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A New Strategy for Cervical Cancer Prevention Among Chinese Women: How Much Do They Know and How Do They React Toward the HPV Immunization?

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Abstract
In 2017, HPV vaccines were first marketed in China. We carried out an investigation among parents of high school students to assess parents' knowledge of cervical cancer and human papillomavirus (HPV)/HPV vaccines, along with their acceptance of HPV vaccination and the factors that influence it, all of which are essential for targeted education regarding HPV vaccination. A cross-sectional study was conducted among parents of high school students in East China using a pretested questionnaire. Data regarding knowledge of cervical cancer, HPV, HPV vaccines, and acceptance of the vaccines were collected and analyzed. In total, 1,200 questionnaires were distributed, with 1,125 valid responses. Overall, 87.5% of respondents knew that cervical cancer is one of the most common genital system cancers; 78.67% knew that HPV causes cervical cancer; 69.2% knew that HPV is primarily transmitted through sex; 54.3% knew that HPV vaccines exist; and 35.6% knew the optimal age for HPV vaccination. Only 4.4% had vaccinated their daughters for HPV, and 35.4% were willing to do so. Reasons for refusal primarily concerned the vaccines' safety (77.4%) and efficacy (61.5%). Multivariate analyses showed that parents who had obtained pneumococcal conjugate vaccines for their daughters showed higher acceptance of HPV vaccines, as well as higher knowledge of cervical cancer, the association of HPV and cervical cancer, and the main transmission route of HPV. Although parents' knowledge level regarding cervical cancer was moderate, it was very low regarding HPV and HPV vaccines. Teenagers' HPV vaccine uptake and parents' willingness to vaccinate their children was also quite low. Educational interventions and awareness campaigns are needed to ensure the success of HPV immunization programs in East China.

Keywords Acceptance · Cervical cancer · HPV · HPV knowledge · HPV vaccine · Parents

Introduction

The human papillomavirus (HPV) is one of the most prevalent sexually transmitted infections in the world. Approximately 70–80% of sexually active women become infected with at least one strain of HPV during their lifetime [1, 2], and the virus is responsible for 99.7% of cases of cervical cancer [3] and 530,000 new cases of cervical cancer globally every year [4]. Over 270,000 women die of cervical cancer worldwide annually, and over 85% of these deaths occur in low- and middle-income countries [5].

China is the largest low- and middle-income country in the world, and the National Office for Cancer Prevention and Control estimates that the age-standardized incidence rate and mortality rate by world standard population of cervical cancer in China were 10.6 per 100,000 women and 3.0 per 100, 000 women, while in East China they were 10.5 per 100,000 women, 2.7 per 100, 000 women, in 2014[6]. That means 102,000 new cervical cancer cases in the country annually, which is almost 20% of new cases of cervical cancer globally, and almost 31,000 women die as a result of disease progression [6]. However, these figures likely underestimate the true incidence of the disease, as a result of low levels of both coverage and screening [7].

The development of vaccines that provide protection against HPV represents a major step toward reducing cervical cancer rates. There are three types of HPV vaccine, the bivalent Cervarix, the quadrivalent Gardasil, and the nonavalent Gardasil-9, which cover different kinds of HPV subtypes and different age groups, from

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9 to 45 years of age [8]. Since 2006, many countries have implemented HPV vaccination programs in attempts to reduce the burden of HPV-associated diseases. Evaluation of HPV vaccination coverage in adolescent girls worldwide showed that vaccination strategies differ, consequently affecting vaccination coverage, ranging from several percent to more than 90% (such as Peru, UK, and Sweden) [9]. In Australia and the UK, girls are routinely offered free HPV vaccination [10].

In 2016, Mainland China approved Cervarix for girls aged 9 to 25 years, Gardasil for women aged 20 to 45 years in 2017, and Gardasil-9 for women aged 16 to 26 years in 2018 [11]. However, these vaccines are not yet covered by the National Immunization Program and are currently much more expensive than other vaccines. Parents are the primary decision-makers regarding obtaining HPV vaccination for their child. In this situation, the success and benefit of the control and prevention of cervical cancer largely depend on parents' levels of awareness and knowledge of the different aspects of the disease and the vaccine. Also, studies have shown that parents who had a positive attitude toward vaccine are more likely to vaccinate their children [12, 13].

Studies on parents' awareness of HPV and their attitudes toward HPV vaccination for their daughters have been performed in many countries [14–19]. In China, despite the numerous published studies focusing on the topic of HPV and vaccination in recent years [20], only a limited number of studies have been conducted among parents in regard to their awareness and knowledge of HPV and HPV vaccines and whether they would like to vaccinate their daughters [21, 22]. A study in Shandong Province showed that only 19.3% of mothers were aware of HPV, while just 26.5% of mothers stated they would approve of their daughters receiving the HPV vaccine [21]. Meanwhile, in Yunnan Province, in Southwest China, 26.5% of women were aware of the association between HPV and a risk of cervical cancer, and 82.7% of women were willing to vaccinate their daughters [22]. However, to the best of our knowledge, no such research has been conducted in Zhejiang, East China; further, no study has assessed knowledge of cervical cancer and HPV and acceptance of HPV vaccines among parents in China following the introduction of the vaccine in 2017.

Considering the above, this study aimed to examine parents of high school girls in East China in regard to their awareness and knowledge of HPV and HPV vaccines and whether they would like to vaccinate their daughters. The results of this study may help guide the design and improvement of interventions and campaigns to sensitize women to HPV infection and vaccination, which would consequently help to reduce the incidence of cervical cancer.

Materials and Methods

Sample Size and Questionnaire

Estimating 50% cervical cancer awareness with 10% allowable error, a nonresponse rate of 20%, and a 95% confidence interval (CI), we determined that a sample of 600 parents was required for our research. However, in order to facilitate subgroup comparisons, the total sample size was doubled, resulting in a final figure of 1,200.

The questionnaire was designed by Zhejiang Provincial Center for Disease Control and Prevention. Later a pilot study was conducted to check the reliability. The questionnaire was modified after feedback from the pilot study, and two rounds of Delphi method collaboration in which face validity was checked by subject matter experts and literatures were reviewed to assess content validity. The questionnaire had 17 questions. It collected sociodemographic data; knowledge regarding cervical cancer, HPV, and HPV vaccines; acceptance of HPV vaccines; and attitude toward the sexual behavior of the respondents' daughters during high school. Questions about knowledge of cervical cancer were the following: (1) "Is cervical cancer one of the most common genital system cancers among women worldwide?" (2) "Do you agree that prevention of cervical cancer does not just concern older women?" (3) "Do you think HPV causes cervical cancer?" Questions about awareness and knowledge of HPV and HPV vaccines were the following: (1) "Is HPV primarily transmitted among humans through sex?" (2) "Are you aware that there are vaccines for cervical cancer?" (3) "Do you know the optimal age for HPV vaccination?" Questions about behavior and attitude toward HPV vaccine and sex were the following: (1) "Have your children received HPV vaccination?" (2) "Would you approve of your children receiving HPV vaccination?" (3) "What is your attitude toward your children having sex during their high school years, and what would you do if they did?"

The paper-based blank questionnaires were taken home by students and were returned by the students once the parents had completed them. The data from the questionnaire were processed anonymously by assigning random codes to each respondent.

Recruitment

All high schools in Zhejiang were eligible for the study. Zhejiang, in the eastern part of China, is one of the smallest provincial-level political units, but it is also one of the most densely populated and affluent. From May to June 2018, 12 junior high schools and 12 senior high schools were randomly

selected. All schools were public school. Six junior high schools and senior high schools were from rural area, while the others were from urban area. In each school, 50 parents of female students were randomly recruited for the study. High school students in China are usually aged 12–18 years.

The study was approved by the ethics committee at Zhejiang Center for Disease Control and Prevention. Informed consent was obtained from all participants before their information was collected. Each participant received one school bag for their participation.

Statistical Analysis

Data were entered into EpiData 3.03 (EpiData Association) and were analyzed using the Statistical Package for the Social Sciences (SPSS), version 19.0 (IBM Corporation, Armonk, New York, USA). Standard descriptive statistics were used for continuous and categorical variables. Univariate and multivariate logistic regression analyses were conducted to explore the association between sociodemographic variables and variables regarding knowledge of cervical cancer, HPV and HPV vaccines, etc. Odds ratios with 95% confidence intervals were used to express measures of the associations. P values of $< .05$ were considered to represent significance (two-sided).

Results

Respondents' Characteristics

A total of 1,200 questionnaires were distributed; of these, we received 1,125 valid responses, which were used in the final analysis. The response rate was 93.8%.

The median age of the parents of adolescent school girls was 42 (range = 27–58), and the mean age of them was 42.1 ± 4.6 years. The proportion of participants who were under 40, 40–50, and 51–60 years was 29.3%, 63.5%, and 7.2%, respectively; 13.0% were male, and 87.0% were female; 51.8% were parents of junior high school students, and 48.2% were senior high school students' parents. Half of the participants had primary-level education or lower, 26.8% had secondary education, and 22.3% had postsecondary education; 13.5% worked in government institutions, 46.5% worked in businesses or service industries, and 40.0% were retired, stay-at-home mothers, stay-at-home fathers, or unemployed. Three-quarters were local residents, one-quarter were migrants from other counties of China, and 44.5% had previously acquired a pneumococcal conjugate vaccine (PCV) for their children. Sociodemographic characteristic of parents of adolescent school girls are presented in Table 1.

Knowledge of Cervical Cancer and HPV-Related Information

Table 2 shows that, of 1,125 parents, 87.5% were aware that cervical cancer is one of the most common genital system cancers among women worldwide, 47.1% agreed that prevention of cervical cancer did not just concern older women, 89.1% knew that HPV causes cervical cancer, and 69.2% knew that HPV is primarily transmitted through sex. Further, 54.3% of the respondents were aware that there are vaccines available for HPV; 35.6% knew the optimal age for HPV vaccination; 4.4% had administered an HPV vaccine to their children, and only 35.4% of respondents were willing to receive an HPV vaccine for their children. Regarding sex behavior, 96.3% indicated that they would object to and warn their children against having sex, 0.3% indicated that they would do nothing, and only 3.5% indicated that they would accept their children's sexual behavior and teach them how to protect themselves during sex.

Reasons for Refusal to Give HPV Vaccination to Daughters

Table 3 shows that, of the 727 participants who were not willing to vaccinate their daughters for HPV, 77.4% were afraid of the side effects of the HPV vaccine, 61.549% doubted the effectiveness of the HPV vaccine, 7.0% felt that their children were too young to have cervical cancer, 2.9% felt that the HPV vaccine was too expensive, 1.7% considered it too time-consuming, and 5.1% expressed other reasons.

Association Between Sociodemographic Variables and Knowledge of Cervical Cancer, HPV, and HPV Vaccines

After controlling for other sociodemographic variables, we found the following associations between sociodemographic variables and knowledge of cervical cancer, HPV, and HPV vaccines.

Table 4 shows that mothers (OR 1.6, 95%CI 1.1–2.3), respondents with an annual household income of more than 200,000 Renminbi (OR 1.5, 95%CI 1.1–2.2), respondents who obtained PCV for their daughters (OR 1.4, 95%CI 1.2–1.8), and respondents whose daughters attended senior high school (OR 1.3, 95%CI 1.2–1.7) were more likely to know that prevention of cervical cancer does not just concern older women. Further, respondents who obtained PCV for their daughters (OR 1.5, 95%CI 1.1–2.2) and those whose daughters attended senior high school (OR 1.8, 95%CI 1.2–2.7) were more likely to know that HPV causes cervical cancer.

Table 5 shows that participants with postsecondary education (OR 3.2, 95%CI 2.0–5.7) and those who obtained PCV for their daughters (OR 1.8, 95%CI 1.4–2.4) were more likely to know the main transmission route of HPV. Further, mothers

Table 1 Respondents' sociodemographic characteristics in the survey from May to June 2018 in Zhejiang Province ($N = 1125$)

Characteristic	*N* (%)
Gender	
Male	146(13.0)
Female	979(87.0)
Age (years)	
< 40	330(29.3)
40–50	714(63.5)
50–60	81(7.2)
Mean	42.1 ± 4.6
Education level	
Primary or lower (< 9 years)	572(50.8)
Secondary (9–12 years)	302(26.8)
Postsecondary (> 12 years)	251(22.3)
Occupation	
Government institution	152(13.5)
Business or service industry	523(46.5)
Others (stay-at-home mother/stay-at-home father/retired/unemployed, etc.)	450(40.0)
Annual household income (Renminbi)	
< 100,000	626(55.6)
100,000–200,000	339(30.1)
> 200,000	160(14.2)
Immigration status	
Resident	882(78.4)
Migrant from other counties of China	243(21.6)
Pneumococcal conjugate vaccine for daughter	
Yes	501(44.5)
No	624(55.5)
Daughter's school level	
Junior high school	583(51.8)
Senior high school	542(48.2)

(OR 2.3, 95%CI 1.6–3.3), respondents with postsecondary (OR 2.6, 95%CI 1.8–3.8) or secondary education (OR 2.0, 95%CI 1.5–2.7), and respondents with an annual household salary of more than 200,000 Renminbi (OR 1.7, 95%CI 1.1–2.5) or between 100,000 Renminbi and 200,000 Renminbi (OR 1.5, 95%CI 1.1–2.0) were more likely to know there are vaccines for cervical cancer. Mothers (OR 1.7, 95%CI 1.1–2.5), respondents with postsecondary (OR 1.5, 95%CI 1.1–2.1) or secondary education (OR 1.4, 95%CI 1.0–1.9), respondents with an annual household income of less than 200,000 Renminbi (OR 1.5, 95%CI 1.1–2.0), and those whose daughter attended senior high school (OR 3.3, 95%CI 2.5–4.4) were more likely to know the optimal age for HPV vaccination.

Table 6 shows that respondents whose daughters had received PCV (OR 2.0, 95%CI 1.0–3.9) and those whose daughters attended senior high school (OR 2.2, 95%CI 1.0–

Table 2 Knowledge of cervical cancer, HPV, and HPV vaccines among participants of survey from May to June 2018 in Zhejiang Province

Variables	Total, *n* (%) ($n = 1125$)
Is cervical cancer one of the most common genital system cancers among women worldwide?	
Yes	984(87.5)
No	141(12.5)
Do you agree that prevention of cervical cancer does not just concern older women?	
Yes	530(47.1)
No	595(52.9)
Do you think HPV causes cervical cancer?	
Yes	885(78.7)
No	240(21.3)
Is HPV primarily transmitted among humans through sex?	
Yes	779(69.2)
No	346(30.8)
What is your attitude toward your children having sex during their high school years, and what would you do if they did?	
Object and warn them against having sex	1083(96.3)
Do nothing	3(0.3)
Accept their behavior, and teach them how to protect themselves during sex	39(3.5)
Are you aware that there are vaccines for cervical cancer?	
Yes	611(54.3)
No	514(45.7)
Do you know the optimal age for HPV vaccination?	
Yes	400(35.6)
No	725(64.4)
Have your children received HPV vaccination?	
Yes	50(4.4)
No	1075(95.6)
Would you approve of your children receiving HPV vaccination?	
Yes	398(35.4)
No	727(64.6)

Table 3 Parents' main reasons for unwillingness to vaccinate their daughters for HPV in the survey from May to June 2018, Zhejiang Province

Reasons	Total, *n* (%) ($n = 727$)
Fear of the side effects of the HPV vaccine	563(77.4)
Doubts of the effectiveness of the HPV vaccine	447(61.5)
My daughter is too young to have cervical cancer	51(7.0)
High cost of the HPV vaccine	21(2.9)
Too time-consuming	12(1.7)
Other reasons[a]	37(5.1)

[a] This is an open question. Answers may include my daughter would not get HPV, most people around me have not vaccinated their daughters, etc.

Table 4 Unadjusted and adjusted[a] odds ratios and 95% confidence intervals, in terms of sociodemographic variables, regarding respondents' knowledge of cervical cancer in survey from May to June 2018 in Zhejiang Province

Predictors	Knowledge of cervical cancer											
	Is cervical cancer one of the most common genital system cancers among women worldwide?				Do you agree that prevention of cervical cancer does not just concern older women?				Do you think HPV causes cervical cancer?			
	OR(95%CI)	*P*	AOR(95%CI)	*P*	OR(95%CI)	*P*	AOR(95%CI)	*P*	OR(95%CI)	*P*	AOR(95%CI)	*P*
Gender												
Male	1		1		1		1		1		1	
Female	0.8(0.5,1.5)	0.5	0.8(0.5,1.4)	0.5	1.5(1.1,2.2)	0.0	1.5(1.1,2.3)	0.0	1.3(0.7,2.1)	0.4	1.2(0.7,2.1)	0.5
Age (years)												
< 40	1		1		1		1		1		1	
40–50	1.2(0.8,1.7)	0.4	1.1(0.7,1.6)	0.8	1.1(0.8,1.4)	0.7	1.0(0.7,1.3)	0.9	1.1(0.7,1.6)	0.8	0.8(0.5,1.3)	0.5
50–60	1.0(0.5,2.0)	1.0	0.8(0.4,1.8)	0.6	0.8(0.5,1.2)	0.3	0.8(0.5,1.4)	0.4	0.9(0.4,1.9)	0.8	0.7(0.3,1.6)	0.4
Education level												
Primary or lower (< 9 years)	1		1		1		1		1		1	
Secondary (9–12 years)	0.9(0.6,1.3)	0.5	0.9(0.6,1.3)	0.5	1.2(0.9,1.6)	0.2	1.1(0.9,1.5)	0.4	1.1(0.7,1.8)	0.6	1.1(0.7,1.6)	0.7
Postsecondary (> 12 years)	0.8(0.5,1.3)	0.3	0.8(0.5,1.4)	0.5	1.6(1.2,2.2)	0.0	1.4(1.0,2.0)	0.1	1.3(0.8,2.2)	0.3	1.1(0.6,2.1)	0.7
Occupation												
Government institution	1		1		1		1		1		1	
Business or service industry	1.1(0.7,1.9)	0.7	1.1(0.6,1.9)	0.9	0.9(0.6,1.3)	0.6	1.1(0.7,1.6)	0.8	0.7(0.3,1.3)	0.2	0.7(0.3,1.4)	0.3
Others (retired/stay-at-home mother/stay-at-home father/unemployed, etc.)	1.2(0.7,2.0)	0.6	1.1(0.6,2.1)	0.8	0.6(0.4,0.9)	0.0	0.8(0.5,1.2)	0.3	0.7(0.3,1.3)	0.2	0.8(0.3,1.7)	0.5
Annual household income (Renminbi)												
< 100,000	1		1		1		1		1		1	
100,000–200,000	1.0(0.7,1.5)	1.0	1.1(0.7,1.6)	0.7	1.4(1.1,1.8)	0.0	1.2(0.9,1.6)	0.3	1.2(0.8,1.8)	0.4	1.0(0.7,1.6)	0.8
> 200,000	1.1(0.6,1.8)	0.8	1.2(0.7,2.1)	0.5	1.8(1.2,2.5)	0.0	1.5(1.1,2.2)	0.0	1.5(0.8,2.9)	0.2	1.4(0.7,2.7)	0.3
Immigration status												
Resident	1		1		1		1		1		1	
Migrant from other counties of China	0.9(0.6,1.3)	0.6	0.9(0.6,1.3)	0.5	0.9(0.7,1.2)	0.4	0.9(0.7,1.3)	0.6	0.7(0.5,1.1)	0.1	0.7(0.5,1.1)	0.2
Pneumococcal conjugate vaccine for daughter												
No	1		1		1		1		1		1	
Yes	0.9(0.6,1.3)	0.6	0.9(0.6,1.3)	0.7	1.4(1.1,1.8)	0.0	1.4(1.2,1.8)	0.0	1.5(1.0,2.1)	0.1	1.5(1.1,2.2)	0.0
Daughter's school level												
Junior high school	1		1		1		1		1		1	
Senior high school	1.2(0.9,1.7)	0.3	1.2(0.8,1.8)	0.4	1.3(1.0,1.6)	0.1	1.3(1.2,1.7)	0.0	1.6(1.1,2.4)	0.0	1.8(1.1,2.7)	0.0

[a] Multivariate logistic regression, adjusted for the other factors shown in the table; *AOR* adjusted odds ratio; *OR* odds ratio; *95%CI* 95% confidence interval

4.6) were more likely to have positive attitudes toward their daughters having sex during their high school years. Further, respondents who did not work in government institutions were less likely to obtain an HPV vaccine for their daughters; meanwhile, respondents who were business or service industry staff (OR 0.4, 95%CI 0.2–0.9) and who were retired (OR 0.3, 95%CI 0.1–0.8) were less likely to obtain an HPV vaccine for their daughters, compared to staff in government institutions. Finally, respondents whose daughters had received a PCV had higher acceptance of HPV vaccines (OR 1.4, 95%CI 1.1–1.8), while those whose daughters attended senior high school had lower acceptance of HPV vaccines than did those whose daughters attended junior high school (OR 0.7, 95%CI 0.5–0.9).

Discussion

Our study found that our respondents' (all of whom were parents of high school girls) level of general knowledge

Table 5 Unadjusted and adjusted[a] odds ratios and 95% confidence intervals, in terms of sociodemographic variables, regarding respondents' knowledge of HPV and HPV vaccines in survey from May to June 2018 in Zhejiang Province

Predictors	Knowledge of HPV and HPV vaccines											
	Is HPV primary transmitted among humans through sex?				Are you aware that there are vaccines for cervical cancer?				Do you know the optimal age for HPV vaccination?			
	OR(95%CI)	*P*	AOR(95%CI)	*P*	OR(95%CI)	*P*	AOR(95%CI)	*P*	OR(95%CI)	*P*	AOR(95%CI)	*P*
Gender												
Male	1		1		1		1		1		1	
Female	1.3(0.9,1.9)	0.2	1.4(0.9,2.1)	0.1	2.0(1.4,2.9)	0.0	2.3(1.6,3.3)	0.0	1.8(1.2,2.7)	0.0	1.7(1.1,2.5)	0.0
Age (years)												
< 40	1		1		1		1		1		1	
40–50	1.1(0.8,1.4)	0.6	1.0(0.8,1.4)	0.8	0.9(0.7,1.2)	0.5	1.0(0.7,1.3)	0.8	1.2(0.9,1.5)	0.3	0.9(0.5,1.2)	0.1
50–60	1.4(0.8,2.3)	0.3	1.7(0.9,3.0)	0.1	0.7(0.4,1.1)	0.1	0.9(0.5,1.6)	0.8	1.3(0.8,2.1)	0.4	0.7(0.4,1.2)	0.2
Education level												
Primary or lower (< 9 years)	1		1		1		1		1		1	
Secondary (9–12 years)	1.3(1.0, 1.8)	0.1	1.3(0.9,1.7)	0.1	2.1(1.6,2.8)	0.0	2.0(1.5,2.7)	0.0	1.2(0.9,1.7)	0.1	1.4(1.0,1.9)	0.0
Postsecondary (> 12 years)	2.8(2.0,4.1)	0.0	3.2(2.0,5.7)	0.0	3.0(2.2,4.1)	0.0	2.6(1.8,3.8)	0.0	1.2(0.91.6)	0.3	1.5(1.1,2.1)	0.0
Occupation												
Government institution	1		1		1		1		1		1	
Business or service industry	0.9(0.6,1.4)	0.7	1.6(0.9,2.7)	0.1	0.6(0.4,0.9)	0.0	0.9(0.6,1.4)	0.8	0.9(0.7,1.4)	0.8	1.0(0.7,1.6)	0.9
Others (retired/stay-at-home mother/stay-at-home father/unemployed, etc.)	0.6(0.4,0.9)	0.0	1.3(0.8,2.3)	0.3	0.4(0.3,0.7)	0.0	0.7(0.5,1.2)	0.2	1.0(0.7,1.5)	1.0	1.2(0.7,1.9)	0.5
Annual household income (Renminbi)												
< 100,000	1		1		1		1		1		1	
100,000–200,000	1.6(1.2,2.2	0.0	1.2(0.9,1.7)	0.2	2.0(1.5,2.6)	0.0	1.5(1.12.0)	0.0	1.6(1.2,2.1)	0.0	1.2(0.8,1.8)	0.3
> 200,000	1.5(1.0,2.2)	0.0	1.1(0.7,1.6)	0.2	2.3(1.6,3.4)	0.0	1.7(1.1,2.5)	0.0	1.3(0.9,1.8)	0.2	1.5(1.1,2.0)	0.0
Immigration status												
Resident	1		1		1		1		1		1	
Migrant from other counties of China	0.8(0.6,1.1)	0.3	0.9(0.7,1.3)	0.6	0.8(0.6,1.1)	0.3	1.0(0.7,1.3)	0.8	0.9(0.7,1.2)	0.5	1.0(0.7,1.3)	0.9
Pneumococcal conjugate vaccine for daughter												
No	1		1		1		1		1		1	
Yes	1.8(1.4,2.4)	0.0	1.8(1.4,2.4)	0.0	1.3(1.1,1.7)	0.0	1.2(0.9,1.6)	0.1	0.8(0.7,1.1)	0.2	0.8(0.7,1.1)	0.2
Daughter's school level												
Junior high school	1		1		1		1		1		1	
Senior high school	1.2(0.9,1.6)	0.1	1.3(0.9,1.7	0.1	1.0(0.8,1.2)	0.8	1.0(0.8,1.3)	0.9	2.9(2.2,3.7)	0.0	3.3(2.5,4.4)	0.0

[a] Multivariate logistic regression, adjusted for the other factors shown in the table; *AOR* adjusted odds ratio; *OR* odds ratio; *95%CI* 95% confidence interval

regarding cervical cancer and HPV was moderate. However, their level of in-depth knowledge concerning HPV and HPV vaccines was low. Approximately 80% of the parents knew that cervical cancer is one of the most common genital system cancers and that HPV causes cervical cancer. This is much higher than results reported in other studies conducted in China [19, 21, 22]. For example, a previous study conducted in Shandong Province reported that only 48.9% of women were aware of HPV's role in causing cervical cancer [21]. There are two possible explanations for the high percentage observed in our study. First, our respondents had a higher education level than did the other studies' participants. In our study, 49.1% of the respondents had secondary-level education or higher, in contrast to just 39.8% of the respondents in the study conducted in Shandong. Second, the previous studies were conducted before HPV vaccines were marketed in China and before the creation of health education programs for cervical cancer. Only half of the parents in our study knew that HPV vaccines existed, and just one-third knew the optimal age for HPV vaccination. Further, over 30% of the parents

Table 6 Unadjusted and adjusted[a] odds ratios and 95% confidence intervals, in terms of sociodemographic variables, of respondents' attitude toward HPV vaccine and sex behavior in survey from May to June 2018 in Zhejiang Province

Predictors	Behavior and attitude toward HPV vaccine and sex											
	What is your attitude toward your children having sex during their high school years, and what would you do if they did?				Have your children received HPV vaccination?				Would you approve of your children receiving HPV vaccination?			
	OR(95%CI)	*P*	AOR(95%CI)	*P*	OR(95%CI)	*P*	AOR(95%CI)	*P*	OR(95%CI)	*P*	AOR(95%CI)	*P*
Gender												
Male	1		1		1		1		1		1	
Female	0.7(0.3,1.6)	0.3	0.7(0.3,1.6)	0.4	1.1(0.5,2.6)	0.8	1.2(0.5,2.8)	0.7	0.9(0.6,1.3)	0.7	1.0(0.7,1.5)	1.0
Age (years)												
< 40	1		1		1		1		1		1	
40–50	1.4(0.7,3.0)	0.4	0.9(0.4,2.3)	1.0	1.2(0.6,2.2)	0.6	1.2(0.6,2.3)	0.7	1.5(1.2,1.2)	0.0	1.1(0.8,1.5)	0.6
50–60	1.4(0.4,5.2)	0.6	1.1(0.3,4.8)	0.9	0.3(0.0,2.2)	0.2	0.3(0.0,2.6)	0.3	0.7(0.6,0.9)	0.0	0.7(0.4,1.3)	0.3
Education level												
Primary or lower (< 9 years)	1		1		1		1		1		1	
Secondary (9–12 years)	1.2(0.5,2.7)	0.7	1.1(0.5,2.5)	0.8	1.4(0.7,2.7)	0.4	1.2(0.6,2.4)	0.6	1.2(0.9,1.6)	0.3	1.0(0.8,1.4)	0.8
Postsecondary (> 12 years)	1.9(0.9,4.0)	0.1	1.6(0.7,4.1)	0.3	1.6(0.8,3.1)	0.2	0.8(0.3,1.9)	0.6	1.8(1.3,2.4)	0.0	1.3(0.9,1.9)	0.1
Occupation												
Government institution	1		1		1		1		1		1	
Business or service industry	0.7(0.3,1.7)	0.4	0.8(0.3,2.0)	0.6	0.5(0.2,0.9)	0.0	0.4(0.2,0.9)	0.0	0.8(0.5,1.1)	0.2	0.9(0.6,1.4)	0.7
Others (retired/stay-at-home mother/stay-at-home father/unemployed, etc.)	0.5(0.2,1.1)	0.1	0.6(0.2,1.8)	0.3	0.3(0.2,0.8)	0.0	0.3(0.1,0.8)	0.0	0.5(0.4,0.8)	0.0	0.7(0.4,1.1)	0.1
Annual household income (Renminbi)												
< 100,000	1		1		1		1		1		1	
100,000–200,000	0.9(0.4,1.9)	0.8	0.7(0.3,1.5)	0.3	1.2(0.6,2.3)	0.6	1.0(0.5,2.0)	0.9	1.3(0.9,1.7)	0.1	1.2(0.9,1.6)	0.3
> 200,000	1.1(0.4,2.7)	0.9	0.8(0.3,2.0)	0.6	1.4(0.7,3.1)	0.4	1.2(0.5,2.7)	0.7	1.6(1.1,2.2)	0.0	1.3(0.9,1.9)	0.2
Immigration status												
Resident	1		1		1		1		1		1	
Migrant from other counties of China	1.4(0.7,3.0)	0.3	1.7(0.8,3.5)	0.2	1.2(0.6,2.2)	0.7	1.3(0.6,2.5)	0.5	0.9(0.6,1.2)	0.3	0.9(0.6,1.2)	0.4
Pneumococcal conjugate vaccine for daughter												
No	1		1		1		1		1		1	
Yes	2.0(1.1,3.9)	0.0	2.0(1.0,3.9)	0.0	1.4(0.8,2.4)	0.3	1.3(0.7,2.3)	0.4	1.5(1.2,1.9)	0.0	1.4(1.1,1.8)	0.0
Daughter's school level												
Junior high school	1		1		1		1		1		1	
Senior high school	2.0(1.0,3.8)	0.0	2.2(1.0,4.6)	0.0	0.9(0.5,1.6)	0.8	0.9(0.5,1.7)	0.8	0.7(0.6,0.9)	0.0	0.7(0.5,0.9)	0.0

[a] Multivariate logistic regression, adjusted for the other factors shown in the table; *AOR* adjusted odds ratio; *OR* odds ratio; *95%CI* 95% confidence interval

did not know that HPV is primarily transmitted through sex; although this percentage is higher than that reported in previous studies in China [21, 22], it is lower than the results of an international study involving respondents from the USA, the UK, and Australia [10]. Such low levels of knowledge reflect a lack of relevant education, and studies have shown that parents with higher levels of knowledge about HPV are more likely to vaccinate their children [12, 13, 15, 23]. Since HPV vaccines have only recently been licensed and marketed in China, to ensure successful HPV vaccination programs, strengthening health education regarding HPV and HPV vaccines is necessary.

In our study, we found that only 35.38% of parents were willing to vaccinate their daughters for HPV. This conforms with the findings of a multicenter national survey conducted across China (36.2%) [19] and those of the abovementioned

study in Shandong Province (26.5%) [21]. However, this percentage is much lower than those reported in other countries [14, 15, 23–25]; for example, studies in Indonesia and Bangladesh revealed that over 90% of women would accept HPV vaccine for their daughters, respectively [23, 24]. Our respondents' main reasons for refusal were doubts of the effectiveness (61.5%) and safety (77.4%) of the vaccines. Reports of adverse vaccine events are common in China, which might explain the negative attitude toward HPV vaccines [26–28]. Another China-based study also found parents' doubts about vaccine safety to be the primary reason for refusal of vaccination (67.9%) [19]. Moreover, studies in other countries have also reported that parents have significant concerns regarding vaccines' safety and efficacy [25, 29]. HPV vaccines have recently been introduced, and experience of their use is limited. Acceptance of HPV vaccines may change considerably if girls and parents are supplied with evidence-based information regarding these important issues. Notably, one study found that if vaccines are recommended by health professionals and are supported by government, uptake can increase considerably [14].

Interestingly, we found that parents who had obtained PCV for their daughters expressed a higher acceptance of HPV vaccines. PCV is a vaccine against disease caused by the bacterium *Streptococcus pneumoniae* (the pneumococcus). PCV is imported and is expensive. Families who can afford to obtain PCV for their daughters would also be likely to be able to afford HPV vaccination, which may explain these parents' higher willingness to obtain HPV vaccination. Our finding suggests that parents who have already vaccinated their daughters with the PCV vaccine could be an important target population when HPV immunization programs are implemented.

In general, we found that parents with higher education or higher family income tended to have higher knowledge regarding vaccination. This accords with the results of studies from China and other countries [14, 21–24]. In particular, parents who worked in government institutions were more likely to vaccinate their daughters; this might be due to information and resource allocation imparity. For example, government officials have a higher chance of learning of the latest information about HPV vaccines and would consequently make appointments earlier. Furthermore, parents of senior high school students tended to know more about cervical cancer and HPV and HPV vaccines. This might be because parents develop a higher concern about sexually transmitted diseases when their daughters reach a sexually active age. However, our study found that their willingness to source the HPV vaccine for their daughters was lower than that of parents of junior high school students (OR 0.7, 95%CI 0.5–0.9). As a result of the structure of our study design, we cannot give an appropriate explanation for this difference. Further research is needed to confirm this finding and explore the reason for this phenomenon.

This study has some limitations. First, to expediently obtain an understanding of parents' level of knowledge about HPV and HPV vaccines, we keep the questionnaire short, which limited the depth of the study. Second, the results of our study should be interpreted with caution given that the format, wording, and sequence of the questions may have biased responses. Third, the self-reported nature of the survey may lead to potential bias that may affect study results.

Conclusion

In conclusion, although our respondents' knowledge level regarding cervical cancer was moderate, it was very low in regard to HPV and HPV vaccines. The HPV vaccination coverage of the study sample's children was quite low, and parents' willingness to vaccinate their daughters was also unsatisfactory. The parents' main concerns were the safety and efficacy of HPV vaccines. Additionally, we found that parents who had obtained PCV for their daughters expressed a higher willingness to vaccinate their daughters for HPV. They also had higher knowledge regarding cervical cancer and HPV and HPV vaccines. These findings suggest that education programs concerning HPV vaccines should target this more open population. Our findings underscore the necessity and urgency of providing evidence-based information regarding HPV vaccines (especially concerning their safety and efficacy) and of promoting understanding of cervical cancer and HPV among both parents and teenagers.

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Compliance with Ethical Standards

Conflicts of Interest The authors declare that they have no conflict(s) of interest.

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