

RESEARCH ARTICLE



# Factors influencing Chinese female college students' willingness to receive human papillomavirus vaccine: A cross-sectional study based on information-motivation-behavioral skills model

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## ABSTRACT

China bears heavy disease burden of cervical cancer, but the willingness to receive human papillomavirus (HPV) vaccine is low. This study aimed to assess the factors affecting the willingness of Chinese female college students to receive HPV vaccine based on the information-motivation-behavior skills (IMB) model. A cross-sectional study was carried out in Henan University of Engineering in February 2020. Demographic characteristics and IMB model variables were collected using an anonymous questionnaire. A structural equation model was constructed to assess influencing factors of HPV vaccination willingness in the IMB model variables using AMOS 24.0. A total of 449 participants completed the survey. Among them, 23.4% were willing to get the HPV vaccine in the next 6 months. The average scores of knowledge, motivation, and behavioral skills were  $1.72 \pm 1.07$ ,  $11.69 \pm 1.71$ , and  $10.14 \pm 1.86$ , respectively. The final revised model indicated a good fit to the data ( $\chi^2/df = 1.684$ , goodness of fit index = 0.984, adjusted goodness of fit index = 0.959, root mean square error of approximation = 0.044). The results of the model showed that the behavioral skills ( $\beta = 0.318$ ,  $P < .001$ ) were positively related to the willingness of HPV vaccination uptake among female students. Moreover, motivation ( $\beta = 0.475$ ,  $P < .001$ ) positively affected students' behavioral skills toward HPV vaccination, which further influenced their willingness of HPV vaccination uptake. HPV-preventive interventions for female students should focus on enhancing motivation and strengthening behavioral skills to increase the willingness to receive HPV vaccine and reduce HPV infection.

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## Introduction

Cervical cancer is one of the most common malignant tumors in women, with 604,127 new cases and 341,831 deaths worldwide in 2020. Low- and middle-income countries account for 88% of new cases and 91% of deaths from cervical cancer worldwide.<sup>1</sup> In China, there were an estimated 100,741 new cases and 59,060 deaths related to cervical cancer in 2020<sup>1</sup>, indicating the heavy disease burden of cervical cancer in the population.

Persistent infection of high-risk human papillomavirus (HPV) is the primary cause of cervical cancer.<sup>2</sup> In 2006, the prophylactic HPV vaccine was first licensed in high-income countries, providing an effective way for primary prevention of cervical cancer. Currently, HPV vaccines have been approved in more than 100 countries. Evidence demonstrated that since the HPV vaccine was introduced into the United States in 2006, the incidence rates of both cervical squamous cell carcinoma and adenocarcinoma have declined among young women aged 15–20 years, a population not regularly screened for cervical cancer.<sup>3</sup> Given the availability of effective tertiary prevention measures for cervical cancer, the World Health Organization (WHO) called for action toward eliminating cervical cancer as a public health problem in 2018.<sup>4</sup> According to the WHO,

prepubescent girls aged 9–14 years are the primary target population recommended for HPV vaccination.

China has also taken action toward cervical cancer prevention and control. Recently, the “Healthy China Action – Implementation Plan for Cancer Prevention and Control (2019–2022)” was announced by the Chinese government, and the action plan proposed to promote HPV vaccination in the target population.<sup>5</sup> However, the imported HPV vaccine was introduced into mainland China in 2016,<sup>6</sup> ten years later than abroad. Therefore, the acceptance of the HPV vaccine was low.<sup>7–11</sup> In addition, the HPV vaccine is not covered by the national expanded program on immunization, so it is difficult to achieve a high HPV vaccine uptake rate in eligible adolescents in mainland China.

Many studies have investigated the factors influencing the willingness of HPV vaccination. It is currently believed that HPV vaccine-related knowledge, perception, motivation, and behavioral-related issues all have an impact on the acceptance of HPV vaccination. However, the main influencing factors may be different among different populations. Although the primary target population recommended by WHO are prepubescent girls aged 9–14 years, currently in China, the implementation of vaccines for this age group is relatively limited,

and vaccination is mainly in women aged 18–45 years, especially female college students younger than 27 years. To improve the willingness to receive HPV vaccine, it is necessary to explore the main influencing factors. The results would also provide a reference for the promotion of the optimal recommended age group of 9–14 years in the future.

The present study uses the information-motivation-behavioral skills (IMB) model as a theoretical framework to explore the influencing factors of Chinese female college students' willingness to receive human papillomavirus vaccine. The IMB model proposes that an individual needs information about a target behavior, personal and social motivation to engage in the behavior, and behavioral skills to correctly perform the behavior in order to fully adopt a health behavior. And it has been widely used in HIV/AIDS and chronic disease interventions in recent years, covers comprehensive and multi-level influencing factors and takes realistic factors into account. Therefore, this study focuses on Chinese female college students and explores the main factors affecting their willingness to receive HPV vaccination by using IMB model, in order to provide data for effective targeted measures to increase the vaccination rate in the future.

## Methods

### Study participants

This cross-sectional study was conducted in February 2020, and participants were recruited online from Henan University of Engineering located in Zhengzhou, Henan Province. Specifically, we sent the electronic version of the informed consent form to the tutor, who guided the students to view it in the class, and then we included the voluntary participants in each class as the research object. Female first-year students older than 18 years were invited to participate in the study. The exclusion criteria were as follows: Medical students; those who had a previous history of vaccination contraindications, and the vaccination contraindications mainly refers to hypersensitivity to the active ingredient or any auxiliary ingredient of the vaccine. Ethical approval of the study was obtained from the Institutional Review Board of the Chinese Center for Disease Control and Prevention on 24 October 2019 (No. 201918–01). All participants signed informed consent.

### Data collection and measurement

The questionnaire was filled in anonymously and independently on a mobile app on the students' personal phones, and the content of the questionnaire included sociodemographic information, participants' information concerning HPV, motivation for vaccination, behavioral skills regarding HPV vaccination, and willingness to HPV vaccination uptake.

For information concerning HPV, there were three items, and the answers were "Agree," "Disagree," or "I do not know."<sup>12,13</sup> Each correct answer scored 1 point, while incorrect or unknown answers scored 0 points. The total score of the information questions was derived by adding the number of correct responses. Motivation and behavioral skills for vaccination were measured by three items, respectively.<sup>12–17</sup>

Answers for these items were measured on a 5-point Likert scale (1=strongly disagree, 2=disagree, 3=neither disagree nor agree, 4=agree, 5=strongly agree). The total score of each dimension was obtained by summing the responses of the items in the corresponding dimension. The willingness to HPV vaccination uptake was evaluated by one item: "Would you like to get HPV vaccination in the next six months."

After the questionnaire was completed, the trained investigators would check and correct the logical error of the questionnaire or exclude the unqualified surveys.

### Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics 25.0. Chi-square or Fisher's exact test analysis was used to compare demographic characteristics between students willing to receive the HPV vaccine within six months and those who were not. Structural Equation Modeling (SEM) was applied to examine the factors influencing students' willingness to receive the HPV vaccine within six months using IBM SPSS AMOS 24.0. The CFA measurement model included three latent constructs (information, motivation, and behavioral skills) that predicted its indicators. Model fit was assessed using the ratio of chi-square values to degrees of freedom ( $\chi^2/df$ ), the goodness of fit index (GFI), the adjusted goodness of fit index (AGFI), and the root means the square error of approximation (RMSEA). A  $\chi^2/df$  ratio of 3 or less, a GFI greater than 0.900, AGFI greater than 0.900, and an RMSEA lower than 0.060 indicated an acceptable model fit. Statistical significance was set at  $P < .05$  (2-tailed test).

## Results

### Characteristics of subjects

A total of 455 students completed the survey, of which 6 students (1.3%) had HPV vaccination and were excluded. The remaining 449 unvaccinated students were included in the final analysis. Most students were Han Nationality (98.9%), lived in rural areas (56.6%), and had an average living expense of 1 000 to 2 000 yuan (63.0%) per month. Among them, 77.1% of their parents were married, and 60.1% of them had junior middle school education or less. About 52.1% and 51.0% of the students had heard of HPV-related diseases and HPV vaccine, respectively. More details are shown in Table 1.

Among the 449 students, 23.4% expressed their willingness to receive the HPV vaccine in the next six months. Students living in urban areas who heard of HPV-related diseases and HPV vaccine were more willing to HPV vaccination uptake in the next six months ( $P < .05$ ).

### Confirmatory factor analysis

Three latent variables were extracted in this study, including information, motivation, and behavioral skills. The Cronbach's alpha of information, motivation, and behavioral skills were 0.600, 0.784, and 0.798, respectively, indicating that the three latent variables had adequate internal consistency. Three observation variables respectively measured the three latent

**Table 1.** Demographic characteristics of the subjects.

| Variables   | All<br>N (%) | Willingness to adopt HPV vaccine within 6 months |            | P     |
|---|--------------|--|------------|-------|
|   |              | Yes (%)  | No (%)     |       |
| Ethnicity   |              |  |            | 1.000 |
| Han   | 444 (98.9)   | 104 (99.1)                                       | 340 (98.8) |       |
| Other   | 5 (1.1)      | 1(0.9)   | 4 (1.2)    |       |
| Permanent residence (for more than one year)          |              |  |            | 0.034 |
| Urban   | 195 (43.4)   | 55 (52.4)  | 140 (40.7) |       |
| Rural   | 254 (56.6)   | 50 (47.6)  | 204 (59.3) |       |
| Marital status of parents                             |              |  |            | 0.299 |
| In marriage   | 346 (77.1)   | 77 (73.3)  | 269 (78.2) |       |
| Other   | 103 (22.9)   | 28 (26.7)  | 75 (21.8)  |       |
| Education level of parents                            |              |  |            | 0.360 |
| Junior high school or below                           | 270 (60.1)   | 58 (55.2)  | 212 (61.6) |       |
| Senior high school (including vocational high School) | 137 (30.5)   | 34 (32.4)  | 103 (30.0) |       |
| College (including technical college) and above       | 42 (9.4)     | 13 (12.4)  | 29 (8.4)   |       |
| Living Expenses (RMB/month)                           |              |  |            | 0.107 |
| <1000   | 154 (34.3)   | 29 (27.6)  | 125 (36.4) |       |
| 1000–2000   | 283 (63.0)   | 71 (67.6)  | 212 (61.6) |       |
| >2000   | 12 (2.7)     | 5 (4.8)  | 7 (2.0)    |       |
| Major in school                                       |              |  |            | 0.516 |
| Science   | 196 (45.0)   | 43 (42.2)  | 153 (45.8) |       |
| Liberal art   | 240 (55.0)   | 59 (57.8)  | 181 (54.2) |       |
| Ever heard of HPV                                     |              |  |            | 0.001 |
| Yes   | 234 (52.1)   | 70 (66.7)  | 164 (47.7) |       |
| No  | 215 (47.9)   | 35 (33.3)  | 180 (52.3) |       |
| Ever heard of the HPV vaccine                         |              |  |            | <.001 |
| Yes   | 229 (51.0)   | 70 (66.7)  | 159 (46.2) |       |
| No  | 220 (49.0)   | 35 (33.3)  | 185 (53.8) |       |

variables, and the specific observation indicators are shown in Table 2. All factor loadings for the IMB variables were significant ( $P < .001$ ), indicating that the hypothesized latent construct predicted well its proposed manifest indicators (Table 2).

### Information-motivation-behavioral skills path model

The model has been modified according to the corresponding fit indexes. The revised model is shown in Figure 1. The fit

indexes for the model were acceptable:  $\chi^2/df = 1.684$ , GFI = 0.984, AGFI = 0.959, and RMSEA = 0.044 (Table 3).

The parameters and tests of significance of the individual paths of the hypothesized IMB model are presented in Table 4 and Figure 1. Consistent with the IMB model, our study indicated that behavioral skills ( $\beta = 0.318$ ,  $P < .001$ ) predicted the willingness of the HPV vaccine uptake. Behavioral skills were predicted by motivation ( $\beta = 0.475$ ,  $P < .001$ ). However, in contrast to the IMB model, information and motivation were not

**Table 2.** Cronbach's alpha and confirmatory factor analysis.

| Constructs        | Variables   | Corresponding items   | Item scores  | Cronbach's alpha | Factor loading |
|-------------------|-------------|---|--|------------------|----------------|
| Information       | Ia          | HPV is related to sexual behavior   | 1 = Agree; 0 = Disagree or do not know   | 0.600            | 0.72           |
|                   | Ib          | HPV infection may result in oral cancer, condyloma acuminatum, and anal cancer                            | 1 = Agree; 0 = Disagree or do not know   |                  | 0.53           |
|                   | Ic          | Regular cervical cancer screening is unnecessary after HPV vaccination                                    | 1 = Disagree; 0 = Agree or do not know   |                  | 0.71           |
| Motivation        | Ma          | Getting vaccinated for HPV will help protect one from HPV infection                                       | 1 = strongly disagree, 2 = disagree, 3 = neither disagree nor agree, 4 = agree, 5 = strongly agree | 0.784            | 0.78           |
|                   | Mb          | Getting vaccinated for HPV will reduce one's risk of cervical cancer                                      | 1 = strongly disagree, 2 = disagree, 3 = neither disagree nor agree, 4 = agree, 5 = strongly agree |                  | 0.79           |
|                   | Mc          | It is necessary to vaccinate against HPV even if you are in a committed relationship                      | 1 = strongly disagree, 2 = disagree, 3 = neither disagree nor agree, 4 = agree, 5 = strongly agree |                  | 0.67           |
| Behavioral skills | Ba          | I feel confident in my ability to get vaccinated for HPV, even if worried about the possible side effects | 1 = strongly disagree, 2 = disagree, 3 = neither disagree nor agree, 4 = agree, 5 = strongly agree | 0.798            | 0.77           |
|                   | Bb          | I feel confident in my ability to get vaccinated for HPV, even if getting the shot hurts a little         | 1 = strongly disagree, 2 = disagree, 3 = neither disagree nor agree, 4 = agree, 5 = strongly agree |                  | 0.86           |
|                   | Bc          | I feel confident in my ability to get vaccinated for HPV, even if it is expensive                         | 1 = strongly disagree, 2 = disagree, 3 = neither disagree nor agree, 4 = agree, 5 = strongly agree |                  | 0.64           |
| Willingness       | Willingness | Would you like to get the HPV vaccine in the next 6 months  | 1 = Yes; 0 = No  | —                | —              |

significantly correlated with willingness, while motivation indirectly predicted the willingness mediated by behavioral skills.

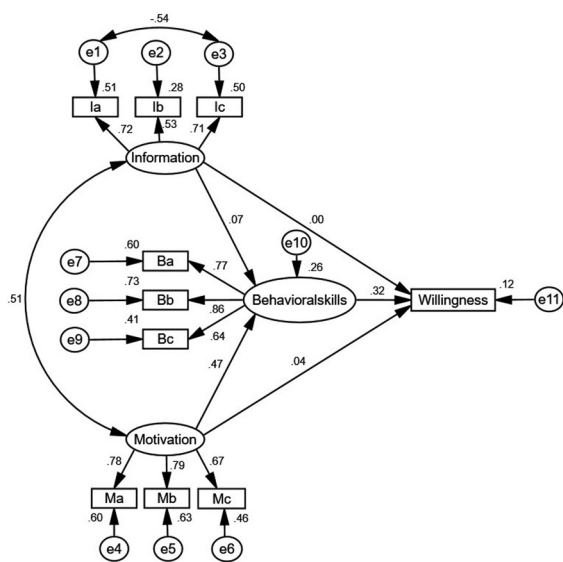
## Discussion

This study investigated the willingness of Chinese female college students to receive the HPV vaccine in the next six months and explored the influencing factors of female college students' willingness to vaccinate against HPV based on the IMB model. The results showed that only 23.4% of female college students were willing to get HPV vaccination in the next six months. Behavioral skills were the direct factor affecting HPV vaccination willingness, and motivation had an indirect impact on HPV vaccination willingness through behavioral skills. The

results indicated that the health education of HPV vaccine needs to be further strengthened in the future, and also provided directions for the future health education of HPV vaccine, for example, for female college students, more emphasis should be placed on the education of HPV vaccination motivation and behavioral skills.

The results of the study showed that, among Chinese female college students, less than one-fourth of students had the willingness to receive the HPV vaccine in the next six months. Previous researches in China showed that among female college students, the willingness to receive the HPV vaccine was 36% – 73%,<sup>10,11,18</sup> which is much higher than the percentage found in our study. Firstly, there was no time frame of vaccination in the previously reported studies when investigating the willingness of the HPV vaccine uptake, while our study specifically asked their willingness to receive the HPV vaccine within the next six months. The HPV vaccine was introduced in mainland China in 2016, which has been purchased mainly by women aged 18–45 years, and the actual vaccination age was postponed due to insufficient knowledge about the HPV vaccine. Secondly, the acceptance of the HPV vaccine may be correlated with the health level and the local social and cultural background. This is also proved by the difference found in vaccination willingness between urban and rural women in our study. In short, the current results suggested that young women in college have a low willingness to the HPV vaccination uptake. Therefore, to implement the global plan to eliminate cervical cancer, it is essential to find out the influencing factors of HPV vaccination willingness and take targeted actions to improve vaccination willingness.

The structural equation model designed in our study indicated a good fit among female college students. The results of the final IMB model showed that the willingness of students to receive the HPV vaccine in the next six months was mainly predicted by behavior skills, and there was no significant direct pathway from information and motivation to the willingness, in contrast to our initial hypothesis. This finding also was against the classic IMB model proposed by Fisher.<sup>19</sup>



Chi-square=39.046 DF=29 Chi/DF=1.346 GFI=.983 AGFI=.968 RMSEA=.028

**Figure 1.** The Information-Motivation-Behavioral Skills model of willingness of human papillomavirus vaccination uptake among Chinese female college students (N = 449). Path coefficients are standardized.

**Table 3.** The fit indices of the revised model.

|                    | $\chi^2$ | df  | $\chi^2/df$ | GFI    | AGFI   | RMSEA  |
|--------------------|----------|-----|-------------|--------|--------|--------|
| Recommended Values | N/A      | N/A | <3.000      | >0.900 | >0.900 | <0.060 |
| Revised model      | 23.573   | 14  | 1.684       | 0.984  | 0.959  | 0.044  |

**Table 4.** Path coefficients of the final IMB model.

| Pathway                         | Regression coefficient | Standardized regression coefficient | SE    | P      |
|---------------------------------|------------------------|-------------------------------------|-------|--------|
| Behavioral skills ← Motivation  | 0.552                  | 0.475                               | 0.086 | <0.001 |
| Behavioral skills ← Information | 0.076                  | 0.065                               | 0.076 | 0.317  |
| Bb ← Behavioral skills          | 0.548                  | 0.857                               | 0.030 | <0.001 |
| Ba ← Behavioral skills          | 0.48                   | 0.771                               | 0.030 | <0.001 |
| Ia ← Information                | 0.356                  | 0.717                               | 0.038 | <0.001 |
| Ib ← Information                | 0.264                  | 0.53                                | 0.030 | <0.001 |
| Ic ← Information                | 0.311                  | 0.707                               | 0.034 | <0.001 |
| Willingness ← Behavioral skills | 0.116                  | 0.318                               | 0.022 | <0.001 |
| Willingness ← Information       | -0.001                 | -0.003                              | 0.026 | 0.967  |
| Willingness ← Motivation        | 0.017                  | 0.041                               | 0.030 | 0.562  |
| Bc ← Behavioral skills          | 0.399                  | 0.638                               | 0.030 | <0.001 |
| Ma ← Motivation                 | 0.536                  | 0.777                               | 0.031 | <0.001 |
| Mb ← Motivation                 | 0.492                  | 0.791                               | 0.028 | <0.001 |
| Mc ← Motivation                 | 0.493                  | 0.675                               | 0.034 | <0.001 |

However, there are relevant model studies showing similar results to the obtained in our analysis, such as the IMB model with curbside recycling behavior proposed by Seacat<sup>20</sup> and the model with essential medicines prescribing behavior proposed by Zhao.<sup>21</sup> The reason may be attributed to the predictive variable. As supported by Fisher,<sup>22</sup> information and motivation have no direct effect on the target behavior when the behavior itself is very complex or requires multiple behavioral skills to achieve it. Here, since the coverage of HPV vaccination of the female college students in our study was too low to be used as a target behavior variable to construct a model, we selected a variable that could reflect the vaccination rate to a certain extent – the willingness to uptake HPV vaccine in the next six months. The willingness to receive HPV vaccination uptake is complex; it is not only influenced by a variety of internal and external factors, such as the information and motivation to HPV vaccination but also requires multiple behavioral skills. Moreover, perceptions of social support from significant others to get the vaccine could also affect the willingness to receive the HPV vaccine.<sup>17,23</sup>

The results showed that behavior skill was the direct factor affecting the willingness to the HPV vaccination uptake. At the same time, motivation for vaccination and HPV vaccine-related knowledge also indirectly affected the willingness through behavior skills. Therefore, to improve the HPV vaccination willingness of female college students in the future, it is necessary to start from the following aspects: first, it is essential to strengthen the education of HPV vaccine-related knowledge in society.<sup>24–27</sup> Vaccine information was related to vaccination motivation and affected the willingness to vaccination through behavior skills. This is also confirmed by the results of our study, which showed that students who had heard of HPV and HPV vaccine before had a much higher willingness to receive the HPV vaccine than those who had not heard of it. Second, the vaccination motivation should be improved; the motivation is not only related to their vaccine-related knowledge but also affected by the acceptance of the HPV vaccine of significant others and social factors. In addition, behavioral skills directly affected the willingness and vaccination behavior, so the behavioral skills of female groups should also be improved. It is worth mentioning that although the subjects of this study were female college students over 18 years of age who are in the sub-optimal age group recommended for vaccination, for the current form of vaccination in China, the results of this study could also provide a reference for the promotion of the optimal recommended age group of 9–14 years in the future. In addition, studies have also suggested that HPV vaccination for adolescents mainly depends on the intent of their parents.<sup>8,28</sup> Therefore, future health education interventions should not only focus on adolescents but also consider their parents.

For the promotion of the HPV vaccination, it needs the participation of the whole society. As health care providers, medical personnel should enhance the awareness of publicity and health education communication skills. Specifically, health education venues could not be limited to hospitals and community health service centers. For example, medical personnel can choose schools, enterprises, public institutions or other

places to carry out health education. And the content of health education can also be customized according to different groups. Through various forms of health education, women's awareness of prevention and treatment of cervical cancer and behavioral skills would be improved. Moreover, the government can provide policy guidance from the following aspects. Firstly, encourage some regions to take the lead, carry out more flexible HPV vaccine financing methods and vaccination policies, so as to play a leading role of demonstration regions; Secondly, accelerate the production and approval process of more high-quality domestic HPV vaccines, ensure the sustainable supply of HPV vaccines, and make it possible to realize the expanded application of vaccines; In addition, promote HPV vaccine supply enterprises to set reasonable prices through various forms such as price negotiation and centralized procurement, so as to improve the vaccine accessibility in rural areas.

Several potential limitations of our study should be noted. First, data were collected through a self-report questionnaire, which may lead to information bias. Second, the study was carried out among female college students in a university, and the HPV knowledge and vaccine receptivity may vary widely by region, sociodemographic factors, and education level may limit the generalizability of the results. Third, the observed indexes included in the final model were relatively few and not comprehensive enough, which needs to be further explored. In addition, since the HPV vaccination rate of the female college students we surveyed was too low to be used as a target behavior variable to construct a model, we selected a variable that could reflect the vaccination rate to a certain extent – the willingness of the HPV vaccine uptake in the next six months. Finally, this was a cross-sectional study and can only detect the correlation among model constructs observed at a single time point. However, the HPV vaccination behavior was a dynamic process. Thus, longitudinal studies should be conducted to evaluate the influencing factors of HPV vaccination.

Our study found that the willingness of Chinese female college students to adopt the HPV vaccination was low. According to the IMB model, behavioral skills of the HPV vaccination were the direct factor influencing the willingness to the HPV vaccination uptake, but the information and motivation may also influence the willingness indirectly. Therefore, HPV preventive interventions for female students should focus on strengthening behavioral skills to increase the willingness of HPV vaccination uptake and improve the vaccination rate. Our findings provide valuable information for the promotion of HPV vaccination in the future.

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## Disclosure statement

No potential conflict of interest was reported by the author(s).

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