

RESEARCH PAPER



HPV vaccine acceptability and willingness-related factors among Chinese adolescents: a nation-wide study

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ABSTRACT

Background: Adolescents are the primary target population for human papillomavirus (HPV) vaccination. The objective of this study is to explore the acceptability of HPV vaccines and evaluate factors related to willingness to be vaccinated among Chinese adolescents.

Methods: A nation-wide survey was conducted across 14 schools in mainland China. The questionnaire consisted of questions relating to socio-demographic characteristics, knowledge of adolescent sexual health, cervical cancer, HPV and HPV-related disease, and students' willingness to be vaccinated. *Chi-square* tests and multivariable logistic regression were conducted in the data analysis.

Results: A total of 4,062 students participated in this study. Among them, only 17.1% of students reported having heard of HPV vaccines; however, 67.3% were willing to receive the HPV vaccine. Multivariable regression analysis showed that students who were from rural areas, have received sexual health education, have heard of cervical cancer or HPV vaccine, have a positive attitude toward vaccination, reported they were at the risk of developing cervical cancer, and those who value their parents' and teachers' opinions were more willing to receive HPV vaccination.

Conclusions: Awareness about the HPV vaccine is low among Chinese adolescents. The factors that most related to willingness to vaccinate among Chinese adolescents were school location, education about vaccination, HPV, and HPV vaccines. Integrating health education on HPV vaccination into existing school-based sexual health curricula may be an effective way to increase HPV vaccination coverage in mainland China.

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Introduction

Cervical cancer is the fourth most common malignancy among women worldwide, and approximately 570,000 new cases and 311,000 deaths are reported every year. Low- and middle-income countries account for 86% of new cases and 88% of deaths from cervical cancer in the world.¹ In mainland China, cervical cancer remains one of the most threatening malignant tumors for women; there were an estimated 106,000 new cases and 47,000 deaths related to cervical cancer in 2018.¹ This high incidence of cervical cancer has been mainly ascribed to the ten-year delay of the introduction of HPV vaccination; while the HPV vaccine was first licensed in most high-income countries in 2006, it was not commercially available in mainland China until the imported bivalent vaccine was launched in July 2016.^{2,3} If efforts are not made to enhance HPV vaccination coverage in mainland China, cervical cancer will remain a significant public health issue in the coming decades.^{4,5}

HPV vaccination is the most efficient approach to preventing cervical cancer, which can be achieved by reducing the frequency of HPV infection, especially in the developing countries and regions where population-based comprehensive nation-wide cervical cancer screenings are not feasible.^{6–8} According to the World Health Organization (WHO), prepubescent girls aged 9–14 years are the primary target group for HPV vaccination.⁹ In China, the primary target populations for HPV vaccination recommended by the WHO are middle school-aged girls. Despite these recommendations, it is difficult to maintain the high HPV vaccine uptake in eligible adolescents in mainland China, as the vaccine is not covered by the national expanded program on immunization (EPI). Because of this, parents/guardians are responsible for paying for at least 800 RMB for each dose. Previous studies have shown that about 75% parents/guardians think that the current price for this vaccine is too high and are therefore unwilling to vaccinate their children.¹⁰

Efforts to scale HPV vaccinations in mainland China not only face issues of accessibility but face various challenges regarding acceptability. The HPV vaccine was introduced to mainland China in 2016, a time when women and college students in China had limited knowledge and awareness of HPV vaccines.^{11,12} Furthermore, vaccine acceptability is also related to knowledge, attitudes, and stigmas in communities where the vaccine is being implemented.^{13,14} Numerous studies to date in China have assessed knowledge and willingness about HPV vaccines among parents and college students.^{11,15,16} However, to date, no studies have examined willingness-related factors for the WHO-recommended primary target population. Research is urgently needed to fill this gap in the literature.

To address this gap, this study aimed to explore the willingness to receive the HPV vaccine and its related factors among Chinese adolescents. Findings in this study may assist in future HPV vaccine-related interventions among adolescents and provide evidence for governmental decision-makers when promoting HPV vaccination across China.

Materials and methods

Study design and participants

This was a nation-wide, questionnaire-based survey conducted across all the seven geographic regions in mainland China from May 2015 to May 2016. Liaoning, Shanxi, Shandong, Guangdong, Hubei, Xinjiang and Sichuan were identified as the provinces to represent each geographic region. In mainland China, each district has both urban and rural areas, which experience great differences in economic activity, education access, medical care, and other areas. Therefore, in this study, one rural middle school and one urban middle school were selected in each district by convenience sampling. Adolescents aged 12–14 years old were selected from each of school and surveyed using a self-administered questionnaire on the HPV-related knowledge and students' willingness for HPV vaccination. Participants eligible for inclusion were junior middle school students aged 12–14 years old who agreed to participate in the study. Participants who did not report gender and/or willingness for vaccination were excluded.

Data collection and quality control

A self-administered questionnaire was developed to survey students in this study. This questionnaire was used and tested in previous studies enrolling different populations based on expert opinion.^{9,10,14} Specifically, the questionnaire included the following items: 1) socio-demographic information, including age, gender, race, region, and school type (urban or rural); 2) perception of adolescent sexual health (“Have you received adolescent sexual health education before the survey?”, “How well do you know about adolescent sexual health?”); 3) perception of vaccination (“Whose opinion do you value most about vaccination?”, “Do you think prevention is better than treatment?”, “Do you think that vaccination can effectively prevent diseases?”, “Do you think that vaccines are useless?”, “Do you think that vaccination is

only required after getting sick?”); 4) knowledge of HPV, HPV-related disease, and HPV vaccine (“Have you ever heard of cervical cancer?”, “Do you perceive a risk of developing cervical cancer or other HPV-related cancers?”, “Have you ever heard of HPV?”, “Have you ever heard of HPV vaccines?”); and 5) willingness for HPV vaccination (“Are you willing to vaccinate yourself?”). (Supplementary file 1)

In each region, data were collected and input independently by two data input personnel using EpiData (EpiData Association, Odense, Denmark). Any inconsistency between the two databases was adjusted based on the paper questionnaires until a consensus was reached. Logic errors (e.g., a student who responded as not having heard of HPV vaccines chose that they knew HPV vaccine could prevent cervical cancer) were double-checked and revised. After consistency checks, the consistency database was transferred to the Beijing Research Center for final analyses.

Ethical considerations

This study was approved by the Ethical Review Committee (ERC) of the West China School of Public Health, Sichuan University. The students were informed of the study objectives and questionnaire subjects before the survey. Verbal informed consent was obtained from each participant, and written informed consent was acquired from their parents before the survey was administered.

Statistical analyses

Analyses of the socio-demographic characteristics, knowledge and perception of adolescent sexual health, HPV, HPV-related disease, and HPV vaccines among adolescents were conducted using description analysis based on case counts and percentages. Differences between female and male students, as well as between urban and rural school students, were assessed using the *Chi*-square test. A univariate logistic regression was employed to analyze the associations of potential factors with the willingness to be vaccinated against HPV. Variables with $P < .1$ were incorporated into the multivariable logistic regression model. A stepwise forwards approach was used in the multivariable logistic regression model. Odds ratios (ORs) with corresponding 95% confidence intervals (CIs) were calculated and reported based on the Wald *Chi*-square statistics. The SPSS 20.0 software (IBM Corp, Armonk, New York) was utilized for all statistical analyses. The missing data were excluded from the final analysis. Statistical significance was assessed by two-tailed tests with an α level of 0.05.

Results

Participants' characteristics

A total of 5,300 students were approached, and 5,024 (94.8%) participated in and completed the questionnaire. Of these participants, 77 were excluded due to lack of gender information, 634 were excluded because they did not report their willingness for vaccination, and 251 were excluded because they were either under the age of 12 or over the age of 15. In total,

Table 1. Demographic characteristics of study participants (n = 4,062).

Variable	Number	Percentage (%)
Gender		
Male	2,126	52.3
Female	1,936	47.7
Ethnic group		
Han	3,953	97.3
Others	109	2.7
School type		
Urban school	2,074	51.1
Rural school	1,988	48.9
Survey year		
2015	2,185	53.8
2016	1,877	46.2
Regions		
Liaoning	376	9.3
Shanxi	736	18.1
Shandong	365	9.0
Guangdong	417	10.3
Hubei	814	20.0
Xinjiang	377	9.3
Sichuan	977	24.1

4,062 students aged 13.00 ± 0.53 years were enrolled in the final analysis, including 2,126 (52.3%) male and 1,936 (47.7%) female students. The majority (97.3%) of participants were identified as being ethnic Han Chinese. Half (48.9%) of the enrolled students were from the rural middle schools (Table 1).

Knowledge and perceptions of adolescent sexual health education and vaccines

As shown in Table 2, 60.7% of the recruited adolescents reported having received adolescent sexual health education before the survey. Among them, 39.7% thought that they knew well or very well about adolescent sexual health knowledge, and 73.8% agreed that prevention was better than treatment for

diseases. Half (51.0%) of the students believed that vaccination effectively prevented disease. Among the participants, 1.6% thought that vaccines were useless, and 2.7% thought that vaccines were needed only after getting sick. When it came to vaccinations, 79.2% of adolescents reported that they would listen to their parents' opinion. Females and students from urban schools reported a higher knowledge level of adolescent sexual health knowledge than males and students from rural schools.

Knowledge and attitudes toward HPV, HPV-related disease, and HPV vaccines

Table 3 summarizes the knowledge and attitude toward HPV, HPV-related disease, and HPV vaccines among Chinese adolescents. Among students who responded to the questionnaire, one-third (32.8%) reported that they had heard of cervical cancer, and 68.2% did not perceive a risk of developing cervical cancer or other HPV-related cancers. Furthermore, only 12.9% and 17.1% of the enrolled students reported having heard of HPV and HPV vaccines before the survey, respectively. Although most students reported not having heard of HPV vaccines, 67.3% of them were still willing to be vaccinated.

When analyzing the results from a gender perspective, female students showed significantly higher knowledge levels of cervical cancer (42.4% vs. 24.1%, $p < .001$), HPV (14.7% vs. 11.3%, $p = .002$), and HPV vaccines (18.5% vs. 15.9%, $p = .031$) when compared with males. Additionally, 52.9% female students perceived a risk of developing cervical cancer or other HPV-related cancers, while only 12.8% ($p < .001$) of male students perceived such a risk. Similarly, female students were more willing to be vaccinated than their male peers

Table 2. Knowledge and perceived of adolescent sexual health and vaccination among Chinese adolescents by gender and school types.

Items	All n (%)	Gender		P	School types		P
		Female n (%)	Male n (%)		Urban school n (%)	Rural school n (%)	
Received adolescent sexual health education*							
No	1,592 (39.3)	684 (35.4)	908 (42.8)	<.001	754 (36.5)	838 (42.2)	<.001
Yes	2,460 (60.7)	1,247 (64.6)	1,213 (57.2)		1,313 (63.5)	1,147 (57.8)	
How well do you know about adolescent sexual health? *							
None	389 (9.7)	138 (7.2)	251 (11.9)	<.001	194 (9.4)	195 (9.9)	<.001
A little	2,037 (50.6)	933 (48.6)	1,104 (52.4)		947 (46.0)	1,090 (55.4)	
Well	1,338 (33.2)	737 (38.4)	601 (28.6)		759 (36.9)	579 (29.4)	
Very well	262 (6.5)	113 (5.9)	149 (7.1)		158 (7.7)	104 (5.3)	
Prevention is better than treatment							
No	1,064 (26.2)	521 (26.9)	543 (25.5)	.321	518 (25.0)	546 (27.5)	.071
Yes	2,998 (73.8)	1,415 (73.1)	1,583 (74.5)		1,556 (75.0)	1,442 (72.5)	
Vaccination can effectively prevent diseases							
No	1,989 (49.0)	928 (47.9)	1,061 (49.9)	.209	970 (46.8)	1,019 (51.3)	.004
Yes	2,073 (51.0)	1,008 (52.1)	1,065 (50.1)		1,104 (53.2)	969 (48.7)	
Vaccine is useless							
No	3,995 (98.4)	1,914 (98.9)	2,081 (97.9)	.014	2,045 (98.6)	1,950 (98.1)	.199
Yes	67 (1.6)	22 (1.1)	45 (2.1)		29 (1.4)	38 (1.9)	
Vaccination is only required after getting sick							
No	3,952 (97.3)	1,902 (98.2)	2,050 (96.4)	<.001	2,043 (98.5)	1,909 (96.0)	<.001
Yes	110 (2.7)	34 (1.8)	76 (3.6)		31 (1.5)	79 (4.0)	
Whose opinion do you value most about vaccination? *							
Myself	479 (12.9)	171 (9.6)	308 (15.9)	<.001	262 (13.8)	217 (11.9)	<.001
Parents	2,951 (79.2)	1,504 (84.2)	1,447 (74.6)		1,525 (80.3)	1,426 (78.1)	
Teachers	295 (7.9)	111 (6.2)	184 (9.5)		112 (5.9)	183 (10.0)	

HPV, human papillomavirus.

* The total number do not add up to 4,062 due to missing data.

Table 3. Knowledge and attitude toward HPV, HPV-related diseases, and HPV vaccines among Chinese adolescents by gender and school types.

Items	All n (%)	Gender		P	School types		P
		Female n (%)	Male n (%)		Urban school n (%)	Rural school n (%)	
Have you ever heard of cervical cancer? *							
No	2,717 (67.2)	1,113 (57.6)	1,604 (75.9)	<.001	1,358 (65.8)	1,359 (68.6)	.061
Yes	1,329 (32.8)	820 (42.4)	509 (24.1)		706 (34.2)	623 (31.4)	
Do you perceive a risk of developing cervical cancer or other HPV-related cancers? *							
No	2,556 (68.2)	839 (47.1)	1,717 (87.2)	<.001	1,362 (70.6)	1,194 (65.5)	.001
Yes	1,194 (31.8)	942 (52.9)	252 (12.8)		566 (29.4)	628 (34.5)	
Have you ever heard of HPV? *							
No	3,507 (87.1)	1,638 (85.3)	1,869 (88.7)	.002	1,769 (85.9)	1,738 (88.3)	.026
Yes	521 (12.9)	282 (14.7)	239 (11.3)		290 (14.1)	231 (11.7)	
Have you ever heard of the HPV vaccines? *							
No	3,313 (82.9)	1,555 (81.5)	1,758 (84.1)	.031	1,676 (82.0)	1,637 (83.8)	.126
Yes	684 (17.1)	352 (18.5)	332 (15.9)		368 (18.0)	316 (16.2)	
Are you willing to vaccinate yourself?							
No	1,329 (32.7)	530 (27.4)	799 (37.6)	<.001	718 (34.6)	611 (30.7)	.008
Yes	2,733 (67.3)	1,406 (72.6)	1,327 (62.4)		1,356 (65.4)	1,377 (69.3)	

HPV, human papillomavirus.

* The total number do not add up to 4,062 due to missing data.

(72.6% vs. 62.4%, $p < .001$). When analyzing the results from a geographic perspective, urban middle school students exhibited higher knowledge levels of HPV (14.1% vs. 11.7%, $p = .026$) compared with the rural middle school students. However, students from rural areas were more worried about the risk of developing cervical cancer or other HPV-related cancers (34.5% vs. 29.4%, $p = .001$) and were more willing to receive HPV vaccination than those from urban areas (69.3% vs. 65.4%, $p = .008$).

Factors related to the willingness for HPV vaccination

As shown in Table 4, nine variables were significantly associated with the willingness to receive HPV vaccination, as suggested by multivariable logistic regression analysis. Students from rural areas were more willing to receive HPV vaccines (AOR: 1.19, 95% CI: 1.02–1.39, $p = .027$) than the urban youths. Also, students who received sexual education or knowledge before the survey were more likely to receive HPV vaccination (AOR: 1.35, 95% CI: 1.15–1.58, $p < .001$). In addition, students who believed that prevention was better than treatment (AOR: 1.45, 95% CI: 1.22–1.72, $p < .001$) or thought that vaccinations effectively prevent disease (AOR: 1.37, 95% CI: 1.17–1.60, $p < .001$) were more willing to receive an HPV vaccine. Students who valued the opinions of their parents and teachers were more likely to be vaccinated against HPV (AOR: 1.41, 95% CI: 1.12–1.76, $p = .003$ and AOR: 1.54, 95% CI: 1.08–2.17, $p = .016$). Students who reported having heard of cervical cancer (AOR: 1.33, 95% CI: 1.12–1.58, $p = .001$) and HPV vaccines (AOR: 1.35, 95% CI: 1.08–1.68, $p = .008$) were more willing to receive HPV vaccination. Students who perceived a risk of developing cervical cancer or other HPV-related cancers were more also likely to accept HPV vaccination (AOR: 2.04, 95% CI: 1.70–2.44, $p < .001$). Six other factors, including gender, race, heard of HPV, adolescent sexual health knowledge level, vaccination being only required after getting sick, and believing vaccines are useless, were excluded from the multivariable logistic regression model.

Discussion

This is the first nation-wide study to measure the awareness and knowledge of HPV and HPV vaccines and to explore HPV vaccine willingness-related factors among Chinese adolescents. In this study, only 17.1% female students reported having heard of HPV vaccines, which was consistent with the results from a meta-analysis that included 58 observational studies in China.¹⁷ However, studies conducted in Malaysia showed that awareness of HPV vaccines among school girls was 77.6%.¹⁴ The lower awareness and poorer knowledge levels observed in our study among Chinese adolescents may be associated with several factors. Firstly, HPV vaccines were not available in mainland China at the time this study was conducted. Secondly, Chinese society is still very socially conservative; thus, sexual health education is often scant or omitted entirely.^{18–20}

In this study, we found that most students indicated that they had heard of neither HPV nor HPV vaccines before, nor had they heard of cervical cancer. However, 67.3% students reported a willingness to get vaccinated against HPV, which was similar to the findings from other studies.^{21,22} This high vaccination willingness rate could be explained through the fact that most students had experience with other vaccines and believed that vaccines can help prevent diseases; thusly, they were willing to receive an HPV vaccine even though they lacked knowledge about HPV (Table 2).

Female adolescents showed higher knowledge levels regarding HPV vaccines and were more willing to vaccinate themselves than were male adolescents, which is in line with previous surveys conducted in both in China and abroad.^{23–25} This is mainly because HPV vaccines are extensively recognized as “cervical cancer vaccines” in mainland China. As a result, most males do not perceive a risk of developing cervical cancer or other HPV-related cancers.

Adolescents from urban areas showed significantly higher knowledge levels regarding HPV, HPV-related disease, and HPV vaccines than did those from rural areas. These findings were consistent with other studies that have reported that girls

Table 4. Factors associated with willingness to be vaccinated with HPV vaccines among Chinese adolescents.

Variables	Number of subjects in analysis	Willing to vaccinate N (%)	OR (95%CI)	P	AOR (95%CI)	P
Gender						
Male	2,126	1,327 (62.4)	Ref			
Female	1,936	1,406 (72.6)	1.60 (1.40–1.82)	<.001		
School type						
Urban school	2,074	1,356 (65.4)	Ref		Ref	
Rural school	1,988	1,377 (69.3)	1.19 (1.05–1.36)	.008	1.19 (1.02–1.39)	.027
Survey year						
2015	2,185	1,473 (67.4)	Ref			
2016	1,877	1,260 (67.1)	0.99 (0.87–1.13)	.847		
Regions						
Liaoning	376	193 (51.3)	Ref		Ref	
Shanxi	736	426 (57.9)	1.30 (1.02–1.67)	<.001	1.31 (1.00–1.71)	.049
Shandong	365	237 (64.9)	1.76 (1.31–2.36)	<.001	1.68 (1.21–2.33)	.002
Guangdong	417	281 (67.4)	1.96 (1.47–2.61)	<.001	1.84 (1.35–2.51)	<.001
Hubei	814	555 (68.2)	2.03 (1.58–2.61)	<.001	2.83 (2.08–3.83)	<.001
Xinjiang	377	283 (75.1)	2.86 (2.10–3.89)	<.001	2.69 (1.93–3.75)	<.001
Sichuan	977	758 (77.6)	3.28 (2.55–4.22)	<.001	3.06 (2.33–4.03)	<.001
Received sexual education/knowledge						
No	1,592	980 (61.6)	Ref		Ref	
Yes	2,460	1,747 (71.0)	1.53 (1.34–1.75)	<.001	1.35 (1.15–1.58)	<.001
Missing	10					
How well do you know about adolescent sexual health?						
None	389	224 (57.6)	Ref			
A little	2,037	1,339 (65.7)	1.41 (1.13–1.76)	.002		
Well	1,338	960 (71.7)	1.87 (1.48–2.36)	<.001		
Very well	262	193 (73.7)	2.06 (1.47–2.90)	<.001		
Missing	36					
Prevention is better than treatment						
No	1,064	650 (61.1)	Ref		Ref	
Yes	2,998	2,083 (69.5)	1.45 (1.25–1.68)	<.001	1.45 (1.22–1.72)	<.001
Vaccination can effectively prevent diseases						
No	1,989	1,246 (62.6)	Ref		Ref	
Yes	2,073	1,487 (71.7)	1.51 (1.33–1.73)	<.001	1.37 (1.17–1.60)	<.001
Vaccine is useless						
No	3,995	2,701 (67.6)	Ref			
Yes	67	32 (47.8)	0.44 (0.27–0.71)	.001		
Vaccination is only required after getting sick						
No	3,952	2,670 (67.6)	Ref			
Yes	110	63 (57.3)	0.64 (0.44–0.95)	.024		
Whose opinion do you value most about vaccination?						
Myself	479	282 (58.9)	Ref		Ref	
Parents	2,951	2,018 (68.4)	1.51 (1.24–1.84)	<.001	1.41 (1.12–1.76)	.003
Teachers	295	212 (71.9)	1.78 (1.31–2.44)	<.001	1.54 (1.08–2.17)	.016
Missing	337					
Have you ever heard of the cervical cancer?						
No	2,717	1,716 (63.2)	Ref		Ref	
Yes	1,329	1,006 (75.7)	1.82 (1.57–2.11)	<.001	1.33 (1.12–1.58)	.001
Missing	16					
Do you perceive a risk of developing cervical cancer or other HPV-related cancers?						
No	2,556	1,600 (62.6)	Ref		Ref	
Yes	1,194	955 (80.0)	2.39 (2.03–2.81)	<.001	2.04 (1.70–2.44)	<.001
Missing	312					
Have you ever heard of the HPV?						
No	3,507	2,314 (66.0)	Ref			
Yes	521	399 (76.6)	1.69 (1.36–2.09)	<.001		
Missing	34					
Have you ever heard of the HPV vaccines?						
No	3,313	2,169 (65.5)	Ref		Ref	
Yes	684	525 (76.8)	1.74 (1.44–2.11)	<.001	1.35 (1.08–1.68)	.008
Missing	65					

All factors in the table were variables with $P < 0.10$ in univariate logistic regression models. A total of 3,365 participants were enrolled into multivariable analysis. OR, odds ratio; AOR, adjusted odds ratio; 95%CI, 95% confidence interval; HPV, human papillomavirus.

Adjusted OR, adjusted odds ratio using multivariable logistic regression model, and six factors (gender, race, heard of HPV, adolescent sexual health knowledge level, vaccination is only required after getting sick, vaccine is useless) were excluded from this multivariable logistic regression model.

who lived in urban settings had higher levels of HPV vaccine awareness relative to students in rural areas.²⁶ However, rural adolescents seemed more likely to accept HPV vaccines, which is consistent with a previous study conducted among Chinese

adult females,¹² but is opposed to findings from other studies among adolescents.²¹ One possible reason for this may be that rural students are more concerned about the risk of developing cervical cancer or other HPV-related cancers (Table 3).

Students in urban settings also have more chances to receive high-quality education, and more opportunities (Internet, TV, and school) to access HPV vaccines, so it may be possible that they pay more attention to the safety and effectiveness of the vaccine.^{27,28} Last but not least, the significant results may be attributed to the large sample size included in this study, as a result, it is easier to get significant results.

A lack of HPV-related knowledge is considered one of the prime barriers to improving HPV vaccine acceptability.^{23,29,30} As was shown in a previous study conducted in Hong Kong, higher HPV-related knowledge levels and more positive attitudes toward HPV vaccination are the important factors predicting vaccine uptake and intention to recommend vaccination.³¹ In the present study, the following knowledge-related factors were found to be associated with HPV vaccine willingness: having heard of cervical cancer, having heard of HPV vaccines, and having a perception of risk for developing HPV-related cancer. These results are consistent with prior studies conducted in a range of countries and settings, where HPV-related education was found to be useful in increasing HPV vaccine acceptability.³²⁻³⁴ This evidence suggests that health-care providers and community members, including both parents and school teachers, should be aware of the need to effectively communicate with young adolescents about HPV infection and HPV vaccines as they approach the age of vaccination.

We found that receiving adolescent sexual health education and having a better understanding of vaccination had a positive impact on an individual's willingness to take the HPV vaccine. As HPV is also a sexually transmitted infection, school-based health education on HPV and HPV vaccines can also be integrated into existing adolescent sexual health education curricula.³⁵ The data from this study clearly show that parents and teachers play an important role in decision-making to vaccinate against HPV; therefore, education targeting parents and school teachers is also urgently needed.

This study benefited from a large sample size from representative cities in all seven geographic regions in mainland China. However, some limitations should also be noted. First, participants were recruited by convenience sampling, which might result in a certain level of selection bias. Second, all schools in this study were middle schools, so the results may not be generalizable to out-of-school youths. Third, not all questions were answered, and missing data were not included in the analysis; thus, some findings should be interpreted with caution. Fourth, price is a critical factor affecting the willingness for vaccination, as parents must pay for the vaccine, and we did not cover this topic in this study. Last, self-reported willingness to receive the HPV vaccine may not indicate that the participants ultimately did receive the vaccine if they were provided the opportunity.

Conclusions

In sum, awareness and knowledge levels of HPV and the HPV vaccine are low among Chinese adolescents, but willingness to vaccinate against HPV is relatively high. School location and

education about vaccination, HPV, and HPV vaccines are the factors that most significantly relate to the willingness to vaccinate among Chinese adolescents. Integrating health education on HPV vaccines into existing school-based sexual health curricula could be an effective way to increase the HPV vaccination coverage in mainland China.

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Disclosure of potential conflicts of interest

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Authorship

Jing Li, Xi Zhang and Youlin Qiao were responsible for study designed and designed the questionnaire; Jing Li has been involved in every aspect of the work, has drafted the first version and was in charge of every version round. Xi Zhang performed the data analysis and interpretation. Zengzhen Wang, Zefang Ren, Zhifang Li, Wei Ma, Xiaohong Gao, and Rong Zhang participated in the study design, data management and collection work. All authors read and approved the final manuscript.

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