RESEARCH ARTICLE

Human Papillomavirus Vaccine Awareness, Acceptability, and Decision-Making Factors among Chinese College Students

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Abstract

Background: College students are recommended as the target groups for catch-up human papillomavirus (HPV) vaccination. Systematical exploration of awareness, acceptability, and decision-making factors of HPV vaccination among Chinese college students has been limited. Materials and Methods: A multi-center survey was conducted in mainland China between November 2011 and May 2012. College students aged 18-22 years were stratified by their grade, gender, and major for sampling. Socio-demographic and HPV-related information such as knowledge, perceptions, acceptability, and attitudes were collected through a questionnaire. Results: A total of 3,497 undergraduates completed the questionnaire, among which 1,686 were males. The acceptability of the HPV vaccine was high (70.8%). Undergraduates from high-level universities, at lower grade, or with greater prior knowledge of HPV vaccines showed higher acceptability of HPV vaccination (p_{trend} <0.001). Additionally, undergraduates with vaccination experience outside the National Expanded Program on Immunization (OR=1.29; 95%CI: 1.10-1.51) or fear of HPV-related diseases (OR=2.79; 95%CI: 2.28-3.41) were more willing to accept HPV vaccination. General knowledge of HPV vaccine was low among undergraduates, and safety was a major concern (71.05%). The majority of students wished to pay less than 300RMB for HPV vaccine and chose the Chinese Center for Disease Control and Prevention as the most appropriate venue for vaccination. Conclusions: Although most undergraduates demonstrate positive attitudes towards HPV vaccination, challenges pertaining to introduction exist in China. Corresponding proactive education and governmental subsidy to do so are urgently needed by this age-group population. Suggestions and potential strategies indicated may help shape the future HPV vaccination program in China.

Keywords: HPV vaccine - acceptability - attitude - knowledge - Chinese undergraduate

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Introduction

Cervical cancer is the fourth most common gynecological malignancy in women in the world, with approximately 528, 000 new cases and 266, 000 deaths in 2012 (Ferlay, 2013). As the most populous country, China accounts for 11.7% and 11.3% of global annual incidence and mortality respectively, indicating the burden of cervical cancer is high within the population. Fortunately, prophylactic human papillomavirus (HPV) vaccines have become available and have been approved for the primary prevention of cervical cancer in over 100 countries. Current data demonstrate that these vaccines help effectively prevent cervical cancer/penile cancer and in some cases genital warts (Garland et al., 2007; Harper, 2008). In particular, clinical data show that HPV vaccines are particularly efficacious in girls when administered prior to their initiation of sexual activity (WHO, 2009).

A recent multicenter survey found that the average age of sexual debut, defined in this study as initiation of sexual intercourse, was 17 years old among Chinese girls (Zhao et al., 2012a), which suggests that students in junior high school (ages 13-15) might be the target population for HPV vaccination. Accordingly, students in the college-

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level schooling (ages 16-23) are the high-risk population for HPV infection and may be qualified as the catch-up group for HPV vaccination. Consistently, the World Health Organization recommends older adolescent females or young women as targeted catch-up vaccination groups (WHO, 2009).

The acceptability of the HPV vaccine has been explored in elder Chinese women and parents of adolescents (Li et al., 2009; Zhao et al., 2012b; Zhang et al., 2013), but systematic studies regarding knowledge and acceptability of HPV vaccine among potential catch-up groups, i.e., college students are still lacking. A further barrier is the potential difficulty to promote a national vaccination program against sexual transmitted diseases among college students in a conservative country such as China. Possible obstacles and decision-making factors for HPV vaccination implementation should thus be examined ahead of anticipated government-funded vaccination initiatives.

Therefore, we conducted a multi-center survey to investigate the acceptability of HPV vaccine among Chinese college students, expose potential obstacles towards and decision-making factors for the implementation of the HPV vaccine, and explore appropriate measures to address potential obstacles. This study could provide suggestions for future strategies of more effective HPV vaccine implementation in China.

Materials and Methods

Study design and population

This study was a multi-center, cross-sectional, stratified survey conducted between November of 2011 and May of 2012. Due to cultural and socioeconomic diversity in China, four-stage sampling was used to identify seven cities representing seven different geographic regions including Northern, Northwestern, Northeastern, Central, Southern, Southwestern and Southeastern China. Most identified cities were the capital of a province in each of the 7 regions. The Chinese Ministry of Education classifies Chinese universities into "high-level university, " which ranks amongst the top 112 universities in China, and "low-level university" which doesn't rank amongst the top 112 universities. In each city, a "high-level university" and a "low-level university" were selected by the convenience sampling. Students in each university (17-23 years old) were stratified by grade, gender, and major for sampling. Stratified sampling was used to achieve relatively similar sample sizes between freshmen and the students of higher years, males and females, and students majoring in liberal arts and science.

Measures

Our questionnaire was adapted from those used in different populations based on epidemiological expert's suggestions. (Li et al., 2009; Zhao et al., 2012b) It consisted of questions pertaining to the participant's knowledge of HPV, cervical cancer, genital warts, and HPV vaccines, and attitude towards sex. A brief introduction of the efficacy of HPV vaccine were given on the questionnaire before the following question were asked, including perceptions of HPV vaccination, reasons for acceptability and obstacles to acceptability of HPV vaccine. These questions were collected from prompted lists which were adopt from experts' suggestion, and were optimized by pilot studies.

Data collection and quality control

An investigator meeting was held before the study, and local interviewers were trained regarding how to administer a questionnaire by the principal investigator. The survey was administrated before or after classroom study in each university. Before enrollment, study objectives and questionnaire matters were explained to students and those who consented to the survey were invited to complete the self-administrated questionnaire. Students were arranged to sit at a certain distance from each other to avoid inter-individual influence. Information was recorded anonymously in order to encourage honest responses. Most of the questions were prompted. Questions regarding administration of the questionnaire were answered appropriately by trained interviewers during the survey and queries regarding correct answers to questionnaire questions were responded to after the survey. The study was approved by the Institutional Review Board of the Cancer Institute of Chinese Academy of Medical Sciences (CICAMS).

Deidentified survey data were independently entered twice in local databases developed by CICAMS using EpiData (EpiData Association, Odense, Denmark). Completed databases were transferred to CICAMS for validation, and inconsistencies were reported to the related site for amendments based upon original answers in questionnaires. The databases were finalized and locked for analysis when complete consensus was reached.

Statistical analysis

Knowledge regarding HPV and vaccinations, perceptions, and acceptability of HPV vaccination were computed simply by numbers and percentage. Differences between subgroups were tested using the Chi-square test. Association between potential predictor variables and vaccination acceptability was analyzed by Logistic regression, and odds ratios (ORs) with 95% confidence intervals (CIs) were calculated based on Wald Chi-square statistics. SAS 9.2 was used to analyze data. Statistical significance was assessed by two-tailed tests with α level of 0.05.

Results

Profile of college students

A total of 3, 497 students were surveyed between November, 2011 and May, 2012. Approximately 3.7% of those students who received the invitation refused to participate due to time consuming. Among these students, 1686 were males (Table 1). Most respondents (94.5%) were Han Chinese, from high-level university (68.32%), and with a mean age of 19.82±1.31 years old (yrs). First-year students accounted for 61.7%, and students of liberal arts and sciences totaled approximately equal numbers (47.86% *vs* 52.14%). Although the age of the initiation

of sexual intercourse was comparable among both sexes (18.15 *vs* 18.58 yrs), more male students reported having a prior sexual intercourse experience (15.81% *vs* 4.08%, $p<0.001$). Also, more students in higher grades reported having a prior sexual intercourse experience as compared with that of freshmen (14.72% *vs* 6.61%, $p<0.001$). Students majoring in liberal arts showed a higher percentage of sexual activity than those in science curricula (11.04% *vs* 8.49%, $p=0.01$). Regarding attitudes towards sexual activity, fifteen percent of all students demonstrated a positive attitude towards premarital sex, and males were more likely to support premarital sex (24.56% *vs* 6.87%, $p<0.001$). Conversely, 23.52% of students had negative attitudes towards premarital sex (males *vs* females: 13.52% *vs* 32.72%).

Knowledge and acceptability of HPV vaccination

Via questionnaire responses, only 14.3% of undergraduates had heard of HPV. 70.6% had heard of cervical cancer and/or genital warts. Only 8.1% of undergraduates had heard of HPV vaccines. Overall, 26.4% responded with "No," to all three questions, while 4.5% answered "Yes" to all three. Major sources of HPV-related knowledge were public lectures, public service announcements, and medical consultations.

Seventy percent of undergraduates expressed an accepting attitude towards HPV vaccination. Women were more positive about receiving a vaccine than men (73.2% *vs* 68.3%, $p=0.001$), and first-year students were more positive than students of higher grades (74.52% *vs* 64.72%, $p<0.001$). Many undergraduate students (81.3%) considered HPV vaccination as a social responsibility for both genders in order to prevent HPV-associated diseases. Accordingly, 73% would like to encourage their sexual partners to be vaccinated.

Significant reasons for the acceptability of HPV vaccination were as follows: expectation of self or partner benefit (74.2%), fear of future HPV infections (54.5%), fear of potential HPV-associated disease (50.5%), and benefit for others (45.5%). Obstacles to HPV vaccination included concern about the safety of vaccines (71.8%), current limited use of the vaccine (40.5%), lack of understanding the risk for cervical cancer/ anal cancer/ genital warts due to HPV infection (35.7%), concern about efficacy of vaccines (31.4%), and suspicion of manufactory of HPV vaccine (30.6%). Surprisingly, only 13.3% would oppose the vaccination program in respect to the potentially unaffordable price (Table 2).

Attitudes towards future HPV vaccination were also explored among undergraduates. We found that 47.1% of students supported HPV vaccination considering its good efficacy, and 49.6% expressed a positive attitude towards government-provided subsidies to national vaccination. 24.2% were neutral to future national HPV vaccination but showed concern of an unaffordable price, and 28.1% were neutral but requested further information regarding long-term effects and side effects of the vaccine (Table 2).

Perceptions of HPV vaccination

Nearly half of undergraduates (48.4%) did not know that it is beneficial be vaccinated before the initiation of sexual activity. Consistently, 55.9% did not think that individuals under 18 years of age should receive the vaccination. Approximately 60% chose "high school" or "university" as the most suitable school-stage for vaccination. Additionally, the Chinese Center for Disease Control and Prevention (Chinese CDC) was selected as the most appropriate institution for HPV vaccination (61.15%). Regarding who should be preferably vaccinated, options cited most were promiscuous people (64%), people with poor hygiene (52%), sexually active people (50%), people with a family history of HPV-related diseases (46.3%), and people with abnormal gynecological/andrological results (33.9%). Although foreign drugs were usually more expensive than domestic drugs, the students expressed no desire for differential pricing for domestic and foreign vaccines on the basis of comparable efficacy. However, 7% of students set 1, 000RMB as their affordable upper limit for vaccination. The remaining students opted to pay

Table 1. Profile of College Students (N=3497)

Characteristics		Male (%) n=1686	Female (%) n=1811	Total (%) N=3497	*p* value
Race (Han)		1604 (95.48)	1691 (93.58)	3295 (94.49)	0.01
Age (years)		19.91±1.33	19.74±1.28	19.82±1.31	>0.05
Sexual maturity (years, mean±SD)		14.36±1.89	13.45±1.42	13.84±1.70	<0.001
Age of sexual debut (years, mean±SD)		18.15±2.33	18.58±2.11	18.25±2.28	>0.05
Sexual behavior (Yes)		257 (15.81)	72 (4.08)	329 (9.71)	<0.001
Grade	Freshmen	731 (43.46)	834 (46.07)	1565 (44.82)	0.02
	Sophomore	289 (17.18)	301 (16.63)	590 (16.90)	
	Junior	650 (38.64)	673 (37.18)	1323 (37.89)	
	Senior	12 (0.71)	2 (0.11)	14 (0.40)	
Major	Liberal arts	715 (42.64)	951 (52.72)	1666 (47.86)	<0.001
	Science	962 (57.36)	853 (47.28)	1815 (52.14)	
University category	High-level university	1167 (69.22)	1222 (67.48)	2389 (68.32)	>0.05
	Low-level university	452 (26.81)	521 (28.77)	973 (27.82)	
	Other	67 (3.97)	68 (3.75)	135 (3.86)	
Attitude to premarital sexual behavior	Support	405 (24.56)	123 (6.87)	528 (15.35)	<0.001
	Oppose	223 (13.52)	586 (32.72)	809 (23.52)	
	Neutral	778 (47.18)	782 (43.66)	1560 (45.35)	
	Unknown	243 (14.74)	300 (50.13)	543 (15.78)	

less than 100RMB (40%), or 300RMB (34%) for HPV vaccine (Table 3).

Factors associated with HPV vaccination among undergraduates

Four variables were significantly associated with acceptability of HPV vaccination in multivariate regression analysis (Table 4). Undergraduates at lower grade (p_{trend}<0.001), or from high-level universities were more willing to accept HPV vaccination. Undergraduates with vaccination experience (such as the flu vaccine) outside the National Expanded Program on Immunization

Table 2. Acceptability of HPV Vaccination among College Students

Item	Frequency	Percent
Acceptability of HPV vaccination for himself/herself (Yes)	2460	70.83
Acceptability of HPV vaccination for partner (Yes)	2538	72.97
Reasons for willing to be vaccinated (Multiple)		
Self or partner benefit	1876	74.15
Benefit for others	1150	45.45
Fear of cervical cancer/genital warts	1278	50.51
Fear of future potential HPV infection	1380	54.55
Fear of being infected	289	11.42
Reasons for not allowing yourself or partner to be vaccinated (Multiple)		
Believe in low self-risk of cervical cancer/anal cancer/genital warts	274	35.72
Limited use to date in China	311	40.55
Doubt of the safety of vaccine	551	71.84
Doubt of efficacy of vaccine	241	31.42
Doubt of manufacturer of vaccine	235	30.64
High price of vaccine	102	13.30
Others	47	6.13
Attitude towards future HPV vaccination in China		
Favor, expecting HPV vaccine can effectively prevent HPV-related diseases	1627	47.08
Favor, in the hope of governmental subsidy and price regulation	1715	49.64
Neutral, but the price will be too high to afford	836	24.19
Neutral, requesting further evaluation for long-term effects and side effects of the vaccine	972	28.13
Oppose, HPV vaccine may lead to promiscuity	80	2.31
Others	37	1.07

Table 3. Perceptions of HPV Vaccination among College Students in China

	Male (%) n=1686	Female (%) n=1811	Total (%) N=3497	*p* value
Responsibility for vaccination				
Male	117 (7.04)	74 (4.11)	191 (5.52)	<0.001
Female	74 (4.45)	60 (3.33)	134 (3.87)	
Both	1290 (77.57)	1524 (84.67)	2814 (81.26)	
unknown	182 (10.94)	142 (7.89)	324 (9.36)	
Best time for HPV vaccination				
Before sexual debut	798 (47.96)	794 (44.21)	1592 (46.01)	0.009
After sexual debut	104 (6.25)	90 (5.01)	194 (5.61)	
Unknown	762 (45.79)	912 (50.78)	1674 (48.38)	
Most appropriate Venue for HPV vaccination				
Center for Disease Prevention and Control	923 (57.01)	1155 (64.92)	2078 (61.15)	<0.001
Maternal and Child Health Hospital	75 (4.63)	104 (5.85)	179 (5.27)	
General Hospitals	174 (10.75)	178 (10.01)	352 (10.36)	
Schools	89 (5.50)	32 (1.80)	121 (3.56)	
Community health service centers/local clinics	100 (6.18)	92 (5.17)	192 (5.65)	
Any health institution	110 (6.79)	126 (7.08)	236 (6.95)	
Unknown	148 (9.14)	92 (5.17)	240 (7.06)	
Affordable price for foreign HPV vaccine (RMB)				
Under 100 (US $, <16.4)	760 (45.65)	603 (33.52)	1363 (39.35)	<0.001
100-300 (US $, 16.4-49.2)	527 (31.65)	669 (37.19)	1196 (34.53)	
300-500 (US $, 49.2-81.9)	166 (9.97)	282 (15.68)	448 (12.93)	
500-1000 (US $, 81.9-163.8)	104 (6.25)	142 (7.89)	246 (7.10)	
Above 1000 (US $, >163.8)	108 (6.48)	103 (5.73)	211 (6.08)	
Affordable price for domestic HPV vaccine (RMB)				
Under 100 (US $, <16.4)	751 (45.24)	651 (36.27)	1402 (40.58)	<0.001
100-300 (US $, 16.4-49.2)	513 (30.90)	692 (38.55)	1205 (34.88)	
300-500 (US $, 49.2-81.9)	208 (12.53)	257 (14.32)	465 (13.46)	
500-1000 (US $, 81.9-163.8)	97 (5.84)	132 (7.35)	229 (6.63)	
Above 1000 (US $, >163.8)	91 (5.48)	63 (3.51)	154 (4.46)	

Table 4. Logistic Regression Analysis of Acceptability of HPV Vaccination among College Students

	No. of subjects in analysis	Willing to vaccinate N (%)	OR (95%CI)
Gender			
Male	1591	1088 (68.4%)	1
Female	1735	1266 (73.0)	0.96 (0.81-1.13)
Age (yrs)			
≤18	546	403 (73.8)	1
>18	2780	1951 (70.2)	0.98 (0.77-1.25)
Grade			
Freshman	1493	1099 (73.6)	1
Sophomore	552	425 (77.0)	1.14 (0.88-1.47)
Junior	1268	823 (64.9)	0.67 (0.56-0.81)
Senior	13	7 (53.8)	0.54 (0.17-1.66)
			p_{trend} <0.001
Major			
Liberal art	1587	1117 (70.4)	1
Science	1739	1237 (71.1)	0.99 (0.85-1.17)
Type of university			
High-level university	2287	1634 (71.4)	1
Low-level university	911	632 (69.4)	0.77 (0.64-0.92)
Others	128	88 (68.8)	0.78 (0.52-1.17)
Experience outside EPI (such as flu vaccine)			
No	1847	1251 (67.7)	1
Yes	1479	1103 (74.6)	1.29 (1.10-1.51)
Fear of cervical cancer/ anal cancer/ genital warts			
No	1153	700 (60.7)	1
Unknown	1036	721 (69.6)	1.57 (1.31-1.89)
Yes	1137	933 (82.1)	2.79 (2.28-3.41)
Prior consultation regarding HPV vaccine information			
Yes	146	113 (77.4)	1
No	3180	2241 (70.5)	0.72 (0.47-1.12)
Sexual behavior			
No	3004	2143 (71.3)	1
Yes	322	211 (65.5)	0.79 (0.61-1.03)
Knowledge of HPV, HPV related diseases, and vaccinesa			
0	886	518 (58.5)	1
1	1950	1459 (74.8)	2.03 (1.70-2.42)
2	343	259 (75.5)	2.03 (1.51-2.73)
3	147	118 (80.3)	2.46 (1.54-3.93)
			p_{trend} <0.001

[a]Scores were given based on answers to whether college students heard of HPV, HPV related diseases, or HPV vaccines. With 1 for Yes and 0 for No, the total score was calculated

(EPI) tended to be willing to accept HPV vaccination (OR=1.29; 95%CI: 1.10-1.51). Students worried about suffering from HPV-related diseases were also more likely to accept vaccination (OR= 2.79; 95%CI: 2.28-3.41). Prior knowledge of HPV, HPV-related diseases, and HPV vaccines significantly increased students' willingness towards vaccination, and a clear increasing trend was observed in respect to scores of knowledge (p_{trend}<0.001). However, there were no significant differences in the acceptability of HPV vaccination between students of different genders, majors, or sex experience.

Discussion

This is the first multicenter study to investigate knowledge of and attitudes towards HPV vaccination among undergraduates in China. We found that the acceptability of the HPV vaccine was high (70.8%) among undergraduates. Undergraduates with greater prior knowledge of HPV vaccines, with vaccination experience outside the National EPI, or fear of HPV-related diseases showed higher acceptability of HPV vaccination. Safety was a major concern (71.05%) for HPV vaccination, and the majority of students only willing to pay less than 300RMB for HPV vaccine. CDC was chosen as the most appropriate venue for vaccination.

To date, many countries have designated age groups to receive catch-up HPV vaccination according to WHO recommendations, such as Abu Dhabi, UAE (18-26 yrs), France (15-23 yrs), America, and Australia (13-26 yrs) (Markowitz et al., 2012). Of note, undergraduates are covered in most of these countries, which signals the importance of understanding perceptions and barriers to HPV vaccination in this group, especially for a populous country like China. Our data showed that 24.6% of the male and 6.9% of the female undergraduates of this study were already sexually active, which was considerably lower than that of American male undergraduates (70%-80%) (Allen et al., 2009; Katz et al., 2011). Considering that HPV vaccination is most effective in individuals prior to their initiation of sexual activity, we can contend that implementing an HPV catch-up vaccination for Chinese college students would be rewarding in significant prevention of HPV transmission and consequently, cervical cancer development, in China.

This study showed that a higher percentage of undergraduates (70.8%) accepted HPV vaccination compared to Chinese parents of young adolescents (62.3%) and adolescents themselves (36.2%) (Zhang et al., 2013). This finding was consistent with the acceptability of vaccination among undergraduates in other nations, ranging from 57.7% to 78% (Liddon et al., 2010; Makwe et al., 2012). However, this acceptability may not necessarily be translated into practice. We notice that the vaccination uptake among undergraduates was low in certain developed countries after HPV vaccine was marketed despite their higher acceptability of HPV vaccination. For example, the actual uptake vaccination rates were only 45% amongst female college students in USA and 1.3% in South Korea (Kang et al., 2009; Lindley et al., 2013). In contrast, 74-90% of the adolescent girls (12-13 yrs) in the UK received three doses of HPV vaccine in 2009/2010 (Markowitz et al., 2012). This may be partially explained by the fact that 9-13 years of age is the target group recommended by the WHO and regional or national guidelines. Additionally, school-based programme also played an important role to help adolescents get access to HPV vaccine. Consequently, despite a high willingness, it is also essential to explore factors that may influence HPV vaccination uptake among undergraduates.

Based on our results, students in lower grades in college, with previous vaccination experience outside EPI, and experiencing fear of cervical cancer were more willing to accept HPV vaccination. In addition, higher acceptability of vaccination was associated with a higher score of HPV-related knowledge (p_{trend}<0.001). Lack of knowledge may compromise awareness of the severity of the disease and ultimately the acceptability and subsequent administration of HPV vaccination. Unfortunately, we found that 26.4% of undergraduates had no knowledge of HPV, HPV-related disease, or the HPV vaccine This percentage was surprisingly high, and higher than that of parents of adolescents (17.6%) (Zhang et al., 2013). It was interesting that although most undergraduates lacked HPV-

related knowledge, 70% of undergraduates would like to accept HPV vaccine after a brief introduction of HPV vaccine. This highlighted the importance of education. Proactive education initiatives for the HPV vaccine will be helpful regardless of vaccination programming, in China. Public lectures, public service announcements, and medical consultations were major cited sources of information. Findings from Korea, United States, and Canada also demonstrated that recommendations from physicians were more viable for the recipients than from friends and parents (Kang et al., 2009). Considering that 71.8% of students reported concern of safety, and some doctors did not favor HPV vaccination in another study (Zhao et al., 2012b), first improving knowledge and awareness among healthcare workers and expanding public education through mass media will also prove invaluable as a component of increasing the acceptability of HPV vaccination in China.

An obstacle for HPV vaccination was the price. Although HPV vaccines are currently marketed at the price of US$300 (about 2000RMB), the majority of undergraduates (75.5%) are only willing to pay less than 300RMB. This gap could significantly hinder HPV vaccination, which has been seen in other countries. Half of Hungarian women who were interested in HPV vaccine refused to get vaccinated due to a high price (Marek et al., 2011). Moreover, 65% of the American college students would like to accept HPV vaccine only if the government provided it for free (Jones et al., 2008). Only recently, the vaccine manufacturers announced a plan to provide HPV vaccine to the Global Alliance of Vaccines and Immunization supported countries by the cost price (US$4.5 per dose), which was considerably lower than the governmental procurement price per dose (US$13). A recent study showed that HPV vaccination at US$9-13 per dose would be cost-effective in comparison to screening-only programs in China (Canfell et al., 2011). Though China will not qualify for GAVI supported pricing, market differential prices exist between developed and developing countries. With the availability of a newly developed domestic HPV vaccine and the government negotiation (Li et al., 2012), the price is expected to diminish to a more affordable level for middle-class Chinese standards. Furthermore, there is some evidence that two doses, or even one dose, of the HPV vaccine may be as protective against viral transmission as three doses (Kreimer et al., 2011), which could further contribute to cost reduction.

Since the source of HPV vaccine was doubted by 30.6% of undergraduates and the Chinese CDC was selected as the most appropriate venue for HPV vaccination, we suggest that HPV vaccine may be assigned as a self-paid vaccine at an initial stage under the supervision of Chinese CDC. Individuals can purchase the vaccine on a voluntary basis. Since half of the students in this cohort requested government subsidy for HPV vaccine, a cost-sharing system may be established after scale-up of HPV vaccination. Government, health insurance, and customers may share the vaccine price. Disadvantaged groups may be given additional support according to a preferential policy (i.e., high subsidy or free of charge). For the general population, a financial subsidy could be provided at an inversely proportional rate to their income level. Ultimately, the HPV vaccine could be incorporated into the EPI to facilitate accessible and equitable benefits for the population (Wang et al., 2010).

Findings in this nationwide multicenter study are significant, compared with previous studies in other counties that were largely based on convenience sampling and conducted at a single university. Potential obstacles and decision-making factors will help define future HPV vaccination efforts among undergraduates in China. Appropriate measures to address the obstacles explored may be valuable for future HPV vaccination policies and campaigns to address. However, this study still has certain limitations. First, this study was conducted at general-curriculum universities, without any medical college undergraduate students or young people who do not attend university. Furthermore, it included a low percent of minorities. Thus, the generalization of our results should be cautious. Second, given the close-ended nature of the questionnaire, it did not allow for students to elaborate upon why he or she may have provided a certain response. An interview or group discussion format may provide more open and valuable information. Finally, caution should be taken when interpreting the impact factors and the acceptability due to the cross-sectional nature of the study.

In conclusion, the acceptability of HPV vaccination is high in Chinese undergraduates, and certain decision-making factors were identified in this study. We hope that public health, reproductive health, health education, disease control, and immunization management professionals collaborate to provide culturally appropriate education regarding the prophylactic vaccine, increase vaccine acceptability, and finally accelerate HPV vaccination in China.

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References

Allen JD, Fantasia HC, Fontenot H, et al (2009). College men's knowledge, attitudes, and beliefs about the human papillomavirus infection and vaccine. *J Adolesc Health*, **45**, 535-7.

Canfell K, Shi JF, Lew JB, et al (2011). Prevention of cervical cancer in rural China: evaluation of HPV vaccination and primary HPV screening strategies. *Vaccine*, **29**, 2487-94.

Ferlay J SI, Ervik M, Dikshit R, et al (2013). GLOBOCAN 2012 v1.0, Cancer Incidence and Mortality Worldwide: IARC CancerBase No. 11 [Internet]. Lyon, France: International Agency for Research on Cancer; 2013.

Garland SM, Hernandez-Avila M, Wheeler CM, et al (2007). Quadrivalent vaccine against human papillomavirus to

prevent anogenital diseases. *N Engl J Med*, **356**, 1928-43.
Harper DM (2008). Impact of vaccination with Cervarix (trade mark) on subsequent HPV-16/18 infection and cervical disease in women 15-25 years of age. *Gynecol Oncol*, **110**, 11-7.
Jones M, Cook R (2008). Intent to receive an HPV vaccine among university men and women and implications for vaccine administration. *J Am Coll Health*, **57**, 23-32.
Kang HS, Moneyham L (2009). Attitudes toward and intention to receive the human papilloma virus (HPV) vaccination and intention to use condoms among female Korean college students. *Vaccine*, **28**, 811-6.
Katz ML, Krieger JL, Roberto AJ (2011). Human papillomavirus (HPV): college male's knowledge, perceived risk, sources of information, vaccine barriers and communication. *J Mens health*, **8**, 175-84.
Kreimer AR, Rodriguez AC, Hildesheim A, et al (2011). Proof-of-principle evaluation of the efficacy of fewer than three doses of a bivalent HPV16/18 vaccine. *J Natl Cancer Inst*, **103**, 1444-51.
Li J, Li LK, Ma JF, et al (2009). Knowledge and attitudes about human papillomavirus (HPV) and HPV vaccines among women living in metropolitan and rural regions of China. *Vaccine*, **27**, 1210-5.
Li R, Li Y, Radley D, et al (2012). 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*, **30**, 4284-91.
Liddon N, Hood J, Wynn BA, et al (2010). Acceptability of human papillomavirus vaccine for males: a review of the literature. *J Adolesc Health*, **46**, 113-23.
Lindley LL, Elkind JS, Landi SN, et al (2013). Receipt of the human papillomavirus vaccine among female college students in the United States, 2009. *J Am Coll Health*, **61**, 18-27.
Makwe CC, Anorlu RI, Odeyemi KA (2012). Human papillomavirus (HPV) infection and vaccines: knowledge, attitude and perception among female students at the University of Lagos, Lagos, Nigeria. *J Epidemiol Glob Health*, **2**, 199-206.
Marek E, Dergez T, Kricskovics A, et al (2011). Difficulties in the prevention of cervical cancer: adults' attitudes towards HPV vaccination 3 years after introducing the vaccine in Hungary. *Vaccine*, **29**, 5122-9.
Markowitz LE, Tsu V, Deeks SL, et al (2012). Human papillomavirus vaccine introduction-the first five years. *Vaccine*, **30**, 139-48.
Wang SM, Qiao YL (2010). Perspective of implementation of prophylactic HPV vaccine in China, *Oncology Progress*, **3**, 134-8.
WHO (2009). Human papillomavirus vaccines: WHO position paper. *Biologicals*, **37**, 338-44.
Zhang SK, Pan XF, Wang SM, et al (2013). Perceptions and acceptability of HPV vaccination among parents of young adolescents: A multicenter national survey in China. *Vaccine*, **31**, 3244-9.
Zhao FH, Tiggelaar SM, Hu SY, et al (2012a). 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*, **36**, 384-90.
Zhao FH, Tiggelaar SM, Hu SY, et al (2012b). A multi-center survey of HPV knowledge and attitudes toward HPV vaccination among women, government officials, and medical personnel in China. *Asian Pac J Cancer Prev*, **13**, 2369-78.