




Exploring Predictors of HPV Vaccination Decisions: A Stage-Based Study on Chinese Parents of Girls

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Purpose: To assess the predictors of Chinese parents of girls' decision stage about the Human Papillomavirus (HPV) vaccination.

Patients and Methods: Two hundred and seventy-three parents of girls aged 9–17 with no HPV vaccination history were recruited to complete an online survey between September–December 2023. We assessed factors thought to influence decisions about HPV vaccination, including sociodemographics, HPV general knowledge, HPV vaccination knowledge, attitudes, and decisional conflict. Parents were asked to choose the decision stages among Stage 1 (have not thought), Stage 2 (considering), and Stage 3 (decided). Predictors of the decision stage were assessed with univariate and multivariate multinomial logistic regression.

Results: The parents of the three decision stages accounted for 48.4%, 29.7%, and 22.0%, respectively. Parents of older girls were more likely to be in the “considering” stage (OR = 1.29) than the “haven't thought” stage. A higher sense of being uninformed was associated with lower odds of being in the “considering” stage (OR = 0.97). Additionally, greater feelings of uncertainty were linked to lower odds of being in the “decided” stage (OR = 0.95) than the “haven't thought” stage.

Conclusion: This study highlights the importance of understanding the various stages of decision-making in HPV vaccination among Chinese parents. Parents' subjective feelings of being informed and certainty appear to be significant factors in advancing through the decision-making stages. Future research should develop and explore the impact of specific knowledge and valued based tools and decision aids.

Keywords: decision stage, decisional conflict, human papillomavirus, China, papillomavirus vaccination

Introduction

Human Papillomavirus (HPV) can cause a wide range of health issues, with low-risk strains causing benign warts while high-risk types, notably HPV 16 and 18, elevate the risk of cervical, anal, and other cancers.¹ According to the World Health Organization (WHO), HPV can cause cancer in approximately 625,600 women and 68,400 men each year globally, which is 5% of all cancers.² HPV exerts a huge burden on financial and healthcare burden with billions of lifetime direct medical costs.^{3,4}

In China, the prevalence of HPV among women is estimated at 18.4%, with the rate of high-risk HPV infections exceeding 15%.⁵ Cervical cancer continues to be a major public health issue, with approximately 106,000 new cases and 48,000 deaths each year.⁶ These statistics highlight the pressing need for effective preventive measures.

While safe sexual practices and a healthy lifestyle are crucial for preventing HPV, HPV vaccines offer broader protection when administered at an early age. HPV vaccines can prevent persistent infections with high-risk HPV strains and significantly reduce the incidence of cervical cancer and precancerous lesions.⁷ Therefore, countries worldwide have been promoting HPV vaccination since 2006, with the World Health Organization recommending it starting in 2009.⁸ Countries around the world have different target populations (eg, vaccination only for girls or for both boys and girls) and recommended age groups, as well as varying delivery strategies.⁹ As for China, HPV vaccines were introduced in 2016, and currently, women aged 9 to 45 are eligible for vaccination.¹⁰ More importantly, HPV vaccines are not included in the national immunization program and must be self-funded, with the three-dose series costing over \$400.^{11,12}

Unfortunately, global HPV vaccination coverage was only 12.2% in 2018, and in China, the rate was even lower, with 10.15% of the first-dose cumulative coverage in 2022.^{13,14} There is a significant body of research identifying factors that contribute to parents' refusal or hesitancy to agree to HPV vaccination, including inadequate knowledge, negative attitudes toward the vaccine, and the absence of publicly funded vaccination programs in certain countries.^{15,16} Most studies to date have approached this issue as a binary outcome—vaccinated or not vaccinated.¹⁷ While some research has explored the stages of HPV vaccine decision-making and the predictors of these stages among Canadian parents, no study has yet compared the decision-making processes of parents of girls regarding HPV vaccination in China.^{18,19} In East Asian cultures, the patriarchal family structure often means that parents play a crucial role in making decisions for their children, with children relying heavily on their parents' advice.^{20,21} Moreover, previous studies have confirmed that parents tend to prioritize different factors when making decisions for themselves compared to their children.²² Therefore, examining parents' decision-making regarding their children's vaccination is especially important in this cultural context.

Materials and Methods

Study Design and Population

This was a cross-sectional study conducted between September to December 2023. All mainland China jurisdictions at this time provided self-paid HPV vaccines.

This study targeted parents and/or guardians (hereafter referred to as parents) of girls aged 9–17 years. The inclusion criteria for parents were having a daughter aged 9 to 17 years who had not received the HPV vaccine. The exclusion criteria included parents whose daughters were ineligible for HPV vaccination, specifically: 1) girls who had experienced a severe allergic reaction to any component of the HPV vaccine, such as yeast, amorphous aluminum hydroxyphosphate sulfate, or Polysorbate 80; 2) girls who were in a critical or terminal condition (with a life expectancy of 6 weeks or less). Parents with multiple daughters who met the inclusion criteria were asked to complete the questionnaire based on the daughter they selected, to ensure randomization.

This study was implemented by Wenjuanxing (a Chinese online survey service provider), and the first page of the online questionnaire showed the aim of the study and outlined that participants could quit the survey anytime they wanted. If the participants clicked the “yes and continue”, the questionnaire would then be presented to ensure informed consent.

Study Instruments

We combined the questionnaire containing 52 items for parents covering 5 parts: sociodemographics, decision stage, knowledge, attitudes toward HPV vaccine, and decisional conflict scale.

Sociodemographics (14 Variables)

There were two parts for the sociodemographics questions with one part reporting parents' information (age, number of children, ethnicity, religion, educational background, area of residence, marital status, healthcare-related major learning experience, healthcare-related job doing experience, monthly family income) and another part for their daughter's information (age, ethnicity, religion, overall health condition).

Decision Stage (1 Item)

The primary outcome variable in our study was parents' self-reported HPV vaccine decision stage. We made the item and its three-stage response level according to the Ottawa Decision Support Framework (ODSF) User Manual-Stage of Decision Making.²³ Parents were asked: "How far along are you with your daughter's HPV vaccine decision?" Three response options were provided: Stage 1 (not yet considered: I have not begun to think about the choices); Stage 2 (considering: I am considering the options now); Stage 3 (decided: I have already made a decision).

Knowledge (17 Items)

In the part of knowledge, we included two aspects of measures concerning the study of Yulia Gendler,²⁴ containing the first aspect of 11 items of HPV general knowledge (eg, "The papillomavirus is transmitted through sexual contact") and the second aspect of 6 items of HPV vaccine knowledge (eg, "The vaccine against the papillomavirus is intended for women only"). For each item, the respondents answered "Yes", "No" or "Unclear", for which a score was calculated based on correct answers (True-1, False-0, Unclear-0), and thus higher scores indicate greater knowledge on both aspects.

Attitudes Toward HPV Vaccine (4 Items)

For this part, we included four main important factors of HPV vaccination decisions in people's value system. The two main benefits are: HPV vaccination protects against all types of HPV-related cancers, and HPV vaccination prevents genital warts caused by HPV. The two main barriers are: the various side effects that can be caused by HPV vaccination, and the cost of the vaccine, with responses ranging from 0 (not important at all) to 10 (extremely important).

Decisional Conflict Scale (16 Items)

Decisional conflict scale (DCS) was developed by O'Connor in 1995 and revised in 2005,²⁵ measuring a person's perceptions of their uncertainty in health care options, the modifiable factors contributing to uncertainty, and the quality of the decision made.²⁶ DCS consists of 16 items with a Likert 5-point scoring method across 5 dimensions, including feeling uncertain (3 items), feeling uninformed (3 items), feeling unclear about values (3 items), and feeling unsupported (3 items), as well as ineffective decision making (4 items). The items were rated using a 5-point Likert scale, with scores ranging from 0 (Strongly Agree) to 4 (Strongly Disagree). The total score of each dimension was obtained by multiplying the mean of the dimension by 25; the total scale score is equal to the sum of the item scores divided by 16 and multiplied by 25 and the score ranges from 0 to 100. A higher score of DCS means a greater decisional conflict or uncertainty. The validation study of the Chinese version of the DCS shows its good criteria validity and satisfactory internal consistency.²⁷ To be specific, the Cronbach's α for DCS total score was 0.963 and that for each subscale ranged from 0.784 to 0.93.²⁷

Ethics

This study was approved by the IRB of Shanghai Children's Medical Center Affiliated to Shanghai Jiao Tong University School of Medicine (No. SCMCIRB-K2024271-1) and was conducted in accordance with the principles outlined in the Declaration of Helsinki.

Data Analysis

This study reports parents' HPV vaccination decisions across three stages, presented as percentages. To assess significant differences in decision stages based on sociodemographic factors, knowledge, attitudes, and decisional conflict, chi-square tests, Fisher's exact tests, and one-way ANOVA were applied, depending on the suitability of the data. When appropriate, post hoc analyses using Bonferroni or Tamhane's T2 tests were performed.

Multinomial logistic regression analyses were used to calculate the odds ratios (OR) of being in Stage 2 (considering) and Stage 3 (decided) compared to Stage 1 (have not thought). The decision stage was the dependent variable. First, we conducted univariate multinomial logistic regression analyses and estimated the associations for each independent variable individually. Subsequently, we performed multivariate multinomial logistic regression analyses by including 11 independent variables in a single model. To select variables that would ensure the most parsimonious multivariate model, variables were included based on significant modifying factors in univariate analysis. OR and 95% confidence

intervals (CI) were calculated. To assess the multicollinearity of the multivariate multinomial logistic regression models, the Variation Inflation Factor (VIF) was calculated for all predictors. A VIF < 5 was obtained for all predictors, which indicates that multicollinearity is not an issue. Model fit diagnostics were reported based on the following criteria: (a) Cox-Snell R², (b) Cragg-Uhler R², and (c) McFadden R². Statistical analyses were performed using SPSS version 26.

Results

Sociodemographics Characteristics

A total of 273 parents of girls participated in the survey. The sociodemographic characteristics of parents and girls are reported in Table 1. Most parents reported being at Stage 1 (48.4%), 29.7% were at Stage 2, and 22.0% were at Stage 3.

Table 1 The Sociodemographic Characteristics of Participants by HPV Vaccination Decision Stage (N=273)

	Total N (%)	Decision Stage			Bivariate Different test, p-value F or H or χ^2 , p-value
		Have not thought N (%)	Considering N (%)	Decided N (%)	
Total	273 (100)	132 (48.4)	81 (29.7)	60 (22.0)	
Information of parents					
Age, mean \pm SD	41.01 \pm 5.83	40.89 \pm 6.41	41.49 \pm 4.62	40.63 \pm 6.01	F = 0.432, P = 0.650
Number of children, median (range)	1 (2)	1 (2)	1 (2)	1 (2)	H = 0.603, P = 0.740
Ethnicity					$\chi^2 = 3.526$, P _{exact} = 0.174
Han	265 (97.1)	130 (98.5)	79 (97.5)	56 (93.3)	
Other	8 (2.9)	2 (1.5)	2 (2.5)	4 (6.7)	
Religion					$\chi^2 = 2.771$, P _{exact} = 0.268
No	261 (95.6)	127 (96.2)	79 (97.5)	55 (91.7)	
Yes	12 (4.4)	5 (3.8)	2 (2.5)	5 (8.3)	
Education background					$\chi^2 = 0.106$, P = 0.948
Without a college degree	94 (34.4)	45 (34.1)	29 (35.8)	20 (33.3)	
With a college degree	179 (65.6)	87 (65.9)	52 (64.2)	40 (66.7)	
Area of residence					$\chi^2 = 0.282$, P = 0.868
City	90 (33.0)	44 (33.3)	25 (30.9)	21 (35.0)	
Others	183 (67.0)	88 (66.7)	56 (69.1)	39 (65.0)	
Marital status					$\chi^2 = 2.525$, P _{exact} = 0.360
Out of marriage	7 (2.6)	3 (2.3)	2 (2.5)	4 (6.7)	
In marriage	266 (97.4)	129 (97.7)	79 (97.5)	56 (93.3)	
Healthcare-related major learning experience					$\chi^2 = 1.529$, P = 0.466
Yes	33 (12.1)	14 (10.6)	9 (11.1)	10 (16.7)	
No	240 (87.9)	118 (89.4)	72 (88.9)	50 (83.3)	
Healthcare-related job doing experience					$\chi^2 = 2.815$, P = 0.245
Yes	26 (9.5)	15 (11.4)	4 (4.9)	7 (11.7)	
No	247 (90.5)	117 (88.6)	77 (95.1)	53 (88.3)	
Monthly family income (yuan)					$\chi^2 = 0.112$, P _{exact} = 0.946
<9000	144 (52.7)	71 (53.8)	42 (51.9)	31 (51.7)	
>9000	129 (47.3)	61 (46.2)	39 (48.1)	29 (48.3)	
Information of girls					
Age, mean \pm SD	12.49 \pm 2.53	12.01 \pm 2.58	13.32 \pm 2.22	12.43 \pm 2.53	F = 7.117, p = 0.001
Ethnicity					$\chi^2 = 0.274$, P _{exact} = 1.000
Han	267 (97.8)	128 (97.0)	78 (96.3)	57 (95.0)	
Other	7 (2.2)	4 (3.0)	3 (3.7)	3 (5.0)	
Religion					$\chi^2 = 0.873$, P _{exact} = 0.758
No	268 (98.2)	129 (97.7)	80 (98.8)	58 (96.7)	
Yes	5 (1.8)	3 (2.3)	1 (1.2)	2 (3.3)	
Overall health condition					$\chi^2 = 1.093$, P _{exact} = 0.607
Excellent	252 (92.3)	122 (92.4)	73 (90.1)	57 (95.0)	
Others	21 (7.7)	10 (7.6)	8 (9.9)	3 (5.0)	

Note: Bold: significant at the 0.05 level.

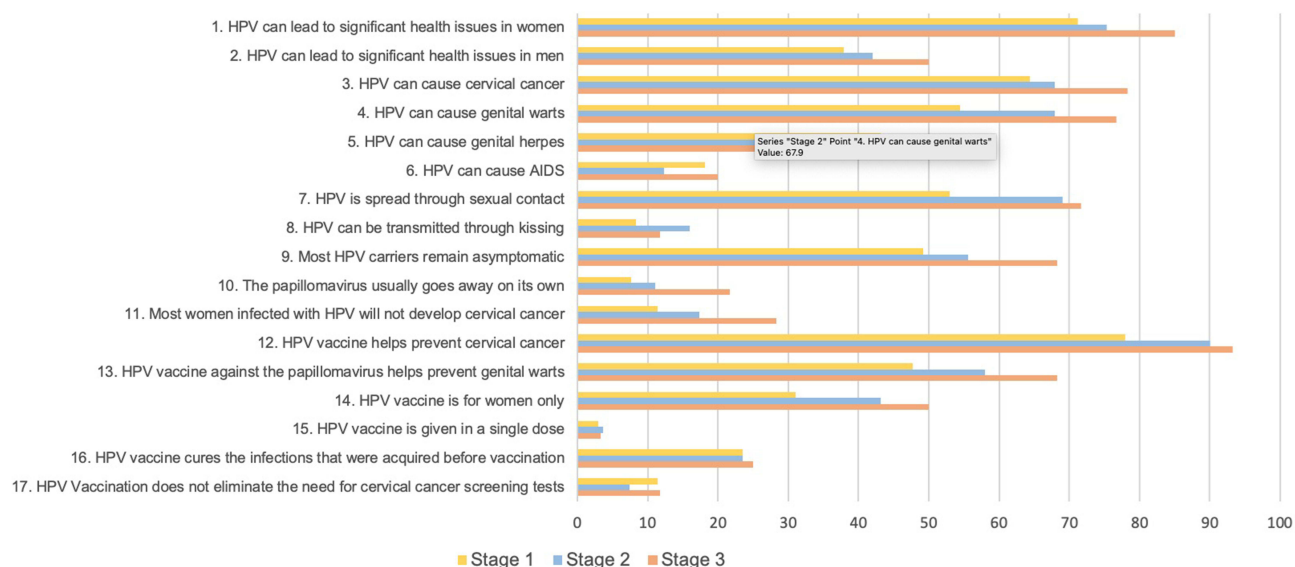


Figure 1 The correct (%) of HPV knowledge by item among parents of girls in different decision stages of HPV vaccination.

The stage of HPV vaccination decision-making significantly differed by the age of the girls ($p = 0.001$). According to the post hoc analysis (Bonferroni), parents in Stage 2 (considering) regarding their daughters' HPV vaccination are significantly older than girls of parents in Stage 1 (have not thought). There were no other differences in socio-demographic variables across the decision stages.

Knowledge of HPV and HPV Vaccination

Figure 1 shows the HPV general knowledge and HPV vaccination knowledge by item among parents at the three different decision stages. Among the 17 items, 7 items (2nd, 6th, 8th, 10th, 15th, 16th, and 17th) had an overall accuracy rate lower than 50%. The three items with the lowest accuracy rates were item 8th (regarding transmission routes of HPV), item 15th (regarding the dosage regimen of the HPV vaccine), and item 17th (regarding the need for cervical cancer screening after vaccination).

Table 2 presents the mean scores for parents' knowledge of HPV and the HPV vaccination. Statistically significant differences were found across the different decision stages in both HPV general knowledge and HPV vaccine knowledge. Post hoc analysis (Bonferroni) revealed that parents in Stage 3 (decided) scored significantly higher in both HPV general knowledge and HPV vaccine knowledge compared to those in Stage 1 (have not thought).

Table 2 The Knowledge of Parents by HPV Vaccination Decision Stage (N=273)

Total mean \pm SD	Decision Stage			Bivariate Different test, p-value
	Have not thought	Considering	Decided	
	mean \pm SD	mean \pm SD	mean \pm SD	F, p-value
11 items about HPV general knowledge*				
4.72 \pm 2.88	4.19 \pm 2.95	4.85 \pm 2.82	5.70 \pm 2.59	F = 5.981, P = 0.003
6 items about HPV vaccination knowledge**				
2.16 \pm 1.27	1.95 \pm 1.38	2.26 \pm 1.08	2.52 \pm 1.17	F = 4.577, P = 0.011

Notes: Bold: significant at the 0.05 level. *Full marks are 11 and a higher score means higher knowledge. **Full marks are 6 and a higher score means higher knowledge.

Table 3 The Attitudes of Parents by HPV Vaccination Decision Stage (N=273)

	Total mean \pm SD	Decision Stage			Bivariate Different test, p-value F, p-value
		Have not thought mean \pm SD	Considering mean \pm SD	Decided mean \pm SD	
Benefits-cancer prevention*	8.03 \pm 2.67	7.37 \pm 3.07	8.46 \pm 2.08	8.90 \pm 2.04	F = 8.701, P < 0.001
Benefits-warts prevention*	7.63 \pm 2.82	7.02 \pm 3.13	8.04 \pm 2.52	8.45 \pm 2.14	F = 6.781, P = 0.001
Barrier-side effects*	5.36 \pm 3.32	5.22 \pm 3.19	5.78 \pm 3.38	5.08 \pm 3.51	F = 0.966, P = 0.382
Barrier-cost*	5.74 \pm 3.22	5.30 \pm 3.20	5.83 \pm 3.22	6.60 \pm 3.22	F = 3.490, P = 0.032

Notes: Bold: significant at the 0.05 level. *range from 0 (not important at all for me) to 10 (extremely important for me). A higher score indicates that parents consider this benefit or barrier factor to be of greater importance.

Attitudes to HPV Vaccination

Table 3 presents the HPV vaccine attitudes of parents across the three decision stages. Overall, respondents emphasized that the benefits of vaccination outweighed the barriers, with two benefit items—cancer prevention and warts prevention—scoring higher than 7. Statistically significant differences were observed among parents at different decision stages regarding the benefits of cancer prevention, the benefits of warts prevention, and the barrier of cost. Post hoc analyses revealed that, for cancer prevention and cost barriers, parents in Stage 3 (decided) scored significantly higher than those in Stage 1 (have not thought). For warts prevention, both Stage 3 (decided) and Stage 2 (considering) parents scored significantly higher than those in Stage 1 (have not thought).

Decisional Conflict Toward HPV Vaccination

Table 4 presents the HPV vaccine attitudes of parents at different decision stages. Statistically significant differences were observed among parents in various decision stages regarding the total decisional conflict score and scores across five subscales. Post hoc tests indicated that parents in Stage 1 (have not thought) reported higher total and subscale scores compared to parents in Stage 2 (considering) and Stage 3 (decided).

Factors Associated with the Decision Stage

In the univariate multinomial logistic regression analyses, several predictors were significantly associated with being in at least one decision stage (compared to being in Stage 1) (Table 5). Parents of older age were significantly more likely to

Table 4 The Decisional Conflict of Parents by HPV Vaccination Decision Stage (N=273)

	Total mean \pm SD	Decision Stage			Bivariate Different test, p-value F, p-value
		Have not thought mean \pm SD	Considering mean \pm SD	Decided mean \pm SD	
Total score	22.13 \pm 16.29	26.73 \pm 16.60	21.91 \pm 15.31	12.29 \pm 12.17	F = 18.269, P < 0.001
Subscale					
Uninformed	23.63 \pm 18.36	29.04 \pm 18.00	21.50 \pm 17.62	14.58 \pm 16.06	F = 14.959, P < 0.001
Unclear about values	21.98 \pm 17.70	26.64 \pm 18.11	20.78 \pm 17.54	13.33 \pm 13.13	F = 12.959, P < 0.001
Unsupported	23.78 \pm 18.80	27.78 \pm 18.75	24.78 \pm 18.49	13.6 \pm 15.57	F = 12.923, P < 0.001
Uncertainty	22.01 \pm 18.83	27.27 \pm 19.70	22.12 \pm 17.24	10.28 \pm 12.96	F = 19.030, P < 0.001
Ineffective decision	19.96 \pm 16.84	23.86 \pm 17.74	20.76 \pm 15.30	10.31 \pm 12.70	F = 14.857, P < 0.001

Notes: Uninformed scores range from 0 (feels extremely certain about best choice) to 100 (feels extremely uncertain about best choice). Unclear about values scores range from 0 (feels extremely clear about personal values for benefits and risks/side effects) to 100 (feels extremely unclear about personal values). Unsupported scores range from 0 (feels extremely supported in decision-making) to 100 (feels extremely unsupported in decision-making). Uncertainty scores range from 0 (feels extremely certain about best choice) to 100 (feels extremely uncertain about best choice). Ineffective decision scores range from 0 (good decision) to 100 (bad decision). Bold: significant at the 0.05 level.

Table 5 Univariate Multinomial Logistic Regression Analysis Between Decision Stages and the Predictors (N=273)

Predictors	Decision Stage		
	Stage 1 (N= 132) Have not thought (reference)	Stage 2 (N= 81) Considering OR [95% CI]	Stage 3 (N= 60) Decided OR [95% CI]
Parents'Age (One year increase)		1.02 [0.97, 1.07]	0.99 [0.94, 1.05]
Number of child (One unit increase)		0.84 [0.49, 1.44]	0.87 [0.48, 1.57]
Parents' ethnicity			
Other		(reference)	(reference)
Han		0.61 [0.08, 4.40]	0.22 [0.04, 1.21]
Parents' religion			
Yes		(reference)	(reference)
No		1.56 [0.30, 8.21]	0.43 [0.12, 1.56]
Parents' education background			
With a college degree		(reference)	(reference)
Without a college degree		1.08 [0.60, 1.93]	0.97 [0.51, 1.85]
Parents' area of residence			
City		(reference)	(reference)
Others		1.12 [0.62, 2.03]	0.93 [0.49, 1.77]
Parents' marital status			
In marriage		(reference)	(reference)
Out of marriage		1.09 [0.18, 6.66]	3.07 [0.67, 14.18]
Parents' healthcare-related major learning experience			
Yes		(reference)	(reference)
No		0.95 [0.39, 2.31]	0.59 [0.25, 1.43]
Parents' healthcare-related job doing experience			
Yes		(reference)	(reference)
No		2.47 [0.79, 7.71]	0.97 [0.37, 2.52]
Monthly family income (yuan)			
>9000		(reference)	(reference)
<9000		0.93 [0.53, 1.61]	0.92 [0.50, 1.69]
Age of girls (One year increase)		1.24** [1.10, 1.39]	1.07 [0.95, 1.21]
Girls' ethnicity			
Other		(reference)	(reference)
Han		0.81 [0.17, 3.73]	0.91 [0.16, 5.09]
Girls' religion			
Yes		(reference)	(reference)
No		1.86 [0.19, 18.20]	0.67 [0.11, 4.15]
Girls' overall health condition			
Excellent		(reference)	(reference)
Others		1.34 [0.51, 3.54]	0.64 [0.17, 2.42]
HPV General knowledge (one unit increase)		1.08 [0.98, 1.20]	1.21* [1.08, 1.36]
HPV Vaccination knowledge (one unit increase)		1.22 [0.98, 1.53]	1.44* [1.12, 1.85]
Benefits-cancer prevention (one unit increase)		1.17* [1.04, 1.30]	1.29* [1.11, 1.50]
Benefits-warts prevention (one unit increase)		1.14 [1.03, 1.26]	1.22* [1.08, 1.39]
Barrier-side effect (one unit increase)		1.05 [0.97, 1.14]	0.99 [0.90, 1.08]

(Continued)

Table 5 (Continued).

Predictors	Decision Stage		
	Stage 1 (N= 132) Have not thought (reference)	Stage 2 (N= 81) Considering OR [95% CI]	Stage 3 (N= 60) Decided OR [95% CI]
Barrier-cost (one unit increase)		1.05 [0.97, 1.15]	1.14 [1.03, 1.26]
Feeling uninformed (one unit increase)		0.98* [0.96, 0.99]	0.95** [0.94, 0.97]
Feeling unclear about values (one unit increase)		0.98 [0.97, 1.00]	0.95** [0.94, 0.97]
Feeling unsupported (one unit increase)		0.99 [0.98, 1.01]	0.96** [0.94, 0.97]
Feeling uncertain (one unit increase)		0.99 [0.97, 1.00]	0.94** [0.92, 0.96]
Feeling made an ineffective decision (one unit increase)		0.99 [0.97, 1.01]	0.95** [0.92, 0.97]

Notes: Feeling uninformed means feeling uncertain about the best choice. Feeling unclear about values means feeling unclear about personal values. Feeling unsupported means feeling unsupported in decision-making. Feeling uncertain means feeling uncertain about the best choice. Feeling made an ineffective decision means feeling made a bad decision. Bold: significant at the 0.05 level. * $p < 0.01$. ** $p < 0.001$. Bold: significant at the 0.05 level.

Abbreviations: OR, odds ratio; 95% CI, 95% Confidence Interval; Reference, reference category.

be in Stage 2 (considering) compared to Stage 1 (have not thought), with an OR of 1.24 [95% CI: 1.10, 1.39]. Parents with higher HPV general knowledge and HPV vaccination knowledge were significantly more likely to be in Stage 3 (decided) compared to Stage 1 (have not thought), with OR of 1.21 [95% CI: 1.08, 1.36] and 1.44 [95% CI: 1.12, 1.85], respectively. Parents who placed higher importance on the benefits of cancer prevention were significantly more likely to be in Stage 2 (considering) and Stage 3 (decided) compared to Stage 1 (have not thought), with OR of 1.17 [95% CI: 1.04, 1.30] and 1.29 [95% CI: 1.11, 1.50], respectively. Parents who placed higher importance on the benefits of warts prevention were significantly more likely to be in Stage 2 (considering) and Stage 3 (decided) compared to Stage 1 (have not thought), with OR of 1.14 [95% CI: 1.03, 1.26] and 1.22 [95% CI: 1.08, 1.39], respectively. Parents who placed higher importance on the barrier of cost were significantly more likely to be in Stage 3 (decided) compared to Stage 1 (have not thought), with an OR of 1.14 [95% CI: 1.03, 1.26]. Parents who felt more uninformed and unclear about their values were significantly less likely to be in Stage 2 (considering) compared to Stage 1 (have not thought), with an odds ratio (OR) of 0.98. Additionally, parents who felt more uninformed, unclear about their values, unsupported, uncertain, and ineffective in decision-making were significantly less likely to be in Stage 3 (decided) compared to Stage 1 (have not thought), with odds ratios (OR) of 0.95, 0.95, 0.96, 0.94, and 0.95, respectively. Further analysis by other predictors indicated that this effect was not significant in the model examining parents of girls.

Results from multivariate multinomial logistic regression analyses are presented in Table 6. The following predictors were found to be significant: the age of the girls, feeling informed, and feelings of uncertainty about parents' HPV vaccination decision stages. Parents of older girls were significantly more likely to be in the "considering" stage (OR = 1.29) compared to those in the "haven't thought" stage. A higher sense of being uninformed was significantly associated with lower odds of being in the "considering" stage (OR = 0.97) compared to the "haven't thought" stage. Additionally, higher feelings of uncertainty were significantly associated with lower odds of being in the "decided" stage (OR = 0.95) compared to the "haven't thought" stage.

Table 6 Multivariate Multinomial Logistic Regression Analysis Between Decision Stages and the Predictors (N=273)

Predictors	Stage 1 (N= 132) Have not thought (reference)	Stage 2 (N= 81) Considering OR [95% CI]	Stage 3 (N= 60) Decided OR [95% CI]
Age of girls (One year increase)		1.29** [1.14, 1.46]	1.11 [0.97, 1.28]
HPV General knowledge (one unit increase)		1.02 [0.90, 1.16]	1.10 [0.96, 1.26]
HPV Vaccination knowledge (one unit increase)		0.96 [0.72, 1.27]	1.05 [0.76, 1.44]
Benefits-cancer prevention (one unit increase)		1.11 [0.91, 1.35]	1.13 [0.92, 1.39]
Benefits-warts prevention (one unit increase)		1.06 [0.88, 1.26]	1.05 [0.87, 1.27]
Barrier-cost (one unit increase)		1.01 [0.92, 1.12]	1.07 [0.96, 1.20]
Feeling uninformed (one unit increase)		0.97 [0.94, 0.99]	0.98 [0.95, 1.02]
Feeling unclear about values (one unit increase)		0.99 [0.96, 1.02]	1.01 [0.97, 1.04]
Feeling unsupported (one unit increase)		1.03 [1.00, 1.07]	1.02 [0.98, 1/06]
Feeling uncertain (one unit increase)		0.98 [0.94, 1.01]	0.95 [0.91, 0.99]
Feeling made an ineffective decision (one unit increase)		1.02 [0.98, 1.06]	1.00 [0.96, 1.05]

Notes: Feeling uninformed means feeling uncertain about the best choice. Feeling unclear about values means feeling unclear about personal values. Feeling unsupported means feeling unsupported in decision-making. Feeling uncertain means feeling uncertain about the best choice. Feeling made an ineffective decision means feeling made a bad decision. Bold: significant at the 0.05 level. **p < 0.001.

Abbreviations: OR, odds ratio; 95% CI, 95% Confidence Interval; Reference, reference category;

Discussion

Cervical cancer is the third most common cancer in women, primarily caused by persistent HPV infections, with high-risk strains such as HPV 16 and 18 being the main culprits.²⁸ Early detection through screening methods like cervical cytology, HPV testing, and colposcopy plays a critical role in managing precancerous lesions and early-stage cancers.²⁹ In recent years, minimally invasive surgery has become a common treatment for low-risk cervical tumors.^{30,31} HPV vaccination, particularly during adolescence, has proven effective in reducing HPV infection rates and the incidence of cervical cancer.²⁹ Furthermore, recent studies emphasize the importance of HPV vaccination even after hysterectomy for high-grade cervical lesions or early-stage cancer, as it can still prevent the development of lower genital tract dysplasia.³²

HPV vaccination has been globally recognized for its role in preventing cervical cancer, with China introducing the vaccine in 2016.¹⁰ Given China's unique family-based decision-making model, where parents play a central role in children's health decisions, understanding parental decision-making around vaccines is crucial.^{20,21} While most existing studies on parents' HPV decisions focus on vaccination status or intention levels, they do not differentiate between the stages of decision-making or identify predictors for each stage.^{33,34} This study fills that gap by examining the three distinct stages of HPV vaccine decision-making among Chinese parents of girls aged 9–17, making it a valuable contribution to understanding the decision-making process in this context.

Our study found that only 22% of parents had reached the final decision-making stage (Stage 3 - decided), which is lower than the 30.1% reported in a similar 2018 study in Canada.¹⁹ This disparity may be attributed to differences in the cost and availability of the HPV vaccine. Specifically, all Canadian provinces and territories offer free HPV vaccines

through school-based immunization programs, whereas China has not yet implemented a national free vaccination program.^{35,36} Additionally, the limited availability of HPV vaccines in China, where they are frequently out of stock despite high demand, contrasts with the widespread accessibility in Canada.^{12,37,38}

We found a significant association between girls' age and the decision-making stage, with parents of older girls more likely to be in the "considering" stage. The association between a child's age and vaccine decision-making is consistent with existing literature, where parents often delay making vaccination decisions until they perceive their children to be at greater risk due to potential exposure to sexual activity.³⁹ Notably, research indicates that sexual activity among adolescents can begin earlier than parents might expect, with over 10% of girls aged 15–19 engaging in sexual activity.⁴⁰ This underscores the importance of vaccinating girls before the onset of sexual activity, highlighting the need for timely education and intervention. In light of these findings, it is crucial to develop targeted interventions for parents of middle and high school students in China. These interventions could include informational materials, health education during parent meetings, and novel approaches such as creating films or short videos to support vaccine-hesitant parents.^{41,42}

As for knowledge level, though the ANOVA and Post Hoc Tests show that parents at Stage 3 (decided) have a significantly higher score of both HPV general knowledge and HPV vaccine knowledge than those at Stage 1 (have not thought), the multivariate analysis shows the insignificant relationship between knowledge and stage, which is different from previous studies.^{19,43} Furthermore, our study included the feeling of being informed rated by parents themselves, and it shows that having more sense of being "uninformed" was significantly associated with lower odds of being under thinking than have not thought. This suggests an avenue for interventions: by enhancing parents' subjective "feeling of being informed", we may help facilitate their progression to decision-making. Previous research has firmly established the importance of informed choice from an ethical perspective and its beneficial impact on patient health outcomes.⁴⁴ In this study, the assessment of the participants' "feeling of being informed" was based solely on one dimension of the DCS self-assessment tool. However, previous research has confirmed that relying exclusively on individuals' self-reported perceptions is insufficient, as this method often overestimates their actual level of informedness. Therefore, future research and practice must utilize more specific, knowledge-based assessment tools to ensure patients make fully informed decisions.⁴⁵ Regarding interventions, knowledge and attitudes are the two fundamental components of informed decision-making.⁴⁴ Therefore, decision aids, which serve as effective tools for delivering knowledge and exploring values, play a crucial role in facilitating decision-making.⁴⁶ Currently, there are existing decision aids for HPV vaccination,^{24,47–49} but none have been specifically tailored to the decision-making needs of individuals in mainland China, nor have they been built based on the vaccination policies in the region. A decision aid designed specifically for mainland China's HPV vaccination policies could better address the unique context and needs of local decision-makers.

Different from previous research with a similar topic,^{18,19} this study also included self-rate certainty feeling as a predictor and found that a higher feeling of uncertainty was significantly associated with lower odds of being decided as compared to have not thought. This result informs us a key intervention strategy to improve the HPV vaccine decision rate is focused on solving parents' uncertainty. According to ODSF, several practices like clinical counselling, decision tools, and decision coaching are efficient ways can relieve the uncertainty of decision-makers and thus improve decision quality.^{50–52}

The current study has several limitations. First, the convenience sample was collected online, and the parents included in this study were largely well-educated. This introduces potential regional and cultural variability, which may limit the generalizability of the results to the broader Chinese population. We recommend that future research reduce the potential impact of bias by employing multi-channel recruitment or offline surveys. Second, as a cross-sectional survey, we cannot make causal claims regarding the associations described in our findings. Third, some of the measures included in this study are not fully validated and may bring about limitations in the interpretation of results. Besides, we only assessed the decision-making stage and did not ask those in the "decided" stage whether they had chosen to vaccinate or not, which limits the development of targeted interventions that address specific decision outcomes and motivations. Finally, this study was not driven by the theory of the decision-making process, like the Precaution Adoption Process Model (PAPM), bringing potential bias in defining the decision stage. Despite these limitations, the current study provides further description of demographic differences that should be considered when implementing strategies to address HPV

vaccination among the age-expanded adult population for which shared clinical decision-making is currently recommended.

Conclusion

HPV vaccine remains unfunded in China and the vaccination rate is low. Using a stage-based model of decision-making, this study found that less than a quarter of parents were in the final stage. Parents having daughters of younger age, feeling more uninformed, and having more uncertainty were more likely to be in the stage of not thinking about getting their daughters vaccinated. This study highlights that the focus of policy development and intervention design (eg, decision aids) should be on enhancing informed decision-making and reducing uncertainty among parents.

Abbreviations

HPV, Human Papillomavirus; ODSF, Ottawa Decision Support Framework; DCS, Decisional conflict scale; OR, Odds Ratios; CI, Confidence Intervals; VIF, Variation Inflation Factor; PAPM, Precaution Adoption Process Model.

Disclosure

The authors report no conflicts of interest in this work.

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