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Factors influencing intention to obtain the HPV vaccine and acceptability of 2-, 4- and 9-valent HPV vaccines: A study of undergraduate female health sciences students in Fujian, China

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ABSTRACT

Background: Little research has been conducted on the intention to obtain HPV vaccine now that the vaccine is approved for use in China. Acceptance of the three HPV vaccines, which differ in valency and price, has never been investigated.
Methods: An online cross-sectional survey assessing female undergraduate students' intention to obtain the HPV vaccine and their acceptability of 2-, 4- and 9-valent HPV vaccines (2vHPV, 4vHPV, and 9vHPV, respectively).
Results: Of a total of 997 complete responses, 55.2% reported intent to obtain the HPV vaccine. Some of the significant factors exerting influence on intent to obtain HPV vaccination were high knowledge score (OR = 1.469, 95% CI:1.087–1.987), perceived high risk of HPV infection (OR = 1.466, 95%CI:1.017–2.114), perception of no serious side effects (OR = 1.562, 95%CI:1.150–2.121), and mass media exposure to HPV vaccination information (OR = 2.196, 95%CI: 1.625–2.966). Socioeconomic status indicators did not significantly influence intent to obtain the HPV vaccine. A higher proportion of respondents were willing to pay for 2vHPV (78.6%) and 4vHPV (68.0%) compared with 9vHPV (49.3%). Socioeconomic status indicators were the strongest correlates of acceptability for all the three vaccines. Exposure to mass media reporting about HPV vaccination is the factor which exerts the most influence on acceptance of 9vHPV after socioeconomic status indicators.
Conclusions: It is important to improve knowledge and health beliefs, and to establish a mass media marketing strategy to promote HPV vaccination in order to enhance HPV vaccine uptake. Undergraduate female students should be provided with detailed information about the different valency vaccine choices to help them make informed decisions about immunization.

1. Introduction

There is a tremendous gynaecological cancer burden in China. China accounts for approximately a third of the global burden of cervical cancer, with about 98,900 new cases of cervical cancer occurring in the year 2015 [1]. In China, there are 557.32 million women who are 15 years of age or older who are at risk of developing cervical cancer. Cervical cancer ranks as the eighth most frequent cancer among women in China and the second most prevalent cancer in women between 15 and 44 years of age [2,3]. The crude incidence of cervical cancer in China in 2013 was 15.17/100,000 and the age-standardized incidence rates based on the Chinese standard population was 11.30/100,000 [4].

Fortunately, after a decade's delay, since U.S. FDA licensure in 2006, the first HPV vaccine was approved in China in 2016. GlaxoSmithKline's Cervarix®, a bivalent vaccine (2vHPV), and

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Merck's Gardasil®, a quadrivalent vaccine (4vHPV), were approved for use in women in China by the China Food and Drug Administration in July 2016 and April 2017, respectively. Merck's Gardasil®9, a 9-valent HPV vaccine (9vHPV), was licensed in May 2018. Each of the three vaccines is licensed for different age ranges, with 2vHPV recommended for ages 9 through 25 (the recommended age was extended to 45 years by the China Food and Drug Administration on July 2018), 4vHPV recommended for ages 20 through 45, and 9vHPV recommended for ages 16 through 26. Since HPV vaccines were only recently introduced in China, studies on the HPV vaccination rate among women in China are relatively scarce. A study published in the Chinese literature in 2018 reported that the HPV vaccine uptake among university students was only 3.9% [5]. Given the many obstacles to HPV vaccine uptake in China, including, most notably, the shortage in HPV vaccine supply [6,7], it is likely that HPV vaccination rates will remain quite low for the foreseeable future among young women in China.

Some studies examined intention to receive HPV vaccines among Chinese females prior to the availability of the HPV vaccine in the Chinese market [8,9]. However, studies on the intention to receive vaccine after it became available in the Chinese market are lacking. In particular, to date, no study has explored female undergraduate students' intention to receive the HPV vaccine, especially students in the field of medicine and healthcare. It is vitally important to conduct a survey among undergraduate medical students for numerous reasons. Firstly, perspectives of students attending medical university are important because these students will play an important role in promoting the HPV vaccine to the public when they enter the workforce upon graduation. Secondly, these students are young adults and are at the age at which it is best to receive the HPV vaccine now that it is available on the market, because they did not get the chance to receive the HPV vaccine when they were adolescents. Further, the college environment may present new opportunities for exposure to sexually transmitted infections, particularly HPV. In China, the prevalence of HPV infection peaks between 20 and 24 years of age [10] which is during college or undergraduate years.

Good knowledge and positive attitudes about HPV and HPV vaccination play an important role in HPV vaccine uptake. Knowledge and awareness about HPV infections and their influence on HPV vaccine uptake have been extensively studied among Chinese woman, largely before the vaccines were approved for used in China [11–13]. Assessments of women's knowledge after the HPV vaccine became available on the Chinese market are lacking, particularly among medical undergraduate students. It is crucial to uncover current knowledge gaps among these students and identify what areas need to be addressed through educational interventions. Many studies have applied the health belief model (HBM) when researching HPV vaccination-related behaviours. Health beliefs or attitudes about HPV infection and the HPV vaccine have been studied among Hong Kong Chinese [14]; however, to our knowledge these have never been investigated among mainland Chinese women.

Currently, three HPV vaccine sub-types are available on the Chinese market; these differ greatly in price. 4vHPV (RMB798/shot) costs slightly more than 2vHPV (RMB580/shot). However, 9vHPV (RMB12798/shot) is nearly twice the price of 4vHPV. Little is known about the proportions of consumers willing to pay for the different types of HPV vaccines on the Chinese market. It is not known how the public may make trade-offs between the different valences of the vaccine and the price. Such information is crucial and highly valuable for vaccine manufacturers and the local Chinese government in assessing the economic viability of the different HPV vaccines.

To fill these gaps, the current study (1) examines knowledge and health beliefs about HPV and HPV vaccination; (2) measures intention to obtain HPV vaccine and identifies key factors influencing intention to obtain the vaccine; (3) explores comparative proportions of consumers' acceptance of 2vHPV, 4vHPV, and 9vHPV; and (4) analyses factors influencing acceptance of 2vHPV, 4vHPV, and 9vHPV.

2. Materials and methods

2.1. Study participants

Participants were all female health sciences students of undergraduate years 1 to 5 enrolled in Fujian Medical University, Fuzhou, China. Convenience sampling was conducted to recruit subjects for this study. The survey was administered online. The link to the survey questions was sent to administrators or lecturers of all the departments to be disseminated to all the registered female students. In an attempt to reach comprehensive recipient coverage, the link to the survey was also sent to students' social media groups or forums. The inclusion criteria were (1) female undergraduate health sciences students, and (2) not having previously received the HPV vaccine.

2.2. Instruments

The first two sections of the questionnaire assessed demographic characteristics and knowledge and health beliefs related to HPV infection and vaccination. In the knowledge section, respondents were asked a series of questions regarding HPV infection, and its relationship to cervical cancer and genital warts (22-item scales). Response options were 'true', 'false', and 'don't know'. A correct response was given a score of 1 and an incorrect or 'don't know' response was scored as 0. The possible total knowledge score ranged from 0 to 22, with higher scores representing higher levels of knowledge. The second section of the questionnaire assessed respondents' health beliefs regarding HPV and HPV vaccination, based on HBM constructs as a theoretical framework [15–17]. The questions probed perceived susceptibility to HPV (three items), perceived severity of HPV infection (three items), perceived benefits of HPV vaccine (three items), perceived barriers to getting vaccination against HPV (two items), perceived self-efficacy to vaccinate (one item), and cue to action (one item). Response options were 'agree' and 'disagree'. The third section of the questionnaire assessed intention to obtain the HPV vaccine. The response options were 'yes, definitely', 'yes, the chances are quite large', 'no, only a moderate chance', and 'no, definitely not'. The participants were also asked for their acceptance of the three different HPV vaccines – 2-, 4- and 9-valent – currently available on the market in China. A note indicating the types of HPV covered in the 2vHPV, 4vHPV, and 9vHPV and their respective prices were provided. Respondents were also informed that HPV vaccines have been recommended in a three-dose series given over six months. The questionnaire was content-validated by several panel experts to ensure the relevance and clarity of the questions. After minor amendments, the questionnaire was pilot-tested on randomly sampled students who were not included in the main study.

2.3. Ethical considerations

This study was approved by the Medical Ethics Committee at the Fujian Medical University, Fuzhou, China. Students were informed that their participation was voluntary, and consent was implied on completion of the questionnaire. All responses were collected and analysed without identifiers.

2.4. Statistical analysis

All statistical analyses were performed using Statistical Package for the Social Sciences, version 20.0 (IBM Corp., Armonk, NY, USA). The significance level was set at $p < 0.05$. Reliability of knowledge items was evaluated by assessing the internal consistency of the items representing the knowledge score. The 22 knowledge items had reliability (Cronbach's α) of 0.931. Multivariable logistic regression analysed factors influencing (1) intention to obtain HPV vaccination and (2) acceptance of 2-, 4- and 9-valent HPV vaccines. All variables found to have a statistically significant association (two-tailed p-value < 0.05) with intention to take the HPV vaccination and acceptance of 2-, 4- and 9-valent HPV vaccines in the univariate analyses were entered into the multivariable logistic regression analysis using a simultaneous forced-entry model (enter method). Odds ratios (OR), 95% confidence intervals (95% CI), and P-values were calculated for each independent variable. The model fit was assessed using the Hosmer–Lemeshow goodness-of-fit test [18]. A significant test indicated that the model is not a good fit and a non-significant test indicates a good fit.

3. Results

3.1. Characteristics of participants

Of the total 7561 undergraduate female health sciences students registered at Fujian Medical University, we received 997 completed responses between 13 and 24 May 2019. A summary of the characteristics of the respondents is provided in Table 1. A small proportion (n = 106, 10.5%) reported ever having had sexual experience, 21 respondents (19.8%) reported having more than one sexual partner, 78 respondents (73.6%) reported that they always use a condom during sexual intercourse, and seven respondents reported having been diagnosed with a sexually transmitted infection.

3.2. Knowledge about HPV or HPV vaccination

Fig. 1 shows the proportion of correct responses to knowledge items. Less than half the respondents were aware that HPV infection can occur without symptoms (42.5%). Only slightly over one-third (34.5%) were aware that HPV can cause oral cancer. The majority of respondents have the misconception that HPV can be cured by antibiotics (70.7%) and there is a cure for HPV infection (81.5%). The mean total knowledge score was 12.8 (SD ± 6.0) out of a possible score of 22. The median was 14 (inter quartile range, IQR, 9–17). Undergraduate year 1 & 2 students have significantly lower mean total knowledge scores (10.4 ± 6.3) than students in undergraduate years 3, 4, & 5 (15.4 ± 4.4). Respondents with Han ethnicity (13.0 ± 5.9) reported a significantly higher mean total knowledge score than students of other ethnicities (9.8 ± 6.6). Respondents originating from Eastern China reported a significantly higher mean total knowledge score (13.4 ± 5.8) than those from Central (10.9 ± 6.3) and Western China (10.6 ± 6.3). There were significant associations between the mean total knowledge score and annual household income. The mean total knowledge score gradually increased with an increase of annual household income: less than RMB50,000 (12.0 ± 6.3); RMB50,000–120,000 (13.1 ± 5.9); and RMB120,000 and above (13.3 ± 5.6).

3.3. Health beliefs regarding HPV and HPV vaccination

Although the majority of the respondents have a high perception of women's susceptibility to contracting HPV (81.1%) and having cervical or vulvar cancer (75.4%), only slightly over half (58.8%) considered that women have a high risk of contracting genital warts. With regard to perception of severity, the majority have a high perception of severity of the harm associated with cervical or vulvar cancer, HPV infection, and genital warts. Regarding perceived barriers to getting vaccinated, a total of 41.2% indicated that they did not have time for HPV vaccination and 32.5% believed that they would suffer severe side effects after receiving the vaccine (Fig. 2).

Table 1
Participant characteristics (N = 997).

Socio-demographics	Frequency (%)
Ethnicity	
Han	928 (93.1)
Other	69 (6.9)
Place of birth	
Urban	392 (39.3)
Rural	605 (60.7)
Location of high school	
Central China	760 (76.2)
West China	155 (15.5)
East China	82 (8.2)
Study year	
Undergraduate years 1 and 2	525 (52.7)
Undergraduate years 3, 4, and 5	472 (47.3)
Study major	
Medicine	853 (85.6)
Non-medicine	144 (14.4)
Maternal education level	
Primary school and below	402 (40.3)
Junior high school	297 (29.8)
High school/technical secondary school	184 (18.5)
University and above	114 (11.4)
Paternal education level	
Primary school and below	169 (17.0)
Junior high school	377 (37.8)
High school/technical secondary school	285 (28.6)
University and above	166 (16.6)
Annual household income (RMB)	
<50,000	355 (35.6)
50,000 to 120,000	394 (39.5)
>120,000	248 (24.9)
Monthly disposable income (RMB)	
<1000	266 (26.7)
1000 to 2000	595 (59.7)
>2000	136 (13.6)
Perceived family economic status	
Rich/Intermediate	525 (52.7)
Poor	472 (47.3)
Risk behaviour	
Ever had sexual experience	
Yes	106 (10.6)
No	891 (89.4)
Number of sexual partner (n = 106)	
1	85 (80.2)
>1	21 (19.8)
Condom use (n = 106)	
Never	10 (9.4)
Rarely	6 (5.7)
Sometimes	12 (11.3)
Always	78 (73.6)
History of being diagnosed with sexually transmitted infection (n = 106)	
Yes	7 (6.6)
No	99 (93.4)

3.4. Intention to obtain HPV vaccination

Fig. 3 shows the responses to intention to obtain the HPV vaccination. In total, 55.2% (n = 550) reported 'Yes, definitely/chances

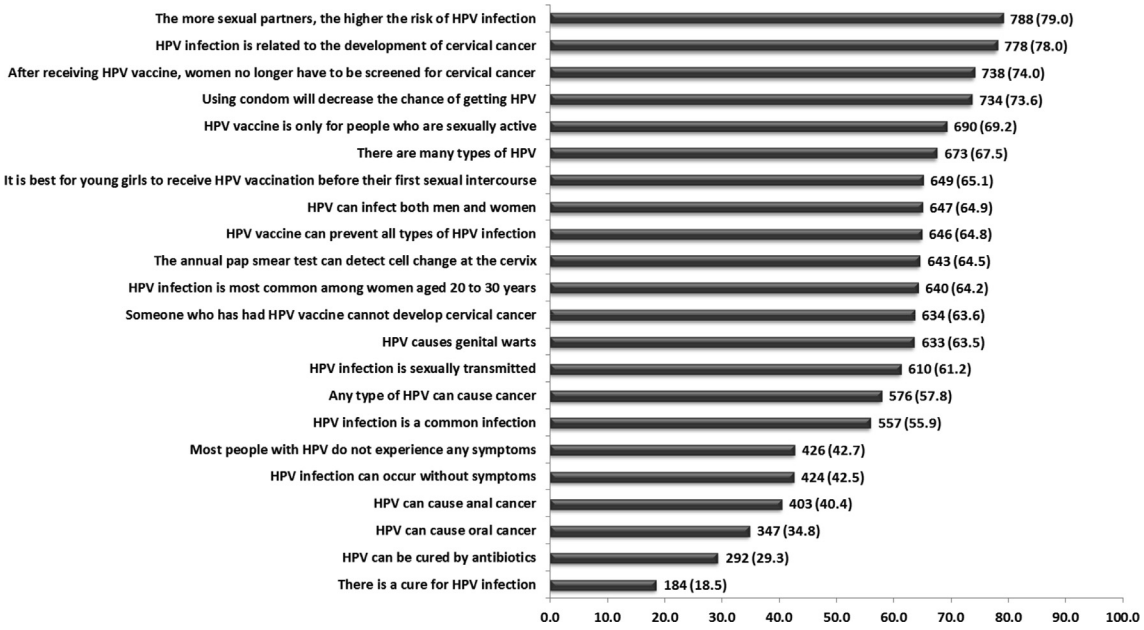

Fig. 1. Correct responses to HPV knowledge items (N = 997).

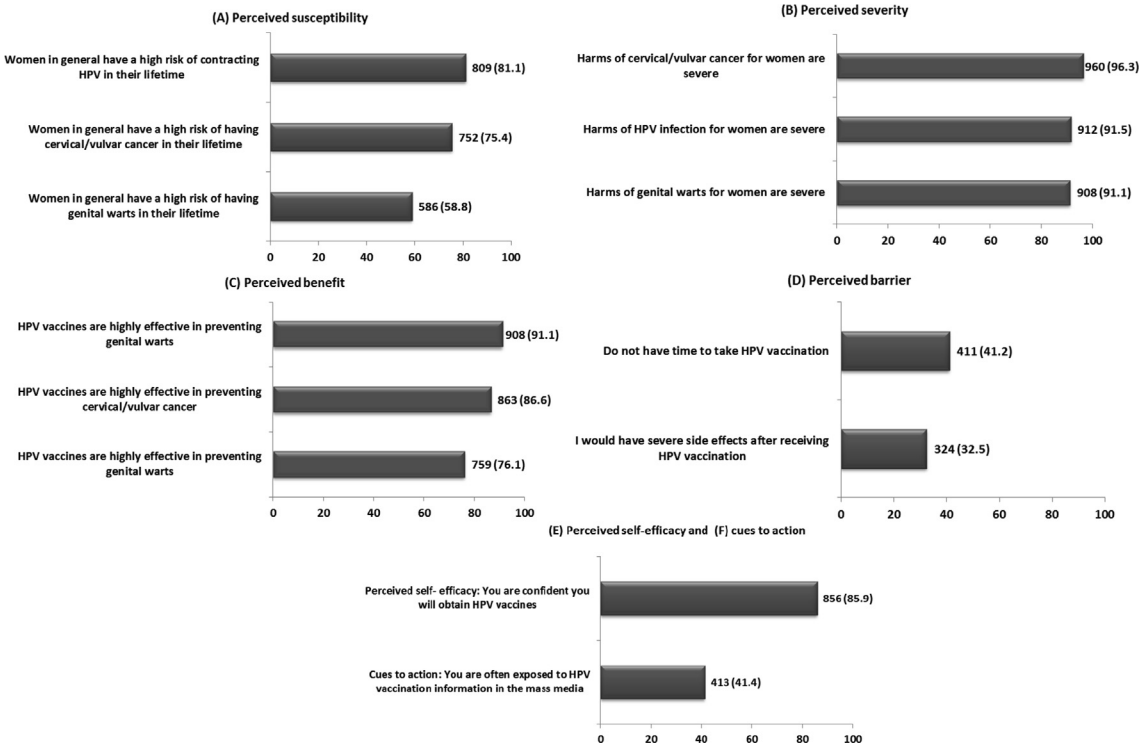

Fig. 2. Proportion of respondents who 'agree' with the Health Belief Model items (N = 997).

are quite large' and 44.8% (n = 447) reported 'No, moderate chance/chances are quite low/definitely not'. Only 21.1% stated 'Yes, definitely will obtain HPV vaccine'. The majority (38.6%) reported 'No, moderate chance of obtaining HPV vaccine'.

As shown in Table 2, variables that were significantly associated with intention to obtain HPV vaccination in the univariate analyses were place of birth, year of study, annual household income, monthly disposable income, perceived family economic status, HPV knowledge, perceived susceptibility, perceived benefit of vaccination, perceived barriers to vaccination, cue to action, and perceived self-efficacy of vaccination. There were no significant differences between ever having had sexual experience and intention to obtain the HPV vaccination. Of the total 21 respondents who reported having had more than one sexual partner, only 11 reported intent to obtain the HPV vaccination. Of the seven persons who reported being diagnosed with sexually transmitted infection, only one reported intent to obtain the HPV vaccination. Of a total of 28 respondents who reported not always using condoms during sexual intercourse, 16 reported intent to receive the HPV vaccine.

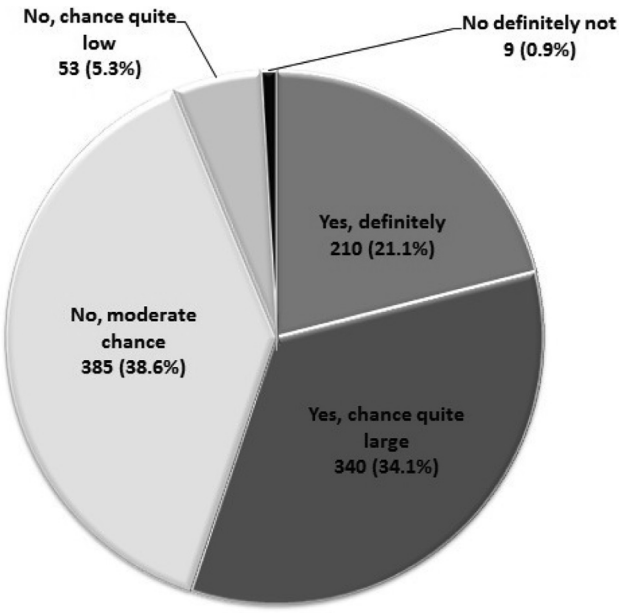

Fig. 3. Proportion of intention to obtain HPV vaccine (N = 997).

From the multivariable logistic regression model, the significant factors associated with intention to obtain the HPV vaccination were high knowledge score (OR = 1.469, 95% CI: 1.087–1.987), perception that women in general have a high risk of contracting HPV in their lifetime (OR = 1.466, 95% CI: 1.017–2.114), no perceived barrier to taking time off to obtain the HPV vaccination (OR = 1.727, 95% CI: 1.289–2.313), no perceived serious side effects of HPV vaccination (OR = 1.562, 95% CI: 1.150 – 2.121), regular exposure to HPV vaccination information in the mass media (OR = 2.196, 95% CI: 1.625–2.966), and confidence about obtaining the HPV vaccine in the near future (OR = 7.281, 95% CI: 4.385–12.088).

3.5. Acceptance of 2-, 4- and 9-valent HPV vaccines

Table 3 summarizes the significant correlates of acceptance of 2-, 4- and 9- valent HPV vaccines in the multivariable analyses. The highest proportion of respondents were willing to accept 2vHPV (78.6%), followed by 4vHPV (68.0%) and 9vHPV (49.3%). Significant factors associated with acceptance of 2-valent and 4-valent vaccines are similar, which are location of high school, study year, paternal educational level, annual household income, and perceived self-confidence in taking the HPV vaccine in the near future. Significant factors of acceptance of the 9-valent vaccine are location of high school, annual household income, monthly disposable income, having no barriers to taking time off to take the HPV vaccination and regular exposure to HPV vaccination information in the mass media.

4. Discussion

The mean knowledge score of slightly above midpoint on the scale implies that awareness and knowledge about HPV diseases and HPV-related cancer was moderate. The lower level of knowledge among undergraduate years 1 & 2 and respondents from lower socioeconomic groups found in this study demonstrates increased need for HPV information for these groups. Further, this study also found that, in particular, most of the respondents were unaware that there is no cure for HPV infection and erroneously believe that HPV can be cured with antibiotics. Such a lack of knowledge may influence perceptions about lack of necessity for protection against HPV infection and thus may increase infection risk. Additionally, this study found that although perceived susceptibility to HPV infection and the risk of cervical or vulvar cancer is high, nevertheless, perception of susceptibility to genital warts is low. This could be due to lack of knowledge about genital warts because only about one-third of the study participants were aware that HPV causes genital warts; a similar result was found in previous studies conducted among Chinese women [11,12]. Such knowledge and perception gaps underscore a crucial need to educate undergraduate students about HPV infection and enhance perceptions about their susceptibility. It is best that targeted education be incorporated into undergraduate teaching and learning in order to produce future health care providers or healthcare workers equipped with good knowledge and positive attitudes on cervical cancer prevention through HPV vaccination; this would contribute to extensive HPV vaccine coverage among the public and, ultimately, the success of cervical cancer prevention in China.

In this study, the percentage of respondents who reported that they will definitely or likely to be vaccinated against HPV was 55.2%, which is quite modest. The intention to receive the HPV vaccine among our study participants was lower than the intention to vaccinate among young adults in Western China (63%) [8] and among a larger cohort of undergraduate students (70.8%) [19]; both of these studies were conducted in recent years, but prior to the approval of the HPV vaccine in China. Thus, there is a dire need to enhance HPV vaccine acceptance among undergraduate female students. Important factors which exert influence on intent to obtain HPV vaccination found in this study were high knowledge, perceived high risk of HPV infection, no perceived serious side effects, and exposure to HPV vaccination information in the mass media. Having knowledge has been shown in another study to influence uptake of the HPV vaccine among Chinese women [11]; the same result in this study indicates that education about HPV is vital. It would be beneficial if the promotion and education about the HPV vaccine is to be extended to parents because students in college still depend on parental payments for immunization. A recent study found that knowledge determined Chinese parents' intention to vaccinate their adolescent children against HPV [20].

Perceived susceptibility to HPV infection in the HBM can be used as a framework to guide the design of interventions to enhance HPV vaccine uptake among females in China because it was found to be significantly associated with intention to obtain the HPV vaccine in this study. Generally, women are not motivated to vaccinate when they are not aware of their own susceptibility to HPV infection. To enhance perception of susceptibility, they should be informed that a recent study in China [10] revealed that the HPV infection rate is highest among women between the ages of 20 and 24 years, and that the prevalence of HPV infection in this age range is as high as 24.3%.

Another important result from our multivariate findings is that perceived barriers to HPV vaccination – specifically, inability to take time off for vaccination – and perceived severe side effects from receiving the HPV vaccination are both significant influencers of intention to obtain the HPV vaccination. Because time and logistics may be barriers to undergraduate students who mainly stay in on-campus accommodation, advocating strategies for outreach to undergraduate students – for example, administering three doses of the HPV vaccine in the university by a health team or having a HPV vaccination programme in the university health services – would greatly enhance HPV vaccine uptake. With regard to concerns about serious side effects of HPV vaccination, a campus campaign is needed to address risk perceptions about the HPV vaccine. It is of upmost importance to provide reassuring evidence about the safety of the HPV vaccine in the campaign by showing the most recent evidence of the vaccine's safety. Over a decade's worth of

Table 2
Factors associated with intention to obtain HPV vaccine (N = 997).

	Frequency (%)	Univariate analysis		p-value	Multivariable logistic regression
		Intention to obtain HPV vaccine			Intention to obtain HPV vaccine Yes *vs.* No
		Yes, definitely/chance quite large (n = 550)	No, moderate chance/chance quite low/definitely no (n = 447)		Odds ratio, 95% CI
Socio-demographics					
Ethnicity					
Han	928 (93.1)	515 (55.5)	413 (44.5)	0.454	
Other	69 (6.9)	35 (50.7)	34 (49.3)		
Place of birth					
Urban	392 (39.3)	232 (59.2)	160 (40.8)	0.043	0.999 (0.728–1.369)
Rural	605 (60.7)	318 (52.6)	287 (47.4)		Reference
Location of high school					
Central China	760 (76.2)	423 (55.7)	337 (44.3)		
Western China	155 (15.5)	83 (53.5)	72 (46.5)	0.855	
Eastern China	82 (8.2)	44 (53.7)	38 (46.3)		
Study year					
Undergraduate year 1 & 2	525 (52.7)	270 (51.4)	255 (48.6)	0.013	1.041 (0.768–1.411)
Undergraduate year 3, 4, & 5	472 (47.3)	280 (59.3)	192 (40.7)		Reference
Study major					
Medicine	853 (85.6)	481 (56.4)	372 (43.6)	0.070	
Non-medicine	144 (14.4)	69 (47.9)	75 (52.1)		
Mother education level					
Primary school and below	402 (40.3)	214 (53.2)	188 (46.8)		
Junior high school	297 (29.8)	164 (55.2)	133 (44.8)		
High school/technical secondary school	184 (18.5)	105 (57.1)	79 (42.9)	0.688	
University and above	114 (11.4)	67 (58.8)	47 (41.2)		
Father education level					
Primary school and below	169 (17.0)	85 (50.3)	84 (49.7)		
Junior high school	377 (37.8)	205 (54.4)	172 (45.6)	0.051	
High school/technical secondary school	285 (28.6)	153 (53.7)	132 (46.3)		
University and above	166 (16.6)	107 (64.5)	59 (35.5)		
Annual household income (RMB)					
<50,000	355 (35.6)	182 (51.3)	173 (48.7)		0.916 (0.576–1.455)
50,000 to 120,000	394 (39.5)	208 (52.8)	186 (47.2)	0.003	0.766 (0.519–1.130)
>120,000	248 (24.9)	160 (64.5)	88 (35.5)		Reference
Monthly disposable income (RMB)					
<1000	266 (26.7)	129 (48.5)	137 (51.5)		0.792 (0.449–1.397)
1000 to 2000	595 (59.7)	331 (55.6)	264 (44.4)	0.003	0.777 (0.488–1.238)
>2000	136 (13.6)	90 (66.2)	46 (33.8)		Reference
Perceived family economic status					
Rich/Intermediate	525 (52.7)	306 (58.3)	219 (41.7)	0.041	1.235 (0.903–1.689)
Poor	472 (47.3)	244 (51.7)	228 (48.3)		Reference
Risk behaviour					
Ever had sexual experience					
Yes	106 (10.6)	56 (52.8)	50 (47.2)	0.607	
No	891 (89.4)	494 (55.4)	397 (44.6)		
HPV knowledge					
Total knowledge score					
Low score (0–14)	519 (52.1)	245 (47.2)	274 (52.8)	p < 0.001	Reference
High score (15–22)	478 (47.9)	305 (63.8)	173 (36.2)		1.469 (1.087–1.987) *
Health beliefs					
Perceived susceptibility					
Women in general have a high risk of contracting HPV in their lifetime					
Yes	809 (81.1)	470 (58.1)	339 (41.9)	p < 0.001	1.466 (1.017–2.114) *
No	188 (18.9)	80 (42.6)	108 (57.4)		Reference
Women in general have a high risk of having genital warts in their lifetime					
Yes	586 (58.8)	336 (57.3)	250 (42.7)	0.106	
No	411 (41.2)	214 (52.1)	197 (47.9)		
Women in general have a high risk of having cervical/vulvar cancer in their lifetime					
Yes	752 (75.4)	422 (56.1)	330 (43.9)	0.301	
No	245 (24.6)	128 (52.2)	117 (47.8)		
Perceived severity					
Harms of HPV infection for women are severe					
Yes	912 (91.5)	503 (55.2)	409 (44.8)	1.000	
No	85 (8.5)	47 (55.3)	38 (44.7)		

(*continued on next page*)

Table 2 (*continued*)

	Frequency (%)	Univariate analysis		p-value	Multivariable logistic regression
		Intention to obtain HPV vaccine			Intention to obtain HPV vaccine Yes *vs.* No Odds ratio, 95% CI
		Yes, definitely/chance quite large (n = 550)	No, moderate chance/chance quite low/definitely no (n = 447)		
Harms of genital warts for women are severe					
Yes	908 (91.1)	507 (55.8)	401 (44.2)	0.182	
No	89 (8.9)	43 (48.3)	46 (51.7)		
Harms of cervical/vulvar cancer for women are severe					
Yes	960 (96.3)	533 (55.5)	427 (44.5)	0.312	
No	37 (3.7)	17 (45.9)	20 (54.1)		
Perceived benefit					
HPV vaccines are highly effective in preventing HPV infection					
Yes	908 (91.1)	514 (56.6)	394 (43.4)	0.004	0.915 (0.509–1.647)
No	89 (8.9)	36 (40.4)	53 (59.6)		Reference
HPV vaccines are highly effective in preventing genital warts					
Yes	759 (76.1)	425 (56.0)	334 (44.0)	0.370	
No	238 (23.9)	125 (52.5)	113 (47.5)		
HPV vaccines are highly effective in preventing cervical/vulvar cancer					
Yes	863 (86.6)	494 (57.2)	369 (42.8)	0.001	1.455 (0.903–2.344)
No	134 (13.4)	56 (41.8)	78 (58.2)		Reference
Perceived barriers					
Do not have time to take HPV vaccination					
Yes	411 (41.2)	202 (49.1)	209 (50.9)	0.002	Reference
No	586 (58.8)	348 (59.4)	238 (40.6)		1.727 (1.289–2.313) ***
I would have severe side effects after receiving HPV vaccination					
Yes	324 (32.5)	149 (46.0)	175 (54.0)	p < 0.001	Reference
No	673 (67.5)	401 (59.6)	272 (40.4)		1.562 (1.150–2.121) **
Cues to action					
You are often exposed to HPV vaccination information in mass media					
Yes	413 (41.4)	283 (68.5)	130 (31.5)	p < 0.001	2.196 (1.625–2.966) ***
No	584 (58.6)	267 (45.7)	317 (54.3)		Reference
Perceived self-efficacy					
You are confident about obtaining HPV vaccine					
Yes	856 (85.9)	529 (61.8)	327 (38.2)	p < 0.001	7.281 (4.385–12.088) ***
No	141 (14.1)	21 (14.9)	120 (85.1)		Reference

[a]Hosmer–Lemeshow test, chi-square: 10.657, p-value: 0.222; Nagelkerke R^2 : 0.240.
* p < 0.05.
** p < 0.01.
*** p < 0.001.

data for hundreds of thousands of boys and girls who received the HPV vaccine indicates that the vaccine is safe and effective [21,22]; this should be made known to the students. The significant influence of mass media exposure associated with the HPV vaccine on the intention to obtain the HPV vaccine found in this study signifies the immense impact of wide media coverage in gaining support for, and acceptance of, HPV vaccination among young adults in China, as similarly reported in a study from another Asian country [23].

In this study, sexual intercourse experience was not found to influence intention to obtain the HPV vaccine; this could be due to the small number of respondents who reported having had sexual experience. However, only half of the respondents who reported having had sexual experience expressed an intention to obtain the HPV vaccine and, similarly, half of the respondents who reported having more than one sexual partner expressed an intention to obtain the HPV vaccine. This warrants considerable attention. Further studies are required to understand the potential barriers to HPV vaccination, specifically among female undergraduate students who have had sexual initiation, to help in designing targeted HPV vaccination interventions for them. Students should be informed that the HPV vaccination is recommended, regardless of sexual activity or exposure to HPV. Women who have had sexual initiation and have already been infected with one or more HPV types will still be protected by the vaccine from other HPV types that they have not acquired. In this context, sexually active women should be informed that the new 9vHPV vaccine has the potential to provide wider protection [24] and the 9vHPV recommended age has been extended to women of 45 years of age.

To the best of our knowledge, this study is the first to assess acceptance of the three types of HPV vaccines available in the current market in China, each of which offers different protections against HPV types and each of which has a different price. A lower proportion of respondents expressed acceptance for 9-vHPV, which is over twice the price of the 2-vHPV vaccine. Another important finding is that socio-economic status indicators did not significantly influence intent to obtain the HPV vaccine in general. However, when the participants were informed of the three HPV vaccines available in the market, the types of HPV covered and their respective prices, socio-economic status indicators remain the strongest predictor of acceptance of each of the three vaccines. These findings imply that the choice of HPV vaccine types among undergraduate females is dependent on cost and affordability. Those from higher socioeconomic backgrounds are likely to obtain

Table 3
Factors associated with acceptability of 2-, 4- and 9- valent HPV vaccines (N = 997).

	Multivariable logistic regression		
	HPV vaccine acceptability at different cost and valences		
	2vHPV (RMB580/per shot) Yes (n = 784) *vs.* No (n = 213)[a]	4vHPV (RMB798/per shot) Yes (n = 678) *vs.* No (n = 319)[b]	9vHPV (RMB 1298/per shot) Yes (n = 492) *vs.* No (n = 505)[c]
	Odds ratio, 95% CI	Odds ratio, 95% CI	Odds ratio, 95% CI
Socio-demographics			
Ethnicity			
Han			1.153 (0.635–2.095)
Other			Reference
Place of birth			
Urban	1.038 (0.665–1.662)	0.912 (0.531–1.278)	0.918 (0.684–1.408)
Rural	Reference	Reference	Reference
Location of high school			
Eastern China	2.587 (1.538–4.350) ***	2.414 (1.453–4.012) **	1.854 (1.117–3.076) *
Western China	1.462 (0.803–2.660)	1.546 (0.861–2.778)	1.216 (0.662–2.236)
Central China	Reference	Reference	Reference
Study year			
Undergraduate year 1 & 2	Reference	Reference	Reference
Undergraduate year 3, 4, & 5	1.524 (1.081–2.148) *	1.729 (1.097–2.724) *	0.857 (0.565–1.301)
Maternal education level			
Primary school and below	0.959 (0.403–2.280)	1.011 (0.479–2.134)	0.791 (0.416–1.504)
Junior high school	1.024 (0.438–2.396)	1.161 (0.560–2.405)	0.942 (0.507–1.753)
High school/technical secondary school	0.973 (0.429–2.207)	1.476 (0.730–2.987)	1.333 (0.703–2.529)
University and above	Reference	Reference	Reference
Paternal education level			
Primary school and below	Reference	Reference	Reference
Junior high school	1.767 (1.153–2.709) **	1.334 (0.893–1.992)	1.054 (0.709–1.566)
High school/technical secondary school	1.922 (1.140–3.240) *	1.444 (0.896–2.327)	1.024 (0.759–1.908)
University and above	3.077 (1.334–7.095) **	2.887 (1.371–6.081) **	1.333 (0.703–2.529)
Annual household income (RMB)			
<50,000	Reference	Reference	Reference
50,000 to 120,000	1.008 (0.685–1.484)	1.151 (0.812–1.632)	1.240 (0.884–1.738)
>120,000	2.430 (1.285–4.595) **	2.485 (1.467–4.209) **	2.113 (1.353–3.300) **
Monthly disposable income (RMB)			
<1000	0.621 (0.299–1.290)	0.620 (0.812–1.177)	Reference
1000 to 2000	0.885 (0.457–1.713)	0.749 (0.424–1.321)	1.163 (0.825–1.641)
>2000	Reference	Reference	2.679 (1.531–4.687) ***
Perceived family economic status			
Rich/Intermediate	1.146 (0.797–1.647)	1.325 (0.959–1.831)	1.128 (0.837–1.521)
Poor	Reference	Reference	Reference
Risk behaviour			
Ever had sexual experience			
Yes			1.118 (0.713–1.754)
No			Reference
HPV knowledge			
Total knowledge score			
Low score (0–14)		Reference	Reference
High score (15–22)		1.318 (0.954–1.822)	1.046 (0.779–1.406)
Health beliefs			
Perceived susceptibility			
Women in general have a high risk of contracting HPV in their lifetime			
Yes	1.118 (0.746–1.677)	1.026 (0.707–1.488)	
No	Reference	Reference	
Perceived benefit			
HPV vaccines are highly effective in preventing HPV infection			
Yes	1.314 (0.759–2.274)		
No	Reference		
Perceived barriers			
Do not have time to take HPV vaccination			
Yes			Reference
No			1.634 (1.239–2.154) ***
Cues to action			
You are often exposed to HPV vaccination information in the mass media			
Yes	1.158 (0.807–1.663)	1.291 (0.936–1.780)	1.381 (1.036–1.842) *
No	Reference	Reference	Reference

(*continued on next page*)

Table 3 (*continued*)

	Multivariable logistic regression		
	HPV vaccine acceptability at different cost and valences		
	2vHPV (RMB580/per shot) Yes (n = 784) *vs.* No (n = 213)[a]	4vHPV (RMB798/per shot) Yes (n = 678) *vs.* No (n = 319)[b]	9vHPV (RMB 1298/per shot) Yes (n = 492) *vs.* No (n = 505)[c]
Perceived self-efficacy			
You are confident about obtaining HPV vaccine			
Yes	1.809 (1.172–2.792) **	1.588 (1.054–2.393) *	
No	Reference	Reference	

* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.
[a] Hosmer–Lemeshow test, chi-square:11.339, p-value: 0.183; Nagelkerke R^2 : 0.169.
[b] Hosmer–Lemeshow test, chi-square:8.082, p-value: 0.426; Nagelkerke R^2 : 0.210.
[c] Hosmer–Lemeshow test, chi-square:10.570, p-value: 0.227; Nagelkerke R^2 : 0.172.

a higher valency HPV vaccine and obtain protection against more HPV types common in cancer. The socioeconomic disparities in the choices of different valences of the HPV vaccine types warrant considerable attention as this may worsen off the socioeconomic disparities in cervical cancer incidence in China, particularly as some research indicates that HPV types 52 and 58 may more prevalent in cervical cancers in at least some regions of China than type 18 [25,26]. Only 9vHPV provides direct protection against types 52 and 58. Results of this study provide useful insights which could help design targeted HPV vaccination policies for people of different socioeconomic backgrounds. In particular, findings revealed an urgent need for negotiating lower prices for the vaccines, given the relatively lower household income of most Chinese citizens. Alternatively, in light of the current high price of imported vaccines, the availability of locally manufactured HPV vaccines, which would likely be less costly, would greatly enhance HPV vaccine uptake [6].

It is also interesting to note that exposure to mass media reports about HPV vaccination is an important factor which exerts the most influence on the acceptance of 9vHPV after socioeconomic status indicators; however, this is not the case for 2vHPV and 4vHPV. This implies that the media can be hugely influential with regard to the choice of the higher valent 9vHPV vaccine, despite its high price. The mass media plays an important role in ensuring the public is informed with detailed information about the bivalent, quadrivalent, and 9-valent HPV vaccines which should be considered when making an informed decision about immunization.

Several limitations of the present study should be considered when interpreting our results. Firstly, only undergraduate female health sciences students from one university were surveyed, and the data collection was cross-sectional and based on self-reported data which may be subject to self-reporting bias and a tendency to report socially desirable responses. A second limitation is the relatively low response rate and the possibility of non-response bias, which may limit generalizability. Thirdly, it should be noted that intention to receive the vaccine does not necessarily result in actual receipt of vaccine; therefore, results should be interpreted with caution. Despite these limitations, the sample was large with diverse sociodemographic backgrounds reflective of the university's enrolment. Finally, future studies should consider examining the perspectives from female students who have received the HPV vaccine and investigate the factors associated with HPV vaccine uptake.

5. Conclusion

Our study is among the first to investigate detailed knowledge and health beliefs about HPV and HPV vaccination among female undergraduate students from the field of medicine and healthcare since the HPV vaccine has been approved for use in China. This study of undergraduate medical students provides important insights into their lack of knowledge and misconceptions, which warrant the incorporation of targeted education into undergraduate teaching and learning in order to produce future health care providers and healthcare workers who can contribute to the success of cervical cancer control and prevention in China. The findings also reveal that female undergraduate students have moderate intention to obtain the HPV vaccine, despite being in the age range with the highest HPV infection rate. This study underscores the need to establish a mass media marketing strategy to promote HPV vaccination and to enhance acceptance of HPV vaccination among undergraduate female students. Considering that cost and affordability influence the choice between 2v-, 4v-, and 9vHPV, undergraduate female students should be provided with detailed information about the different valency vaccine choices to help them to make an informed decision about immunization. In conclusion, this study provides crucial information for assessing the economic viability of the HPV vaccines of different valences in China.

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Disclosure of potential conflicts of interest

Dr. Zimet has served and has received honoraria from Sanofi Pasteur for his work on the Adolescent Immunization Initiative and travel support from Merck & Co., Inc. to present at an HPV vaccine symposium.

Ethical standards disclosure

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects/patients were approved by the Fujian Medical

University. Online informed consents were obtained from all subjects/patients.

Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: [Dr. Zimet has served and has received honoraria from Sanofi Pasteur for his work on the Adolescent Immunization Initiative and travel support from Merck & Co., Inc. to present at an HPV vaccine symposium].

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