Parental Factors Affecting Decision to Vaccinate Their Daughters against Human Papillomavirus

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ABSTRACT

Human papillomavirus (HPV) vaccination was introduced in the National Immunization Program (NIP) in Korea targeting girls aged 12 years to receive two doses of HPV vaccine to prevent cervical cancer. This study aimed to evaluate the factors that may influence parental decision to inoculate their daughters in Korea. A cross-sectional survey was conducted in 2020 by interviewing the parents of 2,000 nationally representative girls eligible for HPV NIP. By the daughters' status of HPV vaccination, the probabilities for each variable were compared with evaluate the factors that could affect parents' decision to inoculate their daughters with HPV vaccines. Compared with parents who were not vaccinated with HPV, parents who were vaccinated with HPV were 2.40 times more likely to decide to vaccinate their daughters with HPV. Parents who regularly undergo cervical cancer screening were 1.39 times more likely to decide to vaccinate their daughters with HPV than parents who do not receive regular checkups. Parents' perceived knowledge and perceived risk had a significant impact on their decision to vaccinate their daughters with HPV vaccines. Parents who had strong belief that HPV vaccine is safe in terms of adverse effects were 10 times more likely to decide to vaccinate their daughters against HPV. Parental factors including HPV-related health behavior and awareness were found to be associated with parental decision to vaccinate their daughters against HPV. To improve HPV vaccine uptake at 12 years, it is required to improve parental awareness on HPV through public communication supported by scientific-based evidence.

Prevention Relevance: Parental HPV vaccination and maternal regular cervical cancer screening were positively associated with parental decision to vaccinate their daughters against HPV. Parents' perceived knowledge of HPV vaccination and perceived risk of cervical cancer play an important role in determining whether their 12-year-old daughters will be vaccinated against HPV.

Introduction

Human papillomavirus (HPV) is known as a primary cause of cervical cancer as well as various disease such as head and neck, genital cancers (including penile, vaginal, vulvar, and cervical), and genital warts (1). Vaccination against HPV can prevent more than 90% of high-risk HPV genotypes that cause cervical cancer (2), which is the third most common cancer among Korean women aged 15 to 34 years (3). World Health Organization (WHO) has a global strategy to eliminate of cervical cancer by achieving full vaccine coverage in 90% of girls by the age of 15 years (4). Therefore, the WHO recommends the inclusion of HPV vaccines in the country's National Immunization Program (NIP) to complete the vaccination before sexual debut in girls (5). Since 2016, HPV vaccination has been integrated with the NIP in the Republic of Korea, which is eligible for 12-year-old girls with a vaccine schedule of two doses. According to the Korea Disease Control and Prevention Agency (KDCA), the HPV vaccination rate for one dose among girls born in 2003–04 was 61.5% in 2016, which gradually increased to 87.2% in 2018 (born in 2005–06) and 89.6% in 2020 (born in 2007–08; ref. 6). The two-dose vaccination rate increased from 54.5% in 2016 to 78.6% in 2020 (7); however, that is still relatively lower than the vaccination rate of other vaccines in the NIP which reach over 90% (8). To improve HPV vaccine uptake among Koreans, vaccine communication is growing todays to improve knowledge and awareness related to HPV and its vaccination. Exposure and number of government-produced public service advertisements are increasing through media (television, social media such as YouTube, Instagram, Twitter, etc.). In advertising, celebrities or influencers are supporting the HPV vaccine and it can attract public attention with positive-framed messages that emphasize the benefits of vaccine. The KDCA are providing various promotional materials (such as leaflets, online video materials) that are informative about HPV vaccination. Schools and medical facilities can easily download the materials to use and spread. Communication strategies in schools are actively conducted by sharing school information that relieves the worries against rumors of HPV vaccination and informing their daughters' HPV vaccination in advance through mobile text message.

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On the basis of a previous study conducted in Korea, the biggest reason why mothers decided not to vaccinate their daughters with HPV (HPV vaccine parental hesitancy) was concerns regarding adverse effects of the HPV vaccine (57.4%), followed by doubts regarding effectiveness of HPV vaccine (24.1%), concerns on daughter's young age (18.5%), and low level of knowledge regarding HPV vaccination (14.8%; ref. 9). It is necessary to understand the parental awareness and acceptability of HPV vaccination because the parents, especially mothers, are the surrogates of underage girls to make decisions of health issue. In this study, we investigated to understand the parental factors associated with HPV vaccination and the reasons for HPV vaccine parental hesitancy in Korea by interviewing the parents of girls eligible for HPV NIP.

Methods

The survey was targeted for two groups of HPV NIP recipients: the vaccinated (girls who have ever vaccinated more than one dose) and the unvaccinated (girls who have never been vaccinated) assigned by random quota sampling with proportional allocation through 17 cities and provinces nationwide. A minimum sample size was computed using a priori two-tailed analysis (power = 0.95, alpha = 0.05) using G*Power 3.1.9.7 software (G*Power, RRID:SCR_013726). Between November 2, 2020 and December 2, 2020, a cross-sectional survey was conducted with the parents of 1,000 vaccinated girls and of 1,000 unvaccinated girls among the eligible population for HPV NIP in 2018 (i.e., girls born in 2005–06).

A structured questionnaire contained the general demographic characteristics including age and education and questions as follows answered by 'yes/no' or 'a 5-point scale': The parental status of HPV vaccination, adherence to routine screening for cervical cancer (answers from fathers were excluded), parental level of awareness of HPV infections, perceived knowledge of related diseases caused by HPV, perceived seriousness of cervical cancer, prevention of cervical cancer via HPV vaccination, perceived susceptibility, and perception on safety of HPV vaccination. The questions with a 5-point scale contain the categories from 'strongly agree' to 'strongly disagree.' Re-categorization of 'yes (including 'strongly agree' and 'agree')' and 'no (including 'neutral', 'disagree', and 'strongly disagree')' was applied when evaluating the degree of parental hesitancy of HPV vaccination. Especially for the unvaccinated group, additional questions including perceived barriers (reasons for HPV vaccine hesitancy) were selectively asked. For respondents who verbally agreed to the survey, the Hankook Research, an experienced market research firm in Korea, conducted data collection through a Computer Aided Telephone Interview (CATI).

Categorical variables were presented as numbers and percentages to represent the distributions. The differences in distributions of two groups were compared using χ^2 test. Probability for parental decision to inoculate their daughters with HPV vaccines was evaluated using logistic regression at statistical significance of $P < 0.05$. Statistical analysis was performed using SAS version 9.4 (SAS Institute Inc., Cary, NC; Statistical Analysis System, RRID:SCR_008567). This study followed the ethical guideline, Declaration of Helsinki, and was exempted from deliberation by the ethics committee of the National Cancer Center in Korea (IRB No. NCC2020-0306). Instead of the written consent, verbal consent of agreement prior to beginning of survey via telephone was obtained for each respondent.

Data availability

The data generated in this study are available upon request from the corresponding author.

Results

Most of the respondents were mothers of NIP recipients (girls), were over 40 years old (approximately 90%), and were educated having degree of college or more (approximately 75%). The proportion of parents that were vaccinated with HPV vaccines was higher among daughters that were vaccinated with HPV (18.4%) than among daughters that were unvaccinated (8.6%; $P < 0.001$). Maternal adherence to routine cervical cancer screening was higher among daughters who received HPV vaccines (87.9%) than among daughters that were unvaccinated (84.0%; $P = 0.015$). The parents of daughters that were unvaccinated against HPV were more likely to disagree that cervical cancer is a severe disease that threatens life (10.4%) than parents of daughters that were vaccinated (4.9%), but the proportions were not significantly different ($P = 0.114$). Moreover, the parents of daughters that were unvaccinated against HPV were more likely to disagree that cervical cancer is a preventable disease through HPV vaccination (17.1%) than parents of daughters that were vaccinated (1.4%; $P < 0.001$). Regarding safety issue of HPV vaccine, there was also significantly different responses in the two groups: Only 4% of the vaccinated group disagreed that HPV vaccine is safe in terms of adverse events whereas more than 35% of the unvaccinated group did (**Table 1**).

The probabilities for each variable were compared with evaluate the factors that could affect parents' decision to inoculate their daughters with HPV vaccine. Compared with parents who were not vaccinated with HPV, parents who were vaccinated with HPV were 2.40 times more likely to decide to vaccinate their daughters with HPV. Parents who regularly undergo cervical cancer screening were 1.39 times more likely to decide to vaccinate their daughters with HPV than parents who do not receive regular checkups. Parents' perceived knowledge and perceived risk had a significant impact on their decision to vaccinate their daughters with HPV vaccines. Parents who had perceived that cervical cancer is a life-threatening disease were 1.53 times; parents who had perceived that cervical cancer is a preventable disease through HPV vaccination were 5.23 times; parents who had perceived risk for daughter if she were not vaccinated were 5.36 times more

Table 1. General characteristics and HPV-related survey of the parents of girls eligible for NIP in 2018 and the comparison of OR to vaccinate their girls against HPV, 2020.

Variable		Daughter's status of HPV vaccination: Unvaccinated (Ref. *N* = 1,000)	Daughter's status of HPV vaccination: Vaccinated (*N* = 1,000)	OR[a] (95% CI)	*P*[*]
Sex					
Female		926 (92.6)	944 (94.4)		0.103
Male		74 (7.4)	56 (5.6)		
Age (years)					
Less than 40		65 (6.5)	76 (7.6)		0.062
40–49		769 (76.9)	787 (78.7)		
50 or more		166 (16.6)	137 (13.7)		
Education					
High school or less		240 (24.0)	251 (25.1)		0.707
College or more		755 (75.5)	742 (74.2)		
No response		5 (0.5)	7 (0.7)		
Status of HPV vaccination					
Yes		86 (8.6)	184 (18.4)	**2.40 (1.82–3.15)**	<**0.001**
No		914 (91.4)	816 (81.6)		
Routine screening for cervical cancer[b]					
Yes		778 (84.0)	830 (87.9)	**1.39 (1.12–1.74)**	**0.004**
No		148 (16.0)	114 (12.1)		
Perceived knowledge that HPV causes cervical cancer					
Yes		763 (76.3)	730 (73.0)	0.84 (0.69–1.03)	0.089
No		237 (23.7)	270 (27.0)		
Perceived knowledge that HPV causes diverse diseases other than cervical cancer					
Yes		531 (53.1)	527 (52.7)	0.98 (0.83–1.17)	0.858
No		469 (46.9)	473 (47.3)		
Perceived knowledge that cervical cancer is a severe disease that threatens my life					
Yes	Strongly agree	287 (28.7)	395 (39.5)	**1.53 (1.25–1.85)**	<**0.001**
	Agree	382 (38.2)	360 (36.0)		
No	Neutral	214 (21.4)	192 (19.2)		
	Disagree	93 (9.3)	41 (4.1)		
	Strongly disagree	11 (1.1)	8 (0.8)		
Do not know		13 (1.3)	4 (0.4)		
Perceived knowledge that cervical cancer is a preventable disease through HPV vaccination					
Yes	Strongly agree	110 (11.0)	316 (31.6)	**5.23 (4.28–6.39)**	<**0.001**
	Agree	328 (32.8)	487 (48.7)		
No	Neutral	360 (36.0)	171 (17.1)		
	Disagree	146 (14.6)	14 (1.4)		
	Strongly disagree	25 (2.5)	0 (0.0)		
Do not know		31 (3.1)	12 (1.2)		
Perceived risk that my 12-year-old daughter is at risk of developing cervical cancer if not vaccinated					
Yes	Strongly agree	78 (7.8)	304 (30.4)	**5.36 (4.42–6.49)**	<**0.001**
	Agree	253 (25.3)	422 (42.2)		
No	Neutral	367 (36.7)	204 (20.4)		
	Disagree	241 (24.1)	59 (5.9)		
	Strongly disagree	38 (3.8)	8 (0.8)		
Do not know		23 (2.3)	3 (0.3)		
Belief that HPV vaccine is safe in terms of side effects or adverse events					
Yes	Strongly agree	6 (0.6)	69 (6.9)	**10.18 (8.04–12.88)**	<**0.001**
	Agree	102 (10.2)	483 (48.3)		
No	Neutral	460 (46.0)	380 (38.0)		
	Disagree	313 (31.3)	39 (3.9)		
	Strongly disagree	45 (4.5)	1 (0.1)		
Do not know		74 (7.4)	28 (2.8)		

Note: Values are presented as number (%).

Abbreviations: CI, confidence interval; OR, odds ratio; Ref., reference.

[*]*P* values were obtained by χ^2 test and logistic regression.

[a]The HPV-related questions were re-categorized as Yes (strongly agree + agree)/No (neutral + disagree + strongly disagree) to estimate OR to explain.

[b]This question was answered by female respondents only.

Table 2. Additional survey interviewing the parents of unvaccinated girls, 2020.

Variable	Categories	Daughter's status of HPV vaccination Unvaccinated group ($N = 1,000$)
I have known that HPV NIP program is provided for a 12-year-old girl.	Yes	904 (90.4)
I have been informed about HPV NIP program through the following route[a]	School	544 (60.2)
	Medical facilities	261 (28.9)
	Media	212 (23.5)
	Personal reminders[b]	205 (22.7)
	Peer	148 (16.4)
The HPV-related information I encountered was[a,c]	Positive	279 (36.5)
	Negative	410 (53.7)
	Uncertain	141 (18.5)
Reasons for parental vaccine hesitancy of HPV vaccines[a]	Adverse events	656 (65.6)
	Too young	147 (14.7)
	No time	114 (11.4)
	Child's denial	75 (7.5)
	Not needed	64 (6.4)

Note: Values are presented as number (%).
[a]Because the answers can be multiply selected, the total percentages of columns can exceed 100%.
[b]Personal reminders sent by KDCA (e.g., Mobile message, postal vaccine information statement, etc.).
[c]Positive information (e.g., recommendations or benefits of HPV vaccines as preventive methods for cervical cancer and other diseases, high vaccine efficacy, etc.); Negative information (e.g., myths related to adverse events, side effects, etc.).

likely to decide to inoculate their daughters. Moreover, parents who had strong belief that HPV vaccine is safe in terms of adverse effects were 10 times more likely to decide to vaccinate their daughters against HPV (**Table 1**).

Most of parents (90.4%) of unvaccinated girls had known that their girls were eligible for HPV NIP and the most common route that parents had been informed about HPV NIP was school (60.2%). Parents remembered that they had encountered negative HPV-related information (53.7%). The biggest concern of vaccine hesitancy in the parents of unvaccinated girls was the adverse events of HPV vaccine accounting for 65.6% (**Table 2**).

Discussion

In this study, parental factors including HPV-related health behavior and awareness were found to be associated with parental decision to vaccinate their daughters against HPV. The largest determinant associated with HPV vaccine hesitancy among parents with unvaccinated daughters was safety concerns of adverse events after HPV vaccination. Successful vaccination is determined by degree of understanding diseases related the certain pathogen, benefits of vaccination, and validity of delivery strategies (10). Previous studies conducted in Korea reported that mothers' perceived benefits about the HPV vaccine play an important role in their choice to vaccinate their daughters (11). Raising the level of awareness of HPV NIP with delivering verified knowledge has remained as a major issue to improve HPV vaccination (12). In Korea, the government has promoted benefits and safety of vaccine since HPV vaccine was implemented in the NIP. The KDCA has monitored and reported the details of adverse events to relieve parental concerns on uncertainty of HPV vaccine safety of HPV (13). Promoting strategies delivering the need of HPV vaccines at the population level are required for the parents to vaccinate their girls because parental decision has an impact on youth vaccination against HPV (14). In addition, beneficial communication encouraging catch-up vaccination and raising awareness among female young adults is also required because the HPV NIP target has been expanded to Korean females aged between 13 and 26 years in 2022 (15, 16). To encourage HPV vaccination, it is necessary to prepare public relations systems and appropriate platforms to share verified information, such as online social media that may play an effective role to present vaccination as a social norm (17, 18).

Misleading information or rumors of adverse events suspected to be linked to HPV vaccination influenced parental vaccine hesitancy although serious adverse events had not been reported with scientific evidence (13, 19). A recent European study reported a successful case of overcoming the vaccine trust crisis in Denmark. Danish comprehensive strategy of combining social and online media interventions, engagement with mothers and adolescents, and risk communication strategies can successfully restore public trust in HPV vaccines (20). In the perspectives of public health, cooperation across multiple sectors is required to verify the accuracy of information on media as well as improving public awareness and confidence of HPV vaccine (21). Countries including Australia and the United States are making extensive national promotional efforts to improve HPV vaccine uptake and knowledge in public. For example, Australia has implemented the HPV NIP since 2007 and the two-dose HPV vaccination rate in girls aged

11 to 14 years was 86.2% in 2019 (22). Vaccine safety surveillance data (a large cohort of Australian girls over 11 years) from Australia's spontaneous adverse event reporting system has provided valuable information on HPV vaccine safety (23). In the United States, the NCI funded 11 research projects on investigation of vaccine hesitancy related to uptake of the HPV vaccine in regions with low adolescent HPV vaccination rates (24). In Korea, the KDCA and Ministry of Food and Drug Safety operate reporting systems for spontaneous adverse event occurring nationwide. However, these reporting systems are only used to monitor the safety of vaccines and do not publicly and immediately disclose surveillance data. Dissemination of vaccine safety surveillance data can help relieve the public from vaccine adverse events and boost research on the adverse events after vaccination. The Centers for Disease Control and Prevention of the United States has the strategic framework to strengthen vaccine confidence against vaccine-preventable diseases. The national program called 'Vaccinate with Confidence' tries to help tackle vaccine misinformation from eroding public trust in vaccines and provide resources for achieving vaccine communication between parents, medical staffs, and community members (25). In Korea, ongoing effort in HPV vaccine communication and research is necessary to improve vaccine confidence in public and to relieve public concern on safety issue of HPV vaccine. A previous study conducted in Korea supports that impression of information rather than the source of information has a strong influence on HPV vaccine decision-making. Therefore, HPV-vaccine advertising through mass media should contain positive information that emphasize preventive benefits of HPV vaccine rather than informing negative impact if not vaccinated with HPV (9).

This study has several limitations. The sample size was insufficient (0.5% of eligible girls) to represent the whole population of NIP recipient cohort in 2018 that may be due to nonresponse bias. Also, there is possibility to neutral bias due to the response by a 5-point scale in the survey questions to investigate the degree of agreement. In this study, neutral response was included in the same category of 'disagree' to avoid too much loss of samples; however, it did not affect the main result. The comparison of trends would have been more pronounced if the scale were changed to a 4-point scale, which does not have an option of neutral selection referring to neutral. Nevertheless, this study is of meaning as the study was based on the primary data of the HPV vaccination status of the 2018 HPV NIP cohort, which was available with the cooperation of the KDCA. As the selection of study population was determined through national regional proportional allocation, it was possible to evenly survey the parents of NIP subjects nationwide. However, our findings are limited in generalizing to the parents of all HPV NIP population because the sociodemographic distribution other than geographic region were not compared with those of the whole population targeted HPV NIP in Korea.

In conclusion, parental HPV vaccination and maternal regular cervical cancer screening were positively associated with parental decision to vaccinate their daughters against HPV. Parents' perceived knowledge of HPV vaccination and perceived risk of cervical cancer play an important role in determining whether their 12-year-old daughters will be vaccinated against HPV. Public communication supported by science-based evidence is required to improve the vaccine uptake among 12-year-old girls and to relieve worries regarding adverse effects of vaccines. National level of supports in communication strategies and research is expected to relieve parental vaccine hesitancy. Further studies on the fully vaccinated rates are also required to evaluate the successful implementation of HPV NIP.

Authors' Disclosures

No disclosures were reported.

Authors' Contributions

Y. Park: Formal analysis, investigation, methodology, writing–original draft, first author of this article. **M. Ki:** Investigation, writing–review and editing. **H. Lee:** Investigation, writing–review and editing. **J.-K. Lee:** Investigation, writing–review and editing. **J.K. Oh:** Conceptualization, supervision, investigation, writing–review and editing.

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