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The role of personal health beliefs and altruistic beliefs in young Chinese adult men's acceptance of the human papillomavirus vaccine

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Administering the human papillomavirus (HPV) vaccine to men offers substantial health benefits for both themselves and their female partners. In mainland China, the HPV vaccine has not been approved for men, and little is known about their acceptance of it. This study aims to assess the acceptability of HPV vaccine among young Chinese adult men and examine the association between personal health beliefs, altruistic beliefs, and HPV vaccination intentions and behavioral attempts. A cross-sectional study was conducted among male university students using a multistage cluster sampling method in eight universities across five districts in Zhejiang Province, China. Data were collected from December 2020 to January 2021 using a self-administered, anonymous online questionnaire. Of the 1937 participants, 1009 who had heard of the HPV vaccine completed the questionnaire. Over one-third (40.4%, 408/1009) had high levels of HPV and HPV vaccine knowledge. A total of 695 of 1009 (68.9%) expressed an intention to receive the HPV vaccine when available, and 329 of 1009 (32.6%) had proactively inquired about male HPV vaccination. Perceived susceptibility, perceived benefits, perceived gender barriers, and perceived benefits of male HPV vaccination for female partner were associated with HPV vaccination intentions. Lower perceived vaccine barriers, greater perceived benefits, and stronger vaccination intentions were associated with higher HPV behavioral attempts. There is an emerging demand for HPV vaccinations among young adult men in mainland China. Personal health beliefs and altruistic beliefs are crucial in promoting young adult men's acceptance of the HPV vaccine. Emphasizing both male-specific benefits and altruistic motivations may enhance HPV vaccine acceptability among young adult men.

Keywords Human papillomavirus vaccine, Young adult men, Personal health belief, Altruistic belief, Vaccine acceptability, China

Human papillomavirus (HPV) is the most common sexually transmitted infection globally, causing not only cervical cancer in women but also penile, oropharyngeal, and anal cancers in men^{1,2}. Universal HPV vaccinations for girls and young adult women have been proven cost-effective in numerous countries³. However, vaccination strategies for boys and young adult men have only been implemented in a few regions⁴⁻⁶. Evidence suggests that vaccinating men against HPV could provide substantial health benefits⁷. As male HPV infection significantly contributes to the infection and subsequent disease in women⁸, male HPV vaccination represents an essential public health strategy that could considerably reduce HPV-related diseases in men and decrease the disease burden in women through herd immunity^{9,10}.

Since the HPV vaccine's introduction in mainland China in 2016, three licensed HPV vaccines (bivalent, quadrivalent, and nine-valent HPV vaccine) have been available for women aged 9 to 45, but none are approved for men¹¹. Health information and media coverage have predominantly emphasized the benefits of HPV vaccine for women, often referring to it as a cervical cancer vaccine¹². This limited information may lead the public,

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particularly men, to perceive HPV infection primarily as a women's health issue and the vaccine as ineffective for men, potentially decreasing men's acceptance of HPV vaccine.

Recent attention in mainland China has focused on HPV vaccine acceptability among girls and young women^{13–15}, with few studies on men. Existing studies have shown that men are generally less aware of HPV infection and vaccination than women^{16,17}. Men often have limited awareness of the severity and susceptibility of HPV infection in men¹⁸, potentially contributing to lower HPV vaccine acceptability and increasing the risk of HPV infections in women¹⁹. Yet, these associations have not been extensively studied in Chinese males.

Although HPV vaccines are not available for men in mainland China, men play an important role in HPV vaccination decisions for their female family members^{20,21}. Highlighting the severity of HPV infection for female partners may enhance men's HPV prevention behaviors^{22,23}. Current studies in mainland China have revealed that men have knowledge gaps about the HPV infections and HPV-attributable cancers^{24,25}. Little is known about men's acceptance of the HPV vaccine, or whether personal health beliefs and altruistic beliefs would promote HPV vaccine acceptability among young Chinese adult men.

This study aims to: (1) assess HPV vaccine acceptability and its correlates among young Chinese adult men; and (2) examine the association between personal health beliefs, altruistic beliefs, and HPV vaccination intentions and behavioral attempts in men. Using the Health Belief Model (HBM), we identify health beliefs associated with HPV acceptability, proposing that perceived severity, susceptibility, barriers, and benefits are critical evaluations before engaging in health behavior²⁶.

Methods

Study design and setting

A cross-sectional study was conducted among male university students from December 2020 to January 2021 in Zhejiang, an eastern coastal province of China. Zhejiang hosts 109 institutions of higher education and over 1.2 million college and graduate students, ranking 4th in GDP among Chinese provinces. A multistage cluster sampling method was used to recruit the respondents. According to its geographical location and economic development level, Zhejiang is divided into five geographic regions: north, south, east, west, and central. First, one to two cities from each district were selected (Hangzhou, Wenzhou, Taizhou, Shaoxing, Ningbo, Quzhou, and Jinhua). Second, one to two universities were purposefully chosen from each city: Zhejiang University, Hangzhou Normal University, Wenzhou Medical University, Taizhou University, Shaoxing University, Ningbo University, Quzhou University, and Zhejiang Normal University. Third, several dormitory buildings were randomly selected from each university according to the distribution of majors and grades. Finally, young men were recruited from each selected dormitory through a simple random sampling method.

The Sample size was estimated using the standard formula for a cross-sectional study²⁷.

$$n = \frac{Z_{\alpha/2}^2 * P * (1 - P)}{\delta^2}$$

Assuming a maximum population variance of ($P=0.5$), a 95% confidence interval ($Z_{\alpha/2}=1.96$), and a 5% margin of error ($\delta=0.05$), the required sample size was 385. To account for a potential 10% non-response rate or invalid questionnaires, the minimum required sample size was increased to 424 participants. Inclusion criteria for participants were as follows: (1) male gender; (2) current university or college students in Zhejiang Province; (3) smartphone ownership; and (4) capability to independently complete the online questionnaire. Exclusion criterion included the inability to understand or complete the online questionnaire, or refusal to participate.

Data collection

Administrators from selected universities were contacted via telephone to obtain approval and cooperation. Five investigators were recruited from each study site and trained by professional research assistants from Zhejiang University before the survey. Data were collected using the online survey platform *Questionnaire Star*. According to each school's schedule, respondents from the randomly selected dormitories were invited to participate. Respondents were informed of the study's purpose before receiving a printed Quick Response code with detailed instructions for the electronic questionnaire. Anonymity and confidentiality were guaranteed. Completing the questionnaire took approximately 10–15 min. Participation was voluntary, with no monetary compensation or gift given. The questionnaire was pre-tested among 234 participants for clarity, feasibility, and reliability.

Ethics approval and consent to participate

The Zhejiang University School of Public Health Research Ethics Committee approved this study (ZGL202006-08). Participants were fully briefed on the study's objectives, anonymity, confidentiality, and voluntary nature, and provided informed consent. All methods were performed in accordance with the relevant guidelines and regulations.

Measures

HBM health beliefs

Items assessing HBM health beliefs were adapted from previous literature^{28,29} to reflect men's personal health beliefs about HPV infection and vaccination and altruistic beliefs toward female partners. Personal health beliefs included perceived severity, susceptibility, barriers, benefits, and vaccination intention. Altruistic beliefs included perceived severity and susceptibility of male HPV infection for female partner, and perceived benefits of male HPV vaccination for female partner. Each dimension was assessed with three to eight items on a five-point Likert

scale (1 = strongly disagree to 5 = strongly agree). Negatively stated items were reverse coded for consistency. Each dimension was scored by taking the average across all items within each dimension.

Socio-demographics and health and risk factor variables

Participants reported their age, ethnicity, education level, major, paternal and maternal education levels, monthly household income (RMB), place of residence, sexual experience, relationship status, history of HPV infection diagnosis, and family history of cervical cancer.

HPV and HPV vaccine awareness

Respondents' awareness of HPV and HPV vaccine was assessed with two "Yes" or "No" questions: "Have you heard of HPV before today?", and "Have you heard of the HPV vaccine before today?". Participants who answered "Yes" were classified as HPV aware and HPV vaccine aware, respectively. Only participants who were aware of HPV vaccine completed the entire questionnaire.

HPV and HPV vaccine knowledge

A 17-item questionnaire was used to assess HPV and HPV vaccine knowledge. Knowledge about HPV was assessed with 12 questions on transmission, susceptible populations, and clinical characteristics. Knowledge of the HPV vaccine was measured with five questions on protective effects and vaccination process. All questions were retrieved and adapted from existing literature^{14,30} and the World Health Organization (WHO)³¹, with good reliability (Cronbach alpha = 0.89). Responses were scored as "Yes" (1 point), "No" or "Don't know" (0 point). Total knowledge scores ranged from 0 to 17, categorized into high level of knowledge (score > 12) and low level of knowledge (score ≤ 12) based on the median total score.

HPV vaccination behavioral attempts

One question was used to measure men's vaccination behavioral attempts: "Have you ever proactively asked whether men could get the HPV vaccine?" (Yes/No).

Statistical analysis

Statistical analyses were conducted using SPSS version 24.0 (SPSS Inc., Chicago, IL, USA). Continuous variables were described as mean ± standard deviation (SD), while categorical variables were described as numbers and frequencies. Vaccination intentions were analyzed as both continuous and binary variables. A dimension score for vaccination intentions was dichotomized as positive intention (> 3 likely to vaccinate) or negative intention (≤ 3 did not plan to or was unsure about vaccination). A hierarchical multiple linear regression was employed to identify correlates of HPV vaccination intention. Model 1 included demographic variables, knowledge, and health and risk factor variables; Model 2 added personal health belief variables; and Model 3 added altruism belief variables. A multivariable logistic regression analysis, adjusting for all covariates, was used to explore factors associated with HPV vaccination behavioral attempts. Variables for regression models were selected based on HBM and empirical literature^{19,28,29} using the Enter method. A multicollinearity test excluded educational level due to high collinearity with age.

Results

Sample characteristics

In total, 1937 respondents completed the questionnaire online, with a response rate of 93.6% (Table 1). Respondents' age ranged from 18 to 30, with a mean age of 20.44 (SD = 2.23). Most respondents (77.6%, 1504/1937) were undergraduates and 20.1% (390/1937) majored in medicine. Nearly half (47.0%, 910/1937) came from urban areas, and 22.7% (439/1937) had a monthly household income of no more than 5000 RMB (\$725).

Before the survey, a considerable proportion of respondents had never heard of HPV (44.8%, 867/1937) or the HPV vaccine (47.9%, 928/1937). Ultimately, 1009 of the 1937 men who had heard of HPV vaccine completed the entire questionnaire. More than one-third of respondents (36.9%, 372/1009) reported having a female partner, while only 23.0% (233/1009) reported ever having sexual intercourse. Very few (1.6%, 16/1009) had a history of infection diagnosis, and only 2.5% (25/1009) had a family history of cervical cancer (Table 1).

HPV and HPV vaccine knowledge

Figure 1 shows the proportion of accurate responses to knowledge items. The majority of respondents were aware that HPV infections can cause cervical cancer and that the HPV vaccine can prevent cervical cancer to a certain extent. In addition, 65.2% (658/1009) correctly stated that HPV can also infect men, but only 44.1% (445/1009) recognized that HPV infection is common in daily life. Overall, only 5.1% (51/1009) of respondents answered all 17 HPV and HPV vaccine knowledge questions correctly, and 40.4% (408/1009) exhibited a high level of HPV and HPV vaccine knowledge.

HBM health beliefs and HPV Vaccination intention and behavioral attempt

Table 2 displays the means and SDs for all health belief variables. Based on factor analysis, the dimension of perceived barriers was divided into perceived gender barriers (including sexual stigmatization and value of male vaccination.) and perceived vaccine barriers (including vaccine safety, side effects, and price). Each HBM dimension had high internal consistency (Cronbach alpha: 0.86–0.97). Men scored relatively high in perceived severity of HPV infection for both themselves and their female partner, perceived benefits of vaccination both for themselves and their female partner, and perceived susceptibility of HPV infection for female partner. They

Characteristic	N (%)
Socio-demographics (<i>n</i> = 1937)	
Age (years), Mean (SD),	20.44 (2.23)
Ethnicity	
Ethnic minorities	84 (4.3)
Han nationality	1853 (95.7)
Education level	
Junior college student	74 (3.8)
Undergraduate	1504 (77.6)
Postgraduate and above	359 (18.5)
Major	
Non-medicine	1547 (79.9)
Medicine	390 (20.1)
Paternal education level	
Primary school and below	263 (13.6)
Junior high school	685 (35.4)
High school/technical secondary school	512 (26.4)
Junior college/university and above	477 (24.6)
Maternal education level	
Primary school and below	444 (22.9)
Junior high school	688 (35.5)
High school/technical secondary school	456 (23.5)
Junior college/university and above	349 (18.0)
Monthly household income (RMB)	
≤ ¥ 5000 (\$725)	439 (22.7)
¥ 5001–10,000 (\$725–1449)	635 (32.8)
¥ 10,001–20,000 (\$1450–2899)	551 (28.4)
> ¥ 20,000 (\$2899)	312 (16.1)
Place of residence	
Urban	910 (47.0)
Rural	1027 (53.0)
Awareness of HPV and HPV vaccine (<i>n</i> = 1937)	
Have you ever heard of HPV before today?	
No	867 (44.8)
Yes	1070 (55.2)
Have you ever heard of HPV vaccine before today?	
No	928 (47.9)
Yes	1009 (52.1)
HPV and HPV vaccine knowledge (<i>n</i> = 1009)	
Knowledge level	
Low	601 (59.6)
High	408 (40.4)
Health and risk factor (<i>n</i> = 1009)	
Ever had sex	
No	675 (66.9)
Yes	232 (23.0)
Refuse to answer	102 (10.1)
Currently have a female partner	
No	637 (63.1)
Yes	372 (36.9)
History of HPV infection diagnosis	
No/Not sure	993 (98.4)
Yes	16 (1.6)
Family history of cervical cancer	
No/Not sure	984 (97.5)
Yes	25 (2.5)

Table 1. Participants characteristics. Continuous variables are expressed as means ± standard deviations, and categorical variables as numbers (percentages). To ensure authenticity and validity of information, 1009 out of 1937 respondents who had heard of the HPV vaccine before the survey finished the entire questionnaire. HPV and HPV vaccine knowledge level was categorized according to the median of knowledge score into “low” knowledge (score ≤ 12) and “high” knowledge (> 12).

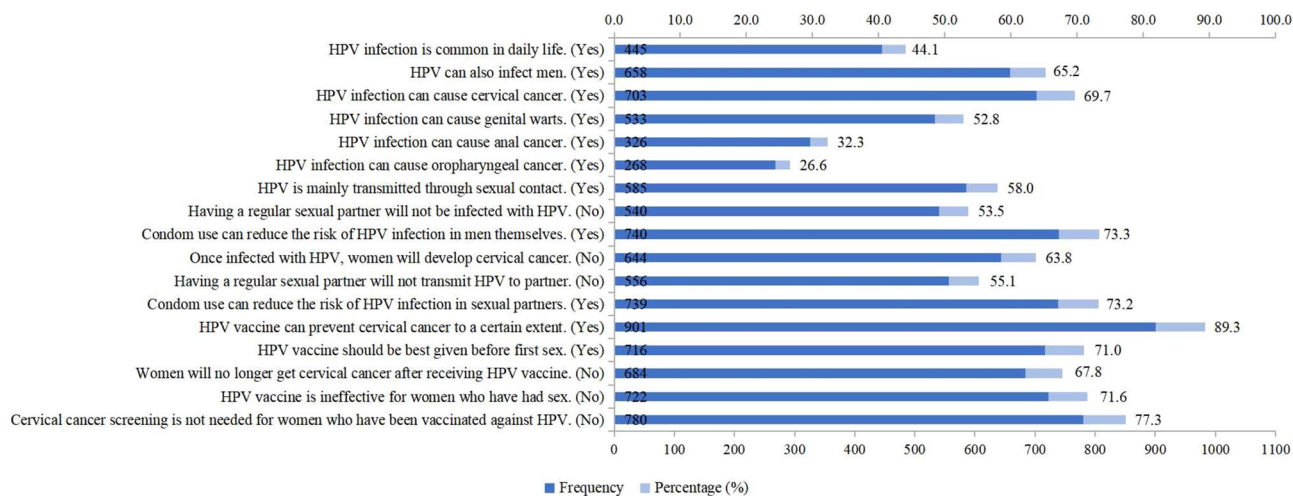


Fig. 1. Correct responses to HPV and HPV vaccine knowledge items ($n = 1009$).

HBM health beliefs	Mean (SD)
Personal health beliefs about HPV infection and vaccination	
Perceived severity	4.09 (0.82)
Perceived susceptibility	2.92 (0.95)
Perceived gender barriers	2.47 (0.87)
Perceived vaccine barriers	3.10 (0.83)
Perceived benefits	3.74 (0.65)
Altruism beliefs toward female partners	
Perceived severity of male HPV infection for female partner	4.18 (0.77)
Perceived susceptibility of male HPV infection for female partner	3.96 (0.85)
Perceived benefits of male HPV vaccination for female partner	4.08 (0.71)
Vaccination Intention	3.67 (0.78)
HPV vaccination behavioral attempt	N (%)
Ever proactively asked whether men could get the HPV vaccine	
No	680 (67.4)
Yes	329 (32.6)

Table 2. HBM health beliefs regarding HPV and HPV vaccination, HPV vaccination intentions, and HPV vaccination behavioral attempts ($n = 1009$). Scores on all HBM health beliefs, including vaccination intention, ranged from one to five, with higher values indicating more endorsement.

reported relatively low levels of perceived gender barriers and moderate levels of vaccine barriers and perceived susceptibility for themselves. Of 1009 young men, 68.9% (695/1009) reported an intention to vaccinate when available, and 32.6% (329/1009) reported proactively asking whether men could get the HPV vaccine before the survey.

Factors influencing HPV vaccination intentions

The results from hierarchical multiple linear regression analyses are presented in Table 3. In Model 1, men with a high knowledge level had greater vaccination intentions ($\beta = 0.22, p < 0.001$). Non-medicine male students expressed a greater willingness to be vaccinated than medicine male students ($\beta = -0.08, p = 0.009$). Altogether, demographic covariates accounted for approximately 4.5% of the variance in vaccination intention ($F = 3.52, p < 0.001$). In Model 2, perceived susceptibility ($\beta = 0.19, p < 0.001$) and perceived benefits ($\beta = 0.42, p < 0.001$) were positively associated with vaccination intention, and perceived gender barriers ($\beta = -0.13, p < 0.001$) negatively influenced vaccination intention. These variables explained an additional 27.0% of the variance ($F = 20.51, p < 0.001$), increasing the adjusted R^2 to 31.7%. After adjusting for potentially confounding factors, the final Model 3 explained an adjusted total variance of 33.8% ($F = 20.08, p < 0.001$). The results indicated that greater perceived benefits of male HPV vaccination for female partners ($\beta = 0.14, p < 0.001$) were associated with stronger HPV vaccination intentions.

Variables	Model 1			Model 2			Model 3		
	β	SE	<i>p</i>	β	SE	<i>p</i>	β	SE	<i>p</i>
1. Covariates									
Age	-0.02	0.01	0.615	0.01	0.01	0.917	-0.01	0.01	0.751
Ethnicity									
Ethnic minorities (Ref.)									
Han nationality	-0.06	0.12	0.069	-0.04	0.10	0.089	-0.04	0.10	0.148
Major									
Non-medicine (Ref.)									
Medicine	-0.08	0.06	0.009	-0.06	0.05	0.024	-0.06	0.05	0.021
Paternal education level									
Primary school and below (Ref.)									
Junior high school	0.01	0.09	0.840	0.01	0.07	0.848	0.01	0.07	0.902
High school/technical secondary school	0.02	0.10	0.655	0.03	0.08	0.473	0.03	0.08	0.504
Junior college/university and above	-0.01	0.11	0.974	-0.02	0.09	0.721	-0.03	0.09	0.608
Maternal education level									
Primary school and below (Ref.)									
Junior high school	0.04	0.07	0.413	0.02	0.06	0.653	0.01	0.06	0.715
High school/technical secondary school	0.05	0.09	0.259	0.04	0.07	0.370	0.03	0.07	0.433
Junior college/university and above	0.04	0.10	0.463	0.04	0.09	0.320	0.04	0.09	0.408
Monthly household income (RMB)									
\leq ¥ 5000 (\$725)									
¥ 5001–10,000 (\$725–1449)	-0.02	0.07	0.590	-0.01	0.06	0.876	-0.01	0.06	0.783
¥ 10,001–20,000 (\$1450–2899)	0.01	0.08	0.837	-0.01	0.06	0.845	-0.01	0.06	0.757
> ¥ 20,000 (\$2899)	0.02	0.09	0.670	0.02	0.07	0.580	0.01	0.07	0.696
Place of residence									
Urban (Ref.)									
Rural	-0.01	0.06	0.830	0.01	0.05	0.650	0.01	0.05	0.743
Knowledge level									
Low (Ref.)									
high	0.22	0.05	<0.001	0.05	0.05	0.060	0.05	0.05	0.069
Ever had sex									
No (Ref.)									
Yes	0.07	0.07	0.051	0.06	0.06	0.050	0.05	0.06	0.103
Refuse to answer	0.03	0.08	0.373	0.04	0.07	0.105	0.04	0.07	0.127
Currently have a female partner									
No (Ref.)									
Yes	0.00	0.05	0.946	-0.01	0.05	0.659	-0.02	0.05	0.445
History of HPV infection diagnosis									
No/Not sure (Ref.)									
Yes	-0.05	0.21	0.137	-0.03	0.18	0.238	-0.03	0.17	0.356
Family history of cervical cancer									
No/Not sure (Ref.)									
Yes	0.02	0.17	0.622	0.00	0.14	0.884	0.01	0.14	0.772
F = 3.52, Adj R ² = 0.045***									
Perceived severity				0.05	0.03	0.068	0.01	0.03	0.662
Perceived susceptibility				0.19	0.02	<0.001	0.17	0.02	<0.001
Perceived gender barriers				-0.13	0.03	<0.001	-0.11	0.03	<0.001
Perceived vaccine barriers				-0.04	0.03	0.143	-0.05	0.03	0.121
Perceived benefits				0.42	0.04	<0.001	0.35	0.04	<0.001
F = 20.51 Adj R ² = 0.317***									
3. Altruism beliefs									
Perceived severity of male HPV infection for female partner							0.04	0.04	0.305
Perceived susceptibility of male HPV infection for female partner							0.03	0.03	0.450
Continued									

Variables	Model 1			Model 2			Model 3		
	β	SE	<i>p</i>	β	SE	<i>p</i>	β	SE	<i>p</i>
Perceived benefits of male HPV vaccination for female partner							0.14	0.04	<0.001
							F = 20.08, Adj R ² = 0.338***		

Table 3. Hierarchical multiple linear regression analysis of HPV vaccination intentions among young men ($n = 1009$). Values expressed as standardized coefficient (β) and standard error (SE). Boldface indicates statistical significance ($*p < 0.05$, $**p < 0.01$, $***p < 0.001$). Model 1 included all covariates including demographic variables, knowledge, and health and risk factor variables. Model 2 added personal health belief variables, and Model 3 added altruism belief variables.

Factors associated with HPV vaccination behavioral attempts

In the multivariable logistic regression (Table 4), after adjusting for potential confounding factors, men who came from rural areas (OR = 1.61, 95% CI 1.14–2.28), had a high knowledge level (OR = 1.82, 95% CI 1.33–2.50), had a history of HPV infection diagnosis (OR = 7.51, 95% CI 1.83–30.89), and had a family history of cervical cancer (OR = 2.88, 95% CI 1.08–7.70) were more likely to exhibit vaccination behavioral attempts. Those who perceived greater vaccine barriers were 0.77 times (95% CI 0.63–0.93) less likely to have vaccination behavioral attempts, whereas those who perceived greater benefits of vaccination were 1.87 times (95% CI 1.38–2.53) more likely to make a behavioral attempt. Moreover, vaccination behavioral attempts were higher among men with stronger vaccination intentions (OR = 1.68, 95% CI 1.32–2.14).

Discussion

Global efforts to eliminate cervical cancer also focus on vaccinating boys and young men against HPV. However, little is known about the acceptance of HPV vaccine and its influencing factors among young Chinese men, as it has not yet been approved for men in mainland China. To our knowledge, this study, for the first time, examined the association between personal health beliefs, altruistic beliefs and HPV vaccine acceptability among young Chinese men. We found a relatively high rate of HPV vaccination intentions (68.9%) among young Chinese adult men and highlighted the importance of both personal health beliefs and altruistic beliefs in men's HPV vaccine acceptability.

Personal health beliefs and altruistic beliefs based on HBM were key factors influencing HPV vaccination intentions among young men in our study. Specifically, perceived susceptibility, perceived benefits, and perceived gender barriers were significantly associated with men's HPV vaccination intentions. These findings align with previous studies, which have suggested that men with higher perceived susceptibility and perceived benefits were more likely to exhibit HPV vaccination intentions^{32,33}. Our results revealed that perceived gender barriers, including sexual stigmatization and the value of male vaccination, were associated with vaccination intentions, adding to the previous studies on barriers influencing men's acceptance of HPV vaccine. The “feminization” of HPV may explain young men's gender barriers to vaccination acceptability³⁴. In mainland China, HPV vaccines are currently approved exclusively for women, and media and health campaigns predominantly target HPV-related health issues for women³⁵. This may inadvertently create the misconception that HPV is solely a health issue for women and so is the vaccine. It is vital to dispel these misconceptions, as such stigmatizing beliefs can potentially reduce men's acceptance of the vaccine.

As expected, greater perceived benefits of male HPV vaccination for female partners were associated with stronger HPV vaccination intentions after considering personal health beliefs and other potential confounding factors. This provides a new perspective for promoting health education on HPV vaccine uptake among target populations. It highlights the significance of “altruistic beliefs” in men's acceptance of HPV vaccine, emphasizing that both male-specific vaccine benefits and altruistic benefits may further enhance HPV vaccine acceptability among young adult men.

When analyzing factors associated with vaccination behavioral attempts, perceived vaccine barriers, perceived benefits, and vaccination intentions were the most highly related factors. Behavioral intention is widely recognized as a strong indicator of future actions and individuals with a strong intention typically proceed to corresponding behaviors^{36,37}. In mainland China, the absence of HPV vaccination programs for men complicates quantifying the impact of vaccination intentions on actual behaviors. However, recognizing the process between intention and behavior³⁸, we use “HPV vaccination behavioral attempts” to bridge this gap. Men with stronger intentions to receive the HPV vaccine were more likely to actively seek vaccination information. This underscores the importance of accessible information, such as eligibility and available resources for male HPV vaccination, in promoting vaccination uptake. Future research should assess not only men's willingness to receive HPV vaccination but also their actual behaviors, providing empirical evidence to support the gradual expansion of HPV vaccination programs in mainland China.

The young adult men in our study exhibited relatively high intentions (68.9%) to get vaccinated against HPV, which is higher than the proportion reported by Jia among male college students at Chinese colleges and universities³⁹ but lower than that found by Dai among students from seven Chinese universities⁴⁰. Moreover, 32.6% of participants had proactively asked whether men could get the HPV vaccine before the survey, indicating the demand for HPV vaccines among young men in mainland China. HPV infection is often considered to be a disease that predominately affects women but is underappreciated in men⁴¹. Related research has shown

Variables	OR (95%CI)	p
Age (mean, SD)	1.01 (0.95–1.08)	0.670
Ethnicity		
Ethnic minorities Ref	Ref	
Han nationality	0.58 (0.29–1.16)	0.124
Major		
Non– medicine	Ref	
Medicine	1.31 (0.94–1.82)	0.106
Paternal education level		
Primary school and below	Ref	
Junior high school	0.83 (0.49–1.40)	0.482
High school/technical secondary school	1.79 (1.01–3.10)	0.051
Junior college/university and above	1.36 (0.72–2.56)	0.339
Maternal education level		
Primary school and below	Ref	
Junior high school	0.98 (0.63–1.51)	0.923
High school/technical secondary school	1.09 (0.65–1.83)	0.741
Junior college/university and above	1.21 (0.65–2.23)	0.546
Monthly household income (RMB)		
≤ ¥ 5000 (\$725)	Ref	
¥ 5001–10,000 (\$725–1449)	0.81 (0.52–1.24)	0.330
¥ 10,001–20,000 (\$1450–2899)	0.69 (0.44–1.09)	0.113
> ¥ 20,000 (\$2899)	0.91 (0.55–1.51)	0.703
Place of residence		
Urban	Ref	
Rural	1.61 (1.14–2.28)	0.007
Knowledge level		
Low	Ref	
High	1.82 (1.33–2.50)	<0.001
Ever had sex		
No	Ref	
Yes	0.78 (0.53–1.16)	0.226
Refuse to answer	0.69 (0.41–1.17)	0.166
Currently have a female partner		
No	Ref	
Yes	1.13 (0.82–1.55)	0.468
History of HPV infection diagnosis		
No/Not sure	Ref	
Yes	7.51 (1.83–30.89)	0.005
Family history of cervical cancer		
No/Not sure	Ref	
Yes	2.88 (1.08–7.70)	0.035
Perceived severity	0.82 (0.67–1.01)	0.063
Perceived susceptibility	1.13 (0.95–1.35)	0.152
Perceived gender barriers	1.14 (0.93–1.38)	0.202
Perceived vaccine barriers	0.77 (0.63–0.93)	0.007
Perceived benefits	1.87 (1.38–2.53)	<0.001
Perceived severity of male HPV infection for female partner	0.90 (0.69–1.17)	0.426
Perceived susceptibility of male HPV infection for female partner	0.94 (0.74–1.20)	0.644
Perceived benefits of male HPV vaccination for female partner	0.82 (0.60–1.13)	0.229
HPV Vaccination intention	1.68 (1.32–2.14)	<0.001

Table 4. Multivariable logistic regression analysis of HPV vaccination behavioral attempts for young men ($n = 1009$). Values expressed as odds ratio (OR) and 95% confidence interval (CI). Hosmer–Lemeshow test: chi-square = 17.351, p -value = 0.127. Nagelkerke $R^2 = 0.208$. Ref = Reference category in logistic regression analysis. Boldface indicates statistical significance.

that HPV infections are also common among men in China, and the most prevalent types of HPV infection are similar between men and women in some regions^{42,43}. Additionally, one prior study investigated the genotypes of genital HPV among male individuals attending a sexually transmitted disease clinic at Beijing Ditan Hospital, showing that the most prevalent HPV types observed could be covered by the available HPV vaccines⁴⁴. Thus, future consideration needs to be given to extending vaccination targets in China to include adolescent and young adult men.

The findings also indicate that young adult men continue to lack knowledge and need basic information about HPV and HPV vaccine. We found that most male college students were unaware of the HPV transmission route, susceptible population, and common diseases that HPV may cause in men. However, they generally demonstrated a relatively good understanding of the role of HPV vaccines in protecting women. These results reaffirmed that health information concerning HPV and HPV vaccines has been geared toward women. Future health education should explicitly address the effects of HPV infection on men and its transmission between partners to improve HPV knowledge among men.

This study acknowledges several limitations. First, the cross-sectional study design limits our ability to infer the causal relationship between personal health beliefs, altruistic beliefs, and HPV vaccine acceptability. The self-reported data might be susceptible to recall bias and social desirability bias. Second, we did not measure actual vaccination behavior since HPV vaccines have not been approved for men in mainland China. While vaccination intentions and behavioral attempts may be subject to social desirability bias, our findings will be essential for health education and interventions to promote HPV vaccination among young men when the vaccine becomes available for them in mainland China. Third, our study did not adequately account for the potential differences between heterosexual men and gay and bisexual men due to the sensitivity of sexual orientations. This bias has been minimized by classifying men based on their relationship status, specifically whether they have a female partner. We also did not differentiate between students in clinical majors and those in other medical fields, leading to an increased proportion of medical students. This may not fully capture the diversity of students across different disciplines in China. Finally, the subjects of this study were highly educated university students, which may limit the generalizability of our findings. Future studies need to be conducted among more diverse and broader populations to validate these findings.

Conclusions

Our study underscores the importance of both personal health beliefs and altruistic beliefs in promoting HPV vaccine acceptability among young Chinese men. We found that perceived susceptibility, perceived benefits, perceived gender barriers, and perceived benefits of male HPV vaccination for female partners were significantly associated with men's HPV vaccination intentions. Public health campaigns should focus on addressing gender barriers and highlighting the benefits of HPV vaccination for both men and their female partners. Tailored health education efforts emphasizing both personal health benefits and relational altruism could enhance HPV vaccine uptake among young men in mainland China.

Data availability

The datasets generated and/or analyzed during the current study are not publicly available, as the researcher has committed to restricting data availability solely for the purposes of the current study license. The instruments and datasets are, however, available from the corresponding author upon reasonable request.

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Author contributions

W. W. conceptualized and designed the study; W. W. collected and analyzed the data; W. W. drafted and reviewed the manuscript, and provided final approval.

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Competing interests

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Additional information

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