervical cancer, human papilloma virus (HPV) and HPV vaccination among women in Northeast China. *J Cancer Educ.* 2020;35(6):1197-1205.
38. Ajzen I. The theory of planned behavior. *Organ Behav Hum Decis Process.* 1991;50(2):179-211.
39. Kepka D, Rutkoski H, Pappas L, et al. US oral health students' willingness to train and administer the HPV vaccine in dental practices. *Prev Med Rep.* 2019;15:100957.
40. Yoo W, Koskan A, Scotch M, Pottinger H, Huh WK, Helitzer D. Patterns and disparities in human papillomavirus (HPV) vaccine uptake for young female adolescents among U.S. states: NIS-Teen (2008-2016). *Cancer Epidemiol Biomarkers Prev.* 2020;29(7):1458-1467.
41. Jones M, Cook R. Intent to receive an HPV vaccine among university men and women and implications for vaccine administration. *J Am Coll Health.* 2008;57(1):23-32.
42. ChinaDaily Inner Mongolia banner to offer free HPV shots. 2020; <https://enapp.chinadaily.com.cn/a/202008/11/AP5f31eea1a3109daf6c775978.htm>
43. Zhang SK, Pan XF, Wang SM, et al. Perceptions and acceptability of HPV vaccination among parents of young adolescents: a multicenter national survey in China. *Vaccine.* 2013;31(32):3244-3249.

How to cite this article: Dai Z, Si M, Su X, et al. Willingness to human papillomavirus (HPV) vaccination and influencing factors among male and female university students in China. *J Med Virol.* 2022;94:2776-2786. doi:10.1002/jmv.27478