

Effects of Information Exposure on HPV Vaccine Knowledge and Misinformation Belief: The Moderating Role of Education

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This study investigated the influence of exposure to four major information sources (i.e., news media, entertainment media, family, and friends) on HPV vaccine knowledge and misinformation belief. Based on an online survey of 320 Chinese adults, the results showed that family communication was the only source that exhibited a significant main effect on HPV vaccine knowledge. Furthermore, education moderated the relationship between entertainment media exposure and HPV vaccine knowledge, as well as the relationship between family communication and HPV vaccine misinformation belief. Specifically, individuals with lower levels of education exhibited lower HPV vaccine knowledge when exposed to more HPV-related content through entertainment media. Similarly, those with lower levels of education who engaged in family discussions about HPV were more likely to acquire misinformation. In contrast, these associations were not significant among individuals with higher levels of education.

Key words : information exposure, HPV vaccine knowledge, HPV vaccine misinformation belief, entertainment media, family communication, friend communication

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1. Introduction

HPV vaccine has been recognized as a vital preventive measure against HPV-related diseases. In mainland China, six HPV vaccines are currently available, with vaccination eligibility depending on age and gender. Given that HPV vaccination was introduced only in 2016 and continues to be promoted primarily as a cervical cancer prevention measure, public awareness of HPV and HPV vaccination remains limited. Consequently, vaccination uptake remains relatively low in China (Zhang, 2022).

Unlike many routine childhood vaccinations included in national immunization programs, HPV vaccination is not included in publicly funded immunization programs in most provinces of mainland China and has received relatively limited public promotion. As a result, individuals often need to actively seek, evaluate, and interpret HPV-related information before making informed vaccination decisions. Individuals encounter HPV-related information from diverse sources within an increasingly complex information environment. Consequently, knowledge gaps and misconceptions regarding HPV and HPV vaccination remain common. For example, HPV is often primarily associated with cervical cancer prevention, whereas public awareness of other HPV-related diseases, such as penile carcinomas, anal carcinomas, and head and neck carcinomas, remains limited (Yuanyue et al., 2018). Individuals therefore rely on multiple information sources, including news media, entertainment media, family members, and friends, to obtain HPV-related information. Understanding how these sources shape HPV-related knowledge and misinformation beliefs is essential for developing effective health communication strategies.

Scholars consistently evidenced that knowledge of HPV vaccine is essential for the success of HPV prevention campaigns, yet only a small proportion of the population possesses comprehensive understanding of it (Jaiswal, LoSchiavo, Maiolatesi, Kapadia, & Halkitis, 2020). Moreover, HPV-related misinformation belief is also a critical factor in HPV prevention efforts, as it diminishes individuals' motivation to receive the vaccine (Calo et al., 2021). Despite the recognized importance of these factors, existing research predominantly examines the impact of single information exposures on either health knowledge or misinformation

belief. This leaves a gap in understanding the relationship between information exposure from both media sources (e.g., news media and entertainment media) and interpersonal sources (e.g., family and friends), and its simultaneous effects on health knowledge and misinformation belief.

In response to the World Health Organization's call to accelerate the improvement of the HPV vaccination rate by 2030 (World Health Organization, 2022), it is crucial to explore how these four major health information sources impact individuals' health knowledge and misinformation belief about HPV vaccine. Additionally, education level can result in differing overall health knowledge (Johnston, Lordan, Shields, & Suziedelyte, 2015). Individuals with varying levels of education also differ in their susceptibility to health misinformation (Scherer et al., 2021), acceptance of health misinformation (Hwang & Jeong, 2023), and belief in health misinformation (Duplaga, 2020). Therefore, this study also examines the moderating role of education in the relationships between information exposure and health knowledge, as well as information exposure and health misinformation belief.

2. Literature Review

Previous research has consistently shown that information exposure from four major sources-news media, entertainment media, family communication, and friend communication-is closely associated with both health knowledge and health misinformation belief, although the direction of these relationships is not always consistent. Importantly, health knowledge and health misinformation belief represent distinct, though related, cognitive outcomes. Thus, the effects of information exposure may differ depending on the type of outcome considered.

Moreover, in the present study, entertainment media referred to entertainment-oriented media and content, including movies, television dramas, and entertainment-related content encountered through social media. Although social media differs from traditional entertainment media in that it functions as an interactive communication platform supporting diverse forms of communication (e.g., Sadiku, Kotteti, & Sadiku 2024), recent scholarship suggests that

media entertainment has expanded beyond traditional formats to encompass entertainment content on social media (Lüders, 2026). As users increasingly consume entertainment experiences through social media alongside films and television programs, social media was included as one example of entertainment media in the present study.

Family communication refers to interpersonal communication about HPV or HPV vaccination occurring among family members, including parents, spouses, siblings, or other household members. Unlike communication with friends, family communication occurs within enduring familial relationships and often involves shared responsibilities and health-related decision making. Family conversations have been shown to influence individuals' health beliefs, attitudes, and behaviors by facilitating the sharing of information, values, and health-related norms (Campbell-Salome & Hesse, 2022). This distinction is particularly relevant in the Chinese context, where the HPV vaccine remains relatively costly, ranging from approximately RMB 300 to 1,200 per dose. For many individuals without an independent source of income, such as university students, vaccination costs are often paid by their parents. Consequently, family members frequently serve as important sources of HPV-related information and play a central role in discussions and decisions regarding HPV vaccination.

1) Information Exposure and Health Knowledge

Gathering health information from news media (e.g., print, broadcast, and online news), entertainment media (e.g., movies, television shows, social media), family, or friends is simple, convenient, and frequent, and there is evidence that these sources serve as the primary media and interpersonal sources of knowledge for individuals (Dutta-Bergman, 2004; Katz, Krieger & Roberto, 2011; Koplas, Braswell & Saray, 2019; Wen et al., 2014).

First, news media acts as a major source of health information. Whether in print or online, news serves as a crucial source of health knowledge that people actively produce and consume every day (Ong, Chen, Sung, & Zhu, 2005). It can enhance an individual's health knowledge. For example, high-quality medical health news effectively conveys accurate information, thereby improving public health knowledge and increasing their awareness about

health issues (Ashoorkhani, Majdzadeh, Hosseini & Taghdisi, 2019). Both radio and newspapers were significant predictors of women's health knowledge (Jesmin, Chaudhuri & Abdullah, 2013). The positive impact of news exposure on health knowledge is further supported by findings related to HPV vaccine. Kelly, Leader, Mittermaier, Hornik and Cappella (2009) discovered that exposure to health-related news stories was significantly associated with knowledge about HPV vaccine.

Taken together, the existing literature suggests that news media serves as an important source of accurate and evidence-based health information, which can enhance individuals' health knowledge. Therefore, we hypothesized that:

H1: Exposure to HPV-related information from news media will be positively associated with individuals' knowledge about HPV vaccine.

Second, there are two opposing viewpoints regarding the impact of entertainment media use on health knowledge. On the one hand, entertainment media has been suggested as more suitable for transmitting health information (Dutta-Bergman, 2004). Because it can promote health knowledge among audiences (Saei, Valadi, Karimi & Khammarnia, 2021). For example, movie, as one type of entertainment media, can significantly increase health knowledge on topics such as pain management (Wager, Stahlschmidt, Heuer, Troche & Zernikow, 2018), HIV/AIDS (Widatiningsih, Sukini & Rofi'ah, 2017), and adolescent reproductive health (Susanto, Nur & Astuti, 2020). Health storylines in television shows, another form of entertainment media, have also been shown to enhance viewers' health-related knowledge (Hoffman et al., 2023). Social media, a major form of entertainment media, can likewise improve public health knowledge, such as knowledge on cervical cancer prevention (Lai et al., 2015; Xu et al., 2016). It also serves as a vital tool for real-time implementation and dissemination of essential prevention, screening, and treatment messages to the community (Xu et al., 2016).

On the other hand, some research has shown that exposure to entertainment media may decrease viewers' knowledge. For instance, Chung (2014) used a sample of 11,000

respondents to verify that frequent viewing of medical dramas may negatively affect the accuracy of people's knowledge about chronic illnesses. Additionally, viewing fictional medical television programs will decrease knowledge about organ donation, as they often contained incorrect information (Quick, Morgan, LaVoie & Bosch, 2014). A systematic review of 19 articles found that 10 studies reported no significant correlation between exposure to TV shows and health knowledge (Hoffman, Shensa, Wessel, Hoffman, & Primack, 2017). Therefore, an inconsistent relationship between exposure to entertainment media and health knowledge was identified.

Third, although the limited research available has explored the impact of family communication on health knowledge, the findings remain inconsistent. Morgan and Miller (2002) suggested a strong correlation between the two. Crawford et al. (1990) posited that family communication can help bridge knowledge gaps. However, Jung, Lin and Viswanath (2013) conducted a national survey and found no significant association between family communication and individuals' knowledge levels regarding H1N1. Conversely, other scholars have argued that family communication positively influences health knowledge, particularly in areas such as AIDS (Crawford et al., 1990; Ramirez et al., 2002), breast cancer (Sinicrope et al., 2009), and medication use (Dew et al., 2014). Therefore, the impact of family communication on health knowledge remains unclear.

Fourth, inconsistencies have also been found in the relationship between communication with friends and health knowledge, as indicated by the limited existing evidence. On the positive side, Shin and Shim (2019) found that receiving information from friends can enhance an individual's knowledge of complementary and alternative medicine, with such communication leading to the acquisition of in-depth health knowledge and subsequent benefits. Similarly, Unger et al. (2015) emphasized that communication between friends, both male and female, can help men gain more knowledge about HPV and HPV vaccine. However, in contrast, Jung et al. (2013), in a national survey, demonstrated no significant link between friend communication and an individual's health knowledge.

Given the inconsistent findings regarding the relationship between exposure to entertainment media, family communication, and friend communication and health knowledge,

it remains unclear how these sources are associated with HPV vaccine knowledge. Therefore, we propose the following research question:

RQ1: How is exposure to HPV-related information from a) entertainment media, b) family communication, and c) friend communication associated with individuals' knowledge about HPV vaccine?

2) Health Misinformation and HPV Vaccine Misinformation

Misinformation was defined as “explicitly false” information at beginning, determined to be incorrect by expert consensus, and did not include rumors, conflicting or disputed information, or exaggerations (Tan, Lee & Chae, 2015). Later, Lazer et al. (2018) assumed that misinformation refers to information that is factually inaccurate or misleading.

Health misinformation refers to any health-related statement presented as a fact that is false according to current scientific consensus (Sylvia Chou, Gaysynsky & Cappella, 2020). It is also often presented to the public in the form of conspiracy theories (Nan, Wang & Thier, 2022). Health misinformation has existed for a long time and has harmed people's well-being for just as long (Zhong, 2023). It has consistently been shown to influence people's attitudes and health behaviors. For example, health misinformation can hinder or obstruct effective care (Wang, McKee, Torbica & Stuckler, 2019), and cause vaccine hesitancy (Lee, Sun, Jang & Connelly, 2022).

Even though the efficacy and safety of the HPV vaccine have been validated by the WHO and numerous national health authorities, misinformation about the HPV vaccine continues to circulate across multiple communication channels. Previous studies have documented the dissemination of HPV vaccine misinformation through news media (Intlekofer, Cunningham & Caplan, 2012), social media (Chen, Ling, Cao & Han, 2020; Jiang, Wang, Liu, Ngien & Wu, 2023; Sundstrom et al., 2021), and family communication (Walker, Owens & Zimet, 2020). Although direct evidence regarding the dissemination of HPV vaccine misinformation through friend communication remains limited, interpersonal discussions with friends may

nevertheless reinforce or challenge misinformation encountered from other information sources through information sharing and social influence.

Such misinformation hinders public health initiatives aimed at preventing HPV-related cancers (Calo et al., 2021). Misinformation about HPV vaccine primarily concerns its safety, side effects, and effectiveness (Sundstrom et al., 2021). Claims that the vaccine is dangerous, ineffective, or suggests unethical ties between governments and pharmaceutical companies persist (Chen et al., 2020; Ekram, Debiec, Pumper & Moreno, 2019; Kornides et al., 2023).

3) Information Exposure and Health Misinformation Belief

Building on the concept of misperceptions proposed by Nyhan and Reifler (2010), health misinformation belief can be understood as beliefs about factual matters that are not supported by clear evidence or expert consensus, including both false and unsubstantiated claims. There is substantial evidence showing that the four major sources of information are strongly associated with health misinformation belief; however, the direction and nature of these effects remain inconsistent across studies.

First, there is no consensus regarding the impact of news media exposure on the spread of misinformation. Some scholars suggested that recent exposure to news media has contributed to the health misinformation problem (Zhong, 2023). Misinformation on news media has been prevalent in various health news contexts, including topics such as COVID-19 (Altay, Nielsen & Fletcher, 2024; Ash, Galletta, Hangartner, Margalit & Pinna, 2024) or mental illness (Perciful & Meyer, 2017). Some scholars argued that news media may sometimes intentionally amplify health misinformation (Altay et al., 2024; Ash et al., 2024).

In contrast, other scholars contend that news media will mitigate the misinformation problem. For example, well-executed news reporting can enhance resistance to misinformation, propaganda, and other forms of deception (Acerbi, Altay & Mercier, 2022; Humprecht, Esser & Van Aelst, 2020). Experimental evidence further demonstrates that news media exposure does not exacerbate COVID-19 misinformation, in some cases, it can reduce the acquisition of false beliefs (Altay et al., 2024). Given these conflicting findings, our study seeks to examine

how exposure to HPV-related news media impacts misinformation belief about HPV vaccine:

RQ2: How is exposure to HPV-related information from news media related to individual's HPV vaccine misinformation belief?

Second, exposure to entertainment media (e.g., movies, television shows, social media) has consistently been shown to aggravate the problem of misinformation, as representations of health-related issues in these mediums are not always accurate (Watts & Moyer-Gusé, 2022). There is much evidence showing that movies and TV shows often spread misinformation by presenting negative and inaccurate depictions of various health topics, thereby contributing to their stigmatization (Perciful & Meyer, 2017). Misinformation about HPV vaccine is also easily found in TV dramas. For instance, McClaran and Rhodes (2021) analyzed vaccine-related storylines involving HPV vaccine across multiple television episodes and found that some narratives portrayed vaccines negatively or depicted inaccurate beliefs.

Additionally, social media consistently contains a lot of misinformation across various subjects, including vaccines, substances, infectious diseases, and diet (Wang et al., 2019; Wang & Togher, 2024). Kornides et al. (2023) revealed that almost one-quarter of Tweets contained disinformation or misinformation about HPV vaccine.

Third, family communication is also a major source of misinformation exposure in the health arena. It often contains misinformation across multiple health issues, such as COVID-19 vaccines (Malhotra, 2024) or cancer (Warner, Waters, Cloyes, Ellington & Kirchhoff, 2021). Chia, Lu and Sun (2023) explored a dual-pathway model of misinformation transmission within family communication patterns related to COVID-19 vaccines. Their research demonstrated that individuals who encounter misinformation from media sources are likely to pass this misleading or erroneous information to elderly family members, indirectly highlighting the role of family communication in the dissemination of misinformation.

Regarding the influence of family communication on HPV vaccine-related misinformation, Walker and colleagues (2020) found that family discussions about HPV vaccine can lead to the spread of misinformation, which subsequently affects individuals' attitudes toward the

vaccine. They emphasized that interactions with parents, siblings, and other relatives often involve significant amounts of misinformation about HPV vaccine, including false beliefs about its risks and effectiveness.

Fourth, communication with friends, similar to that with family, often contains a considerable volume of health misinformation. It has been shown that friend communication is a key driver of the spread of health misinformation (Fahim, Cooper, Theivendrapillai & Straus, 2023). Friends frequently pass along health misinformation to others, including elderly individuals (Chia et al., 2023), men (Fahim et al., 2023), and women (Harjule, Manva, Mehta, Gurjar & Agarwal, 2023). Previous research argued that health misinformation often employs vague or ambiguous language, which can easily lead individuals to believe it applies to themselves or their friends, resulting in its frequent sharing (Zhou, Xiu, Wang & Yu, 2021). In the context of HPV vaccine, although there is no direct evidence demonstrating a significant correlation between friend communication and HPV vaccine misinformation belief, multiple studies have indicated that people often discuss it with their friends (Tung, Jones & Lu, 2022; Walker et al., 2020). Therefore, based on this evidence, we estimate that individuals are likely to receive misinformation about HPV vaccine from their friends.

Taken together, the existing literature consistently suggests that entertainment media, family communication, and friend communication are important channels through which health misinformation is transmitted. Therefore, we expect that greater exposure to HPV-related information from these sources will be positively associated with misinformation belief. We hypothesize that:

H2: Exposure to HPV-related information from a) entertainment media, b) family communication, and c) friend communication will be positively associated with individuals' HPV vaccine misinformation belief.

4) The Moderating Role of Education Level

Differences in education levels among individuals are associated with their improvement in

health knowledge, as education has been shown to enhance cognitive abilities, such as reading and information processing skills (Cascio & Lewis, 2006). A low level of education is a limiting factor in the ability to understand health messages from news and entertainment media (Ezeah, Ogechi, Ohia & Celestine, 2020). Conversely, a high level of education leads to a significant increase in health knowledge (Johnston et al., 2015).

Differences in education are also found to have an important impact on health misinformation. Higher educational attainment is negatively correlated with the acceptance of health misinformation (Hwang & Jeong, 2023). Conversely, Scherer et al. (2021) demonstrated that individuals with lower educational attainment are more susceptible to health misinformation across three health contexts: vaccines, cancer, and sexually transmitted infections, including HPV.

The moderating role of education can be further understood through the knowledge gap hypothesis (Tichenor, Donohue & Olien, 1970), which suggests that individuals with higher socioeconomic status, particularly those with higher levels of education, tend to acquire information at a faster rate than those with lower education levels. As a result, information gaps between these groups tend to widen over time, especially when new information is introduced through mass media. This pattern has been consistently supported by subsequent research. For example, a meta-analysis by Hwang and Jeong (2009) found a positive correlation between education level and knowledge, indicating that higher-educated individuals tend to acquire more information, thereby reinforcing knowledge gaps over time. In the context of health knowledge, Johnston et al. (2015) found that higher levels of education are associated with greater health knowledge.

Although the knowledge gap hypothesis was originally developed in the context of mass media, its core logic has been extended to broader information environments, including interpersonal communication. Individuals with higher levels of education are generally better equipped to process, evaluate, and verify information regardless of whether it originates from media sources or interpersonal interactions (e.g., family and friends). In contrast, those with lower levels of education may face greater difficulty in critically assessing information, making them more vulnerable to misinformation across different information channels.

Thus, building on the knowledge gap hypothesis, this study aims to examine how education level moderates the impact of information exposure on HPV vaccine knowledge and HPV vaccine misinformation belief. Based on the hypotheses and research questions we have proposed, the moderating effect will also be tested within the corresponding hypotheses and research questions.

H3: The positive association between exposure to HPV-related information from news media and HPV vaccine knowledge will be stronger for individuals with a high education level compared to those with a low education level.

RQ3: How does education moderate the association between exposure to HPV-related information from a) entertainment media, b) family communication, and c) friend communication and individuals' HPV vaccine knowledge?

RQ4: How does education moderate the association between exposure to HPV-related information from news media and individual's HPV vaccine misinformation belief?

H4: The positive association between exposure to HPV-related information from a) entertainment media, b) family communication, and c) friend communication and HPV vaccine misinformation belief will be stronger for individuals with a low education level compared to those with a high education level.

3. Method

1) Respondents

Data collection was conducted with approval from the Institutional Review Board (IRB) at author's university, adhering to the relevant guidelines and regulations set forth by the IRB.

A priori power analysis was conducted using G*Power 3.1.9 for hierarchical multiple regression. We used the F-test for the increase in R^2 to determine the required sample size.

Given that interaction effects are typically small in social science research, and following Cohen's (1988) recommendations, we assumed a small-to-medium effect size ($f^2 = .04$). With $\alpha = .05$, power = .80, four tested predictors (the four information sources), and eleven total predictors in the full model, the required sample size was 304.

Participants for the online survey were recruited through wx.com, a widely used online survey platform in China. The platform has a large nationwide participant pool (approximately 300 million registered users) and is commonly used in academic research to recruit Chinese participants. Using the platform's screening function, only adults who had not received any HPV vaccination were eligible for the survey. Eligible participants were asked to read the study description and provide informed consent before completing the questionnaire.

Although the current HPV vaccination policy in mainland China only permits individuals under age 45 to receive the HPV vaccine, evidence shows that parents' attitudes toward HPV vaccination play a critical role in shaping their family members' intentions. In particular, men's attitudes have been found to significantly influence their wives' and children's decisions in China (Gao, 2015; Lin et al., 2022). This suggests that adults over 45-despite being ineligible for vaccination-may still exert an important influence on younger generations' vaccination decisions through their knowledge or awareness about the HPV vaccine. Therefore, this study also included participants aged over 45.

A total of 320 adults completed the survey. The sample consisted of 56.88% males, with ages ranging from 18 to 61 ($M = 31.96$, $SD = 10.73$). 50% of the participants had higher education (two-year college or above), and the remaining 50% had lower education (high school or below).

2) Measures

Exposure to HPV-related information was categorized into four primary sources: news media, entertainment media, family communication, and friend communication. To measure this exposure, we adapted items from Kelly et al. (2009), focusing on the frequency of

encounters over the past 30 days. Responses were recorded on a 5-point scale (1 = never, 5 = always) to improve clarity and facilitate subsequent analysis, with higher scores representing higher exposure frequency. Participants were asked the following questions: “How often have you come across information about HPV or HPV vaccine in the news (newspapers, TV news, or online news) in the past 30 days? ($M = 3.13$; $SD = 1.01$),” “How often have you come across information about HPV or HPV vaccine in entertainment media (movies, TV shows, or social media) in the past 30 days? ($M = 3.08$; $SD = 1.12$),” “How often have you come across information about HPV or HPV vaccine from your family in the past 30 days? ($M = 2.54$; $SD = 1.17$),” and “How often have you come across information about HPV or HPV vaccine from your friends in the past 30 days? ($M = 2.90$; $SD = 1.22$).”

To evaluate participants’ knowledge about the HPV vaccine, we used 2 items from Waller, Ostini, Marlow, McCaffery & Zimet (2013), which were listed in the Supplementary Material of the original study. These items have been used in prior research to measure HPV vaccine knowledge. Both questions are the most basic knowledge about HPV vaccine. They are “Someone who has had HPV vaccine cannot develop cervical cancer.” “Girls who have had HPV vaccine do not need a [Pap test/Smear test/Pap smear test] when they are older.” Respondents are asked to determine whether the content is true or false. Due to the answer for these two questions are false, thus if they choose true, it was coded as 0 representing the answer was incorrectly. Reversely, if they answered false, it was coded as 1 representing the answer was correct. Finally, the summary score was calculated as HPV vaccine knowledge score ($M = 1.69$, $SD = 0.60$). The closer the score is to 2, the higher the level of knowledge participants had. Given the small number of factual items, the knowledge measure was treated as a simple index rather than a multi-item scale.

Misinformation belief regarding HPV vaccine was also assessed using six items derived from previous studies (Ekram et al., 2019; Kornides et al., 2023). Ekram et al. (2019) analyzed HPV vaccine-related videos on YouTube over a period of more than six months, while Kornides et al. (2023) examined HPV vaccine-related tweets on Twitter for over three months. Both studies identified the most common categories of misinformation about HPV

vaccine. We selected six thematic items from these studies and asked participants to indicate whether each statement about HPV vaccine was true or false. As people in mainland China generally have little knowledge of Gardasil and tend to focus more on vaccine type (e.g., bivalent, quadrivalent, or nine-valent) and origin (domestic vs. imported), we used the term “HPV vaccine” in these six items instead of Gardasil. Responses were coded as 1 for “true” and 0 for “false” (see <Table 1>). The summary score across these six items was calculated to represent the level of HPV vaccine misinformation, with a higher score indicating a greater degree of misinformation belief ($M = 1.46$, $SD = 1.17$).

These items were conceptualized as a formative index rather than a reflective scale because they represent distinct misinformation categories rather than interchangeable indicators of a single underlying construct. Therefore, internal consistency was not considered the primary criterion for evaluating this index. Instead, the validity of the index was supported by its theoretical grounding in prior research identifying prevalent HPV vaccine misinformation themes (Ekram et al., 2019; Kornides et al., 2023).

<Table 1> Proportion of true and false responses to HPV vaccine misinformation belief

	True (%)	False (%)
1. HPV vaccine has been found to sterilize young women.	3.75	96.25
2. Receiving HPV vaccine can cause people to have sore arms.	48.75	51.25
3. Due to not enough research being done, there are many side effects of HPV vaccine that I am not aware of.	55	45
4. HPV vaccine is the only vaccine that may cause people death.	4.69	95.31
5. The vaccine industry is a significant profit center within the healthcare sector, therefore actively promoting HPV vaccine administration is seen as a move for national governments and pharmaceutical companies to profit.	26.88	73.13
6. HPV vaccination is not reducing cervical cancer rates. It is making matters worse.	6.88	93.13

4. Results

1) Correlation Analysis

Before testing the hypotheses, correlations among the key variables were examined (see <Table 2>). In the gender analysis, females were coded as 1 and males as 0. Gender and education level demonstrated a significant positive correlation with HPV vaccine knowledge, while age, news media exposure, entertainment media exposure, and family communication exhibited a significant negative correlation. However, except for HPV vaccine knowledge, none of the variables showed any significant correlation with HPV vaccine misinformation belief.

Although the bivariate correlations between information exposure variables and HPV vaccine misinformation belief were not statistically significant, this does not preclude the emergence of significant conditional effects in the regression models. Bivariate correlations reflect average associations across the full sample, whereas the regression analyses examined whether these

<Table 2> Intercorrelations and descriptive statistics for study variables

Variable	1	2	3	4	5	6	7	8	9
1. Age	1								
2. Gender	.01	1							
3. Education level	-.02	.24**	1						
4. News media exposure	-.04	.07	.17**	1					
5. Entertainment media exposure	.02	.04	.13*	.62**	1				
6. Family communication exposure	.03	.06	.19**	.43**	.42**	1			
7. Friend communication exposure	-.01	.14**	.24**	.42**	.41**	.58**	1		
8. HPV vaccine knowledge	-.27**	.16**	.15**	-.15**	-.18**	-.18**	-.06	1	
9. HPV vaccine misinformation belief	.03	.00	-.07	.03	.11	.09	.02	-.18**	1
<i>M</i>	31.96	0.43	2.92	3.13	3.08	2.54	2.90	1.69	1.46
<i>SD</i>	10.73	0.50	1.10	1.01	1.12	1.17	1.22	0.60	1.17

Note. *N* = 320

p* < .05, *p* < .01

relationships varied by education level. Thus, the absence of a significant overall correlation may indicate that the effects of information exposure on misinformation belief are contingent rather than uniform, and may be suppressed or offset when aggregated across groups with different educational levels.

2) Hypotheses Testing

Two hierarchical regression analyses were conducted to test these hypotheses and research questions. To examine the interaction effect, education and information exposure were centered

<Table 3> Predictors of HPV vaccine knowledge: Hierarchical multiple regressions

	Model 1 (Demographic content)	VIF	Model 2 (Main effects)	VIF	Model 3 (Interaction effects)	VIF
Age	-.27**	1	-.27**	1.01	-.26**	1.01
Gender	.17**	1	.14**	1.07	.16**	1.09
C_Education			.15**	1.12	.15**	1.13
C_News media exposure			-.09	1.77	-.08	1.81
C_Entertainment media exposure			-.10	1.74	-.12	1.81
C_Family communication exposure			-.15*	1.64	-.13*	1.66
C_Friend communication exposure			.04	1.66	.03	1.69
C_Education x C_News media exposure					-.09	1.88
C_Education x C_Entertainment media exposure					.15*	1.96
C_Education x C_Family communication exposure					.03	1.73
C_Education x C_Friend communication exposure					.05	1.60
R^2	.10		.17		.19	
Adjusted R^2	.10		.15		.16	
F	$F(2,317)=17.66,$ $p < .001$		$F(7,312)=9.21,$ $p < .001$		$F(11,308)=6.71,$ $p < .001$	
ΔR^2	.10		.07		.02	
ΔF	$F(2,317)=17.66,$ $p < .001$		$F(5,312)=5.34,$ $p < .001$		$F(4,308)=2.11,$ $p = .080$	

Note. "C" means the centering process. * $p < .05$, ** $p < .01$

<Table 4> Predictors of HPV vaccine misinformation belief: Hierarchical multiple regressions

	Model 1 (Demographic content)	VIF	Model 2 (Main effects)	VIF	Model 3 (Interaction effects)	VIF
Age	.03	1	.02	1.01	.02	1.01
Gender	-.00	1	.02	1.07	.00	1.09
C_Education			-.08	1.12	-.09	1.13
C_News media exposure			-.06	1.77	-.05	1.81
C_Entertainment media exposure			.13	1.74	.11	1.81
C_Family communication exposure			.10	1.64	.11	1.66
C_Friend communication exposure			-.06	1.66	-.05	1.69
C_Education x C_News media exposure					-.03	1.88
C_Education x C_Entertainment media exposure					.01	1.96
C_Education x C_Family communication exposure					-.16*	1.73
C_Education x C_Friend communication exposure					.05	1.60
R^2	.001		.03		.05	
Adjusted R^2	-.01		.01		.02	
F	F (2,317)=0.19, $p = .827$		F (7,312)=1.25, $p = .277$		F (11,308)=1.45, $p = .149$	
ΔR^2	.001		.03		.02	
ΔF	F (2,317)=.19, $p = .827$		F (5,312)=1.67, $p = .142$		F (4,308)=1.79, $p = .131$	

Note. "C" means the centering process. * $p < .05$, ** $p < .01$

to create an interaction term. HPV vaccine knowledge was simultaneously regressed on basic demographic variables (age, gender, and education level), the four information exposure sources, and the interaction between information exposure and education (see <Table 3>). A similar approach was applied to HPV vaccine misinformation belief (see <Table 4>).

Regarding the main effects of information exposure on HPV vaccine knowledge, as shown in <Table 3>, exposure to HPV-related information from news media was not a significant predictor of HPV vaccine knowledge ($B = -.06$, $SE = 0.04$, $\beta = -.09$, $p = .18$), which is contrary to our initial estimation. Thus, H1 was rejected. In addressing RQ1, we found that

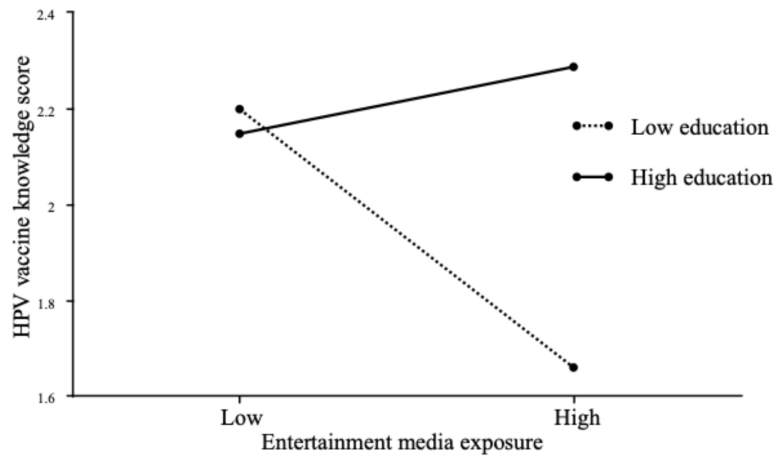
exposure to HPV-related information from family communication was a significant negative predictor of HPV vaccine knowledge ($B = -.08$, $SE = 0.03$, $\beta = -.15$, $p = .03$). However, exposure to HPV-related information from entertainment media ($B = -.05$, $SE = .04$, $\beta = -.10$, $p = .16$) and friend communication ($B = .02$, $SE = 0.03$, $\beta = .04$, $p = .51$) did not demonstrate a significant impact.

Regarding the main effects of information exposure on HPV vaccine misinformation belief, as shown in <Table 4>, four sources did not demonstrate any significant impact. Therefore, H2 was rejected. In response to RQ2, HPV-related news media exposure does not influence individuals' misinformation belief about HPV vaccine ($B = -.06$, $SE = 0.09$, $\beta = -.06$, $p = .48$).

Regarding the interaction effect between education and HPV-related information exposure, we identified two significant interactions for HPV vaccine knowledge and misinformation belief.

For HPV vaccine knowledge (see <Table 3>), the combination of education level and news media exposure did not demonstrate a significant impact ($B = -.05$, $SE = 0.04$, $\beta = -.09$, $p = .21$), indicating that H3 was rejected. However, the interaction between education level and entertainment media exposure revealed a significant effect ($B = .07$, $SE = 0.03$, $\beta = .15$, $p = .04$). To further interpret this interaction effect, additional simple slope analyses were conducted to examine the conditional effect of entertainment media exposure on HPV vaccine knowledge at different levels of education, while controlling for age and gender. The results showed that entertainment media exposure was negatively associated with HPV vaccine knowledge at low levels of education ($\beta = -.19$, $p < .001$), whereas the association was not significant at high levels of education ($\beta = -.02$, $p = .663$). These findings suggest that the negative effect of entertainment media exposure on HPV vaccine knowledge is no longer significant among individuals with higher levels of education (see <Figure 1>).

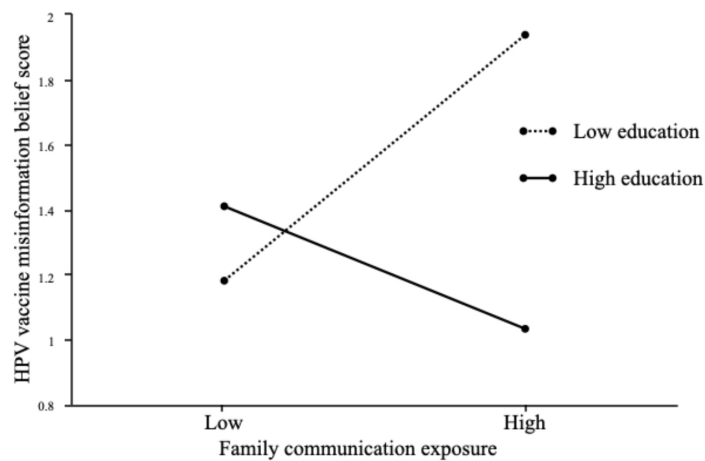
For HPV vaccine misinformation belief (see <Table 4>), only the interaction between education level and family communication about HPV was significant ($B = -.15$, $SE = 0.07$, $\beta = -.16$, $p = .03$), indicating that H4 was partially supported. The simple slope analyses showed that family communication exposure was positively associated with HPV vaccine



<Figure 1> Interaction effects between entertainment media exposure and education level on knowledge about HPV vaccine

Note. High education level represents a 2-year college education and above, while low education level represents a high school education and below.

misinformation belief at low levels of education ($\beta = .24, p = .003$), whereas the association was not significant at high levels of education ($\beta = .10, p = .079$) (see <Figure 2>). These findings suggest that the positive association between family communication exposure



<Figure 2> Interaction effects between family communication exposure and education level on misinformation belief about HPV vaccine

Note. High education level represents a 2-year college education and above, while low education level represents a high school education and below.

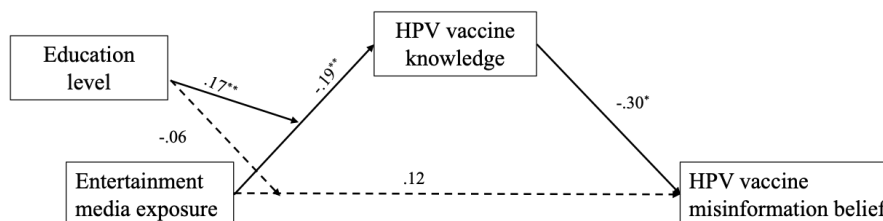
and misinformation belief is stronger among individuals with lower levels of education and diminishes among those with higher levels of education.

Regarding RQ4, no interaction was observed between HPV-related news media exposure and education level on individuals' HPV vaccine misinformation ($B = -.03$, $SE = .08$, $\beta = -.03$, $p = .69$).

Given that the overall explanatory power of the misinformation belief model was relatively low and considering the significant association between health knowledge and misinformation belief (e.g., Scherer et al., 2021; Xiao, Su & Lee, 2021), we conducted an additional moderated mediation analysis using PROCESS Model 8 with 5,000 bootstrap samples to further examine the underlying mechanism (Hayes, 2018).

When family communication exposure was entered as the independent variable, no significant moderated mediation effect was observed (index = $-.02$, BootSE = $.02$, 95% CI $[-.07, .02]$).

However, when entertainment media exposure was entered as the independent variable, a significant moderated mediation effect emerged (index = $-.05$, BootSE = $.04$, 95% CI $[-.13, -.00]$). Specifically, the positive indirect effect of entertainment media exposure on HPV vaccine misinformation belief through HPV vaccine knowledge was significant at low levels of education (indirect effect = $.06$, 95% CI $[.00, .14]$), but not at high levels of education (indirect effect = $.01$, 95% CI $[-.02, .03]$) (see <Figure 3>). These findings suggest that although entertainment media exposure does not have a significant direct effect on misinformation belief, it indirectly influences it through HPV vaccine knowledge. This indicates that the effect operates through a cognitive pathway of knowledge acquisition and is contingent on individuals' education level.



<Figure 3> A moderated mediation model

5. Discussion

In contrast to prior research that has typically focused on one or two information sources in isolation, this study investigated the impact of daily information exposure through four principal sources-news media, entertainment media, family communication, and friend communication-on both knowledge and misinformation belief regarding HPV vaccine, while also considering the moderating effect of education level. Although the levels of knowledge about HPV vaccine are not low and misinformation belief is not high, significant disparities were observed across demographics, frequency of information exposure, and educational attainment. To advance the efforts of HPV vaccination in China, it is imperative to understand how these factors affect knowledge and misinformation belief regarding HPV vaccine.

Regarding demographic factors, younger individuals, females, and those with higher levels of education tended to report higher levels of HPV vaccine knowledge, consistent with prior research (Johnston et al., 2015; McBride & Singh, 2018; Unger et al., 2015). No significant relationship was found between demographic factors and HPV vaccine misinformation belief.

Among the four major sources of health information, only family communication demonstrated a significant main effect on HPV vaccine knowledge. The more individuals engage in discussions with their family about HPV or HPV vaccine, the lower their knowledge about the vaccine tends to be. This finding contradicts previous evidence suggesting that family discussions about health generally enhance health knowledge (Crawford et al., 1990; Sinicrope et al., 2009). We speculate that this may be because many Chinese individuals still harbor doubts regarding the effectiveness of HPV vaccine (Ma et al., 2019). Especially, Chinese parents appear to maintain skepticism about HPV vaccine (Wong, Lee, Nagi, Chor, & Chan, 2013). This inaccurate information can easily be transmitted to family members during discussions about HPV or HPV vaccine, thereby diminishing their knowledge. Future research can consider testing the mediating role of misinformation between family communication and HPV vaccine knowledge.

Two meaningful interaction effects between education and information exposure were

identified.

First, education and HPV-related entertainment media exposure demonstrated a significant positive interaction effect on HPV vaccine knowledge. For individuals with an education level of 2-year college education or higher, increased exposure to HPV-related information from entertainment media didn't impact their HPV vaccine knowledge. Conversely, for individuals with a high school education or less, exposure to entertainment media content about HPV or HPV vaccine lead a significant decrease on their knowledge.

Entertainment media exposure has been shown to not only promote health knowledge (Dutta-Bergman, 2004; Lai et al., 2015) but also to diminish it (Chung, 2014; Quick et al., 2014). Therefore, the impact depends on how individuals process health information. Ezeah et al. (2020) proposed that individuals with low education levels may have a reduced ability to understand health information from entertainment media. Thus, we propose that individuals with lower education levels may struggle to comprehend correct content (Ezeah et al., 2020) and are more likely to believe incorrect information (Duplaga, 2020). Consequently, they may convert only a small amount of useful information into their knowledge while being significantly influenced by a larger volume of misinformation. As their exposure frequency increases, the amount of misinformation they encounter far exceeds the new information they learn, which may ultimately lead to a decline in their knowledge. In contrast, individuals with higher levels of education are better equipped to process and critically evaluate information, as suggested by the knowledge gap hypothesis (Tichenor et al., 1970). Higher levels of education are associated with stronger cognitive abilities (e.g., processing speed, reasoning, and intellectual engagement) (e.g., Parisi et al., 2012), which may enable individuals to process and evaluate health-related information more effectively. As a result, even when exposed to mixed or potentially inaccurate information in entertainment media, they are more likely to extract accurate knowledge while discounting misleading information.

Moreover, the characteristics of entertainment media messages may also explain why such content influences HPV vaccine knowledge. Unlike traditional health information sources, entertainment media often conveys health-related information through narratives rather than explicit educational messages. Narrative transportation theory (Green & Brock, 2000) suggests

that individuals who become immersed in a story may become less attentive to inconsistencies in the narrative and more likely to adopt story-consistent beliefs, thereby increasing the persuasive impact of narrative content. Previous research has further shown that narrative communication can reduce counterarguing and produce relatively enduring persuasive effects (Appel & Richter, 2007; Ma, 2020). Therefore, entertainment media may influence audiences not only because they perceive such information as credible but also because narrative engagement can reduce critical scrutiny of embedded messages. However, this mechanism is unlikely to operate uniformly across individuals. Although both higher- and lower-educated individuals may become equally immersed in entertainment narratives, individuals with higher levels of education generally possess stronger information-processing skills (Cascio & Lewis, 2006) and may be better able to critically evaluate health-related information. Consequently, they are more likely to identify inaccurate or incomplete health messages embedded in entertainment content rather than accepting them uncritically. In contrast, individuals with lower levels of education may rely more heavily on narrative information and be less likely to critically evaluate its accuracy, making them more susceptible to misinformation conveyed through entertainment media. This mechanism may also explain why entertainment media exposure was associated with lower HPV vaccine knowledge only among participants with lower levels of education.

Second, family communication and education exhibited a significant interaction effect on misinformation belief about HPV vaccine. Individuals with education levels of at least a 2-year college education did not experience significant changes in misinformation belief, even when they frequently discussed HPV or HPV vaccine with family members. These results align with previous research. For example, a meta-analysis of 61 empirical studies found that higher educational attainment is associated with lower susceptibility to health misinformation (Nan et al., 2022). Similarly, Hwang and Jeong (2023) found that individuals with higher education levels exhibit lower acceptance of health misinformation. During communication with family members, individuals with higher levels of education may be better able to evaluate and identify inaccurate information based on their existing knowledge. As a result, they are less likely to be influenced by misinformation. This evidence suggests that individuals

with higher levels of education may be more resistant to misinformation.

However, for those with a high school education or less, increased discussions about HPV or HPV vaccine within their families correlated with a higher HPV vaccine misinformation belief. To date, although limited studies have shown that family communication contains substantial misinformation about the HPV vaccine, including false beliefs about its risks and effectiveness (Walker et al., 2020), there is growing evidence that family communication plays a central role in the spread of health misinformation more broadly (Chia et al., 2023; Malhotra, 2024; Warner et al., 2021). Given this evidence, it is plausible that family communication may also be associated with higher levels of HPV vaccine misinformation belief. Individuals with lower education levels are more susceptible to health misinformation (Scherer et al., 2021) and are more likely to believe it (Duplaga, 2020). Therefore, when they encounter family communication containing substantial HPV vaccine misinformation, they are easily influenced and tend to acquire even more misinformation.

The unique influence of family communication may also be understood within the Chinese cultural context. In Chinese society, family communication often plays an important role in health-related decision-making due to strong family ties and culturally embedded values emphasizing family influence (e.g., Feng, 2025). Therefore, conversations about HPV vaccination within families may represent a particularly influential source of health information. When such conversations contain misinformation regarding vaccine safety or effectiveness, individuals may be repeatedly exposed to inaccurate information within a family context where health-related opinions are frequently exchanged and reinforced. However, the ability to evaluate and challenge such information may depend on individuals' educational backgrounds. A meta-analysis of 61 empirical studies demonstrated that individuals with higher education levels were less susceptible to health misinformation (Nan et al., 2022). Thus, individuals with higher education levels may be better positioned to identify and reject misinformation encountered through family communication, whereas those with lower education levels may be more likely to incorporate inaccurate information into their beliefs.

Furthermore, the PROCESS analysis revealed a significant moderated mediation pattern in the relationship between information exposure and HPV vaccine misinformation belief.

Specifically, among individuals with lower levels of education, exposure to HPV-related content through entertainment media was associated with decreased HPV vaccine knowledge, which in turn was linked to higher levels of misinformation belief, whereas this indirect effect was not observed among those with higher levels of education. These findings highlight the conditional nature of the relationship between information exposure and misinformation belief. Individuals with lower levels of education may be more vulnerable due to limited information-processing capacity, which hinders their ability to distinguish accurate from misleading content and amplifies the indirect negative effect of entertainment media exposure on knowledge and, subsequently, on misinformation belief.

Building on these findings, this pattern may also be understood considering the specific informational context in China. The HPV vaccine was only introduced in mainland China in 2016 and has been widely promoted as a cervical cancer vaccine. As a result, public understanding of HPV and the vaccine remains relatively limited and fragmented. At the same time, entertainment media, particularly social media platforms, contain a substantial amount of misinformation related to the HPV vaccine. For example, a content analysis of Chinese social media found that 90.3% of negative posts exhibited typical features of conspiracy theories, such as claims that the vaccine is dangerous or toxic and that its promotion is primarily profit-driven (Chen et al., 2020). Similarly, Jiang et al. (2023), analyzing 67,773 social media posts, identified HPV vaccine-related scandals as one of the major themes in online discussions. Thus, in such an information environment, exposure to HPV-related content through entertainment media is more likely to involve misleading or conflicting information, which may undermine accurate knowledge acquisition and, in turn, increase susceptibility to misinformation belief.

In addition, family communication may serve as a secondary interpersonal channel through which misinformation is reinforced. When individuals exposed to inaccurate information through media discuss HPV-related topics with family members, these misconceptions may be further circulated and amplified. Such interpersonal communication may directly reinforce misinformation belief, particularly among individuals with lower levels of education.

6. Implications

This research has both theoretical and practical implications. From a theoretical perspective, we have demonstrated the impact of information exposure on health knowledge, particularly highlighting the crucial role of family communication, which not only shows a significant direct negative impact on HPV vaccine knowledge but also exhibits a notable interactive effect with education level on HPV vaccine misinformation belief. We have also identified potential interaction patterns between entertainment media exposure and education in shaping HPV vaccine knowledge.

Health knowledge and misinformation belief play critical roles in individuals' health decision-making and behaviors (Lee et al., 2022; Wang et al., 2019). Notably, misinformation can persistently influence people's beliefs and actions even after it has been corrected, a phenomenon referred to as the continued influence effect (Johnson & Seifert, 1994). Therefore, based on our findings, future research can develop a more comprehensive framework to interpret individuals' health decisions and behaviors by incorporating health information exposure, health knowledge, and misinformation belief, with particular emphasis on the roles of entertainment media exposure and family communication.

From a practical perspective, this research provides valuable insights into health communication strategies aimed at enhancing HPV prevention. First, given the paramount importance of family communication, educational programs should be directed toward families, particularly those with members who have a high school education or less. If family communication consistently conveys accurate information about HPV vaccine, it is anticipated that all family members will attain higher levels of knowledge and be exposed to less misinformation, regardless of the frequency of their discussions.

Second, considering the prevalence of misinformation about HPV vaccine in entertainment media, efforts to verify and correct misinformation should be prioritized, particularly on social media platforms. The Chinese government should endeavor to minimize the occurrence of misinformation online.

Third, educational initiatives can focus on enhancing media literacy, especially among

individuals with lower education levels. With increased media literacy, even if individuals encounter excessive HPV-related content containing misinformation, they are less likely to accept it and will therefore be less affected by it.

Fourth, although the present study focuses on HPV-related health information and vaccination communication, the implications of these findings may extend beyond HPV to other voluntary and self-paid preventive health contexts. Similar to HPV vaccination, many adult vaccines, such as influenza and herpes zoster vaccines, are often obtained outside routine immunization programs and require individuals to access, evaluate, and interpret health information from multiple sources. Because these preventive health behaviors may involve substantial out-of-pocket costs, individuals with limited financial resources, such as university students or older adults who rely on family support, may particularly depend on family members for health-related information and communication. Therefore, the role of interpersonal information sources identified in this study may also be relevant to other preventive health contexts characterized by voluntary participation, financial considerations, and information uncertainty.

Lastly, although this study was conducted among Chinese adults, the findings may provide relevant implications for Korean health communication researchers and practitioners. China and Korea share several cultural and media characteristics, including the continuing influence of family communication on health-related decision-making (e.g., Chang, Lee, Kim & Lee, 2008; Feng, 2025) and the widespread use of digital media for health information seeking. In both contexts, health information is increasingly encountered not only through traditional sources but also through interpersonal communication and entertainment-oriented digital content. Therefore, the findings highlight the importance of considering the communication context through which health information is received when designing HPV vaccination campaigns. For Korean health practitioners, interventions may benefit from addressing misinformation circulating in family discussions and developing strategies to promote critical evaluation of health information encountered through digital entertainment platforms.

Despite its contributions, this study has several limitations that should be acknowledged. First, the cross-sectional design based on self-reported data limits the ability to establish

causal relationships among variables. In particular, the temporal ordering between information exposure and HPV vaccine knowledge or misinformation belief cannot be clearly determined, raising the possibility of reverse causation. Second, the use of a convenience sampling approach limits the generalizability of the findings. The sample may not be representative of the broader population, and therefore the results should be interpreted with caution when extending to other contexts. Third, self-reported measures of exposure to HPV-related information over the past 30 days may be subject to recall bias, particularly for topics that are not frequently encountered or salient, which could partly explain the non-significant effects of media exposure. In addition, the dependent variables were assessed with a limited and uneven number of items: HPV vaccine knowledge was measured using only two true/false items (adapted from Waller et al., 2013), while misinformation was measured with six items. Although internal consistency metrics such as Cronbach's α are not applicable to such dichotomous items, the small number of items may still limit the ability to capture meaningful variation and affect model robustness. Future research should employ more comprehensive and balanced measures to improve precision and reliability. Lastly, the relatively low explained variance in the regression models predicting misinformation belief suggests that HPV vaccine misinformation endorsement is shaped by multiple factors beyond the media exposure and communication sources examined in this study. Future research should incorporate additional predictors, such as prior health knowledge, media literacy, prior vaccine attitudes, trust in health authorities, perceived risk, or social network influences, to develop a more comprehensive understanding of misinformation endorsement.

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정보 노출이 HPV 백신 지식과 오정보에 대한 믿음에 미치는 영향: 교육 수준의 조절효과

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본 연구는 네 가지 정보원(뉴스 미디어, 엔터테인먼트 미디어, 가족 및 친구)에 대한 노출이 HPV 백신 지식과 오정보에 대한 믿음 미치는 영향을 살펴보았다. 중국 성인 320명을 대상으로 실시한 온라인 설문조사 결과, 가족 커뮤니케이션만이 HPV 백신 지식에 유의한 주효과를 보이는 것으로 나타났다. 또한 교육 수준은 엔터테인먼트 미디어 노출과 HPV 백신 지식 간의 관계뿐만 아니라 가족 커뮤니케이션과 HPV 백신 관련 오정보 믿음 간의 관계도 조절하는 것으로 나타났다. 구체적으로, 교육 수준이 낮은 사람들은 엔터테인먼트 미디어를 통해 HPV 관련 콘텐츠에 더 많이 노출될수록 HPV 백신 지식 수준이 낮게 나타났다. 마찬가지로, 교육 수준이 낮은 사람들은 가족과 HPV에 관한 논의를 더 많이 할수록 오정보를 습득할 가능성이 높은 것으로 나타났다. 반면, 교육 수준이 높은 사람들에서는 이러한 관계가 유의하지 않았다.

주제어 : 정보 노출, HPV 백신 지식, HPV 백신 오정보에 대한 믿음, 엔터테인먼트 미디어, 가족 커뮤니케이션, 친구 커뮤니케이션

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