Investigating Media Coverage and Public Perceptions of the HPV Vaccine in China – A Content Analysis of Weibo Posts

Junyi Hu1 · Thomas William Whyke1 · Joaquin Lopez-Mugica2

Accepted: 25 August 2022 / Published online: 5 September 2022
© The Author(s), under exclusive licence to Springer Science+Business Media, LLC, part of Springer Nature 2022

Abstract
Human papillomavirus (HPV) is one of the most common sexually transmitted infections worldwide. The HPV vaccination has been widely advocated around the world since the vaccine is beneficial in avoiding diseases, including some sexually transmitted diseases, brought on by HPV infections. For most Chinese, the HPV vaccine is still a relatively new concept, having only been made available to the general public in 2016. Despite the vaccine’s increased prominence, there is still a lack of investigation about how the public is influencing the conversation about HPV vaccines and the public’s perception of this vaccine. With the theoretical construct of the Health Belief Model, this study conducts both quantitative and qualitative content analysis to investigate the existing media narratives around HPV vaccines in China and the changes in public opinion by looking at users’ contributions on Weibo, one of China’s most popular social networking sites. It was found that different groups of Weibo users had contributed to diverse narratives surrounding HPV vaccination. Though the public awareness of HPV vaccination had been improved along with increasingly active communication practices and enhanced public health services, public knowledge about HPV remains inadequate. Therefore, to facilitate the popularisation of HPV related knowledge, more effort should be invested in tailoring and disseminating messages that communicate responsive and comprehensive HPV related information.

Keywords  Human Papillomavirus Vaccines · Health Belief Model · Social Media · China · Content Analysis · Sexual Health · Vaccination Awareness

* Thomas William Whyke
Thomas-William.Whyke@nottingham.edu.cn
1 The School of International Communications, The University of Nottingham Ningbo China, Ningbo, Zhejiang, China
2 Wenzhou-Kean University, Wenzhou, Zhejiang, China
Introduction

Sexual transmission of the HPV virus, which causes cervical cancer in women and penile cancer in men, is highly prevalent worldwide. As the human papillomavirus (HPV) vaccine is effective in preventing diseases, including sexually transmitted diseases, brought by HPV infections, receiving HPV vaccination has been widely recommended by various medical organisations and governmental departments across the world. In China, the HPV vaccine was not introduced until 2016, which makes it a relatively new entity for the public. On 21st April 2020, China’s domestically produced HPV vaccine was approved by the National Medical Product Administration to be issued to the public, which became a heated topic in China. For instance, state-owned traditional and new media, in consultation with medical practitioners, advise women of suitable ages to have the HPV vaccine, and enlighten readers with introductory information and case stories (Mo & Xie, 2022; Yang et al., 2018). There are also popular science articles clarifying the types of HPV vaccination (Cui, 2021; Liu, 2021). In addition to discourse initiated by governmental, media and health organisations, there are non-official discussions among ordinary netizens on China’s social media platforms. Nonetheless, notwithstanding the increasing visibility of the HPV vaccine, how the public is contributing to the discourse surrounding this vaccine and the changes in public perception are under-investigated. As the constructs of the Health Belief Model (HBM) have been widely applied in various studies to identify individual’s perceptions that determine their intentions to adopt preventative health behaviours (Orji et al., 2012; Rosenstock, 1974), the theoretical framework can provide a beneficial approach to the investigation of the public attitudes towards HPV vaccination. Therefore, combined with the HBM, this study investigates users’ contribution to HPV vaccine-related public discussion on Weibo, one of the largest social media platforms in China, to examine existing media narratives and the changes in public perception of the health behaviour brought by the launch of domestic HPV vaccine.

Literature Review

The Health Belief Model as a Theoretical Framework

The Health Belief Model (HBM) was derived from the attempt of several social psychologists in the 1950s to investigate the link between individuals’ health beliefs and their preventative health behaviours, in order to expand the influence of public health services (Janz & Becker, 1984; Rosenstock, 1974). Regarded as one of the earliest developed and most widely applied theories of health behaviours (Glanz et al., 2002; Orji et al., 2012), HBM provides a systematic approach to identify factors that contribute to the individual’s intention of adopting preventative health actions (Janz & Becker, 1984; Rosenstock, 1974).
There are six theoretical constructs in HBM that are postulated to constitute the motivation of individuals to practice health behaviours including perceived susceptibility, perceived seriousness, perceived benefits, perceived barriers, self-efficacy and cues to action. Perceived susceptibility refers to individual’s evaluation of the probability of getting a disease, suggesting that individuals will be more likely to adopt health behaviours if they believe themselves to be vulnerable to infections. Perceived severity is the seriousness of an illness, which indicates that individual’s motivation to take actions is based on their judgements on the impacts of developing a health condition. Perceived benefits refer to the individual’s perception of the effectiveness of performing the advised health behaviour. Perceived barriers describe the individual’s evaluation of the costs or obstacles that are associated with advised health actions. Self-efficacy is the confidence in one’s ability to perform a behaviour. Cues to action refer to the triggers that prompt one’s readiness to act, which can include media campaigns, social events or a group of people. Among the six variables, perceived susceptibility and perceived severity are categorised as threat perception, perceived benefits and perceived barrier are the basis for individual’s behavioural evaluation (Abraham & Sheeran, 2005). Apart from the four components that comprise the original HBM, self-efficacy and cues to action are included in the later theoretical developments of the HBM (Carpenter, 2010; Orji et al., 2012).

During the first decades of its inception, the model focused on the perceived susceptibility of certain illnesses to improve early diagnosis. It gave importance to preventive health conducts such as medical check-ups and other prevention strategies to detect potential and early health disorders (Glanz et al., 2002). In the seventies, the precautionary health measures to predict a variety of behaviors incorporated a pragmatic approach to developing behavioral health treatment information, which granted “a useful framework for understanding of individual differences in health behaviour patterns and for designing behavior change interventions” (Kirscht, 1988; Abraham & Sheeran, 2005, 31). The model has also been criticized for the unnecessary level of convolution due partly to the consecutive efforts to assimilate the most varied health problem causes, which have brought inadequate and contradictory results (Norman & Brain, 2005).

Overall, Becker (1974) claims that the HBM could be a suitable theoretical framework to validate medical health care recommendations as well as to tackle health care psychological and social concerns. The present study adopts the Health Belief Model to identify what content of the HPV vaccine has been communicated in Weibo discussions, which can reflect the public health beliefs about HPV vaccination behaviour and guide the promotion of the health action.

The HBM and Social Media

In the field of health communication, the theoretical construct of HBM has been widely used to examine media coverage of health-related behaviour and benefit the design of health education campaigns (Kim, 2018; Zhang et al., 2017). The HBM has been designed specifically for understanding those people who were attempting
to act to ameliorate their well-being conditions as a healthy manner to prevent a negative health result (Wong et al., 2020; Yang et al., 2022). Previous studies have used HBM to examine the public perception and knowledge of health-related behaviour on social media platforms (Briones et al., 2012; Massey et al., 2020; Yoo et al., 2018). Several studies have shown that social media plays an important role in disseminating the exchange of information to promote community-level communications between healthcare institutions, non-profit organizations, and the general public (Thackeray et al., 2012; Yang, 2015). These social players can spread protected healthcare awareness campaigns about certain dangerous diseases and offer high-quality information to encourage efficient lifestyles and preemptive actions (Loft et al., 2020). Other scholarly work has outlined the efficiency of social media on Twitter, Instagram, or Facebook in promoting health communication and public engagement. These studies also stress the optimal capacities of the new technologies for peer-to-peer support, since they can facilitate pictures, videos, audio, and texts, making easier the user-friendliness and the intelligibility of the information available (Abramson et al., 2015; Diddi & Lundy, 2017; Vraga et al., 2018). By contrast, some critical studies point to the perils of misinformation about unhealthy products and low medical services that can manipulate people’s adopted beliefs and preventative behaviors, and transform them into unhealthy habits (Orr et al., 2016; Broniatowsk et al., 2018; Lama et al., 2019; Chou et al., 2020).

HBM in China has also proved that the model can serve as the intermediating bridge between media disclosure and individual’s intentions to pursue healthy behavior in external cues like social media (Chen & Liu, 2021; Liu et al., 2022). More and more, Chinese people look for protected healthcare information brought about by professional bodies and social actors in digital media platforms (Zhang et al., 2020). This not only suggests that individuals search for passive information by means of scanning online news or social media posts, but also points out that people can be engaged in more active learning processes by having discussions online (Jiang et al., 2021).

**The HPV Vaccine in China and Social Media**

The introduction of the HPV vaccine in China is relatively late compared to other countries, which means that there was a slow growth in the media coverage of the HPV vaccine in the early stages (Wong et al., 2020). Even if most of the literature review on HPV vaccine is in Chinese language, there are still several studies in the English language, which have explored Chinese understanding of cervical cancer and HPV vaccination in terms of information accessibility, efficiency, and safety (Wang et al., 2014; Santhanes et al., 2018; Hu et al., 2020). Studies have also shown how demographics, geographies, socio-economic status, and gender can manifest acceptance or rejection of the HPV vaccine in China (Hong et al., 2013; Zhang et al., 2016; He et al., 2018; Liu et al., 2019). Cost-effectiveness has also become another key variable, in the individual’s perception of the HPV vaccine, because of the high prices and shortage in the provision of imported vaccines as well as disparities between regions to afford them (Xue, 2019). Li et al. (2018) have used
content analysis to examine the coverage of the HPV vaccine in Chinese newspapers from 2000 to 2016, suggesting the newspaper’s coverage of the HPV vaccine is insufficient and problematically framed. Since being licensed in China in 2017, the HPV vaccine has attracted an increasing amount of attention among the public, with more and more HPV vaccine-related information appearing in different media channels. During this stage, media narratives are mainly supportive of the vaccination, encouraging the public to get HPV vaccinated (Chen et al., 2020; Su, 2020). Regarding the public attitudes toward HPV vaccination, many studies show that the vast majority of Chinese women have a positive attitude toward HPV vaccination (Hu et al., 2021; Wang et al., 2020b).

On the one hand, studies have demonstrated the efficacy and success of the exchange of messages on Chinese social media including Wechat and Weibo, in propagating a positive assertiveness about the HPV vaccine and gaining proper information about its usefulness (Shi & Salmon, 2018; Su, 2020). On the other hand, scholars have also observed a lack of trust in the government’s management of the production and distribution of the vaccine manufacturers in the surveyed digital messages (Zhang et al., 2016; Hu et al., 2020). This has been documented through the 2018 Changchun Changsheng Biotechnology vaccine scandal, which made transparent the defects of the HPV vaccination. These past studies have stated how such incidents can contribute to a potential decline in the acceptance of the inoculation procedure in the long run. However, along with the active media environment and high willingness of getting HPV vaccinated, a nationwide survey has found that the public has limited knowledge of the HPV vaccine and only a small proportion of the population has received the vaccination in mainland China (Hu et al., 2021).

Such disparities indicate the significance of investigating the current stage of media coverage and public perception about the HPV vaccine, which can benefit the practice of tailoring health education on HPV vaccination. As social media is one of the most popular channels for the public to seek information and exchange thoughts (Wang, et al., 2020a), it can reflect the existing media narratives and awareness level of the HPV vaccine among the public. Considering the advantage of HBM constructs in identifying factors that are indicative of individual’s health beliefs, we propose the first research question (RQ):

**RQ1:** How does the presentation of HBM constructs vary across different author groups of Weibo posts?

Before the official release of the domestically produced HPV vaccine in 2020, the types of vaccine that are available for use were imported from other countries. The supply of HPV vaccine is insufficient, and the price of the vaccine was considered beyond the affordability for a large proportion of women in China (Wong et al., 2019). Several studies have used HBM constructs to examine the social media discourse when the public only had access to the imported HPV vaccines. The study of Chen et al. (2020) on Weibo analysed the media narratives in hot posts, which finds that the individual users mainly post about the difficulties in having HPV vaccination. Meanwhile, the occurrence of HBM elements that are associated with health knowledge is decreasing (Chen et al., 2020). Su (2020) focuses on the coverage of the WeChat official account of the HPV vaccine, suggesting the benefits of HPV vaccination is the most mentioned of HBM elements, followed by perceived barriers.
to getting HPV vaccinated. Accordingly, the obstacles in accessing HPV vaccination are perceived and attracting attention from the public. As the launch of the domestic HPV vaccine can alleviate the shortage in supply and economic burden in affording vaccines (Hu et al., 2021), it tends to reduce the existing barriers and therefore lead to changes in public perception of and concern on the HPV vaccine issue. Based on the context, we want to investigate the following research questions:

**RQ2**: How does the presentation of HBM constructs in Weibo posts change after the launch of the domestic vaccine?

**RQ3**: What topics related to HPV vaccine are Weibo users most concerned with before and after the launch of domestic vaccine?

**Method**

This research did not require ethical clearance as Weibo comments are readily available and readily accessible to anyone on the Internet. Moreover, online user personal information is anonymous on Weibo and in Weibo posts and therefore not disclosed. Special permission to request access to the readily available Weibo posts was therefore not required.

**Data Collection**

In this research, we collected and analyzed data from Sina Weibo. Weibo, one of the most popular social media platforms in China, is a quasi-Twitter microblogging application that has attracted approximately 573 million monthly active users as of December 2021 (Weibo, 2022). Apart from serving as a leading interest-based social network with economic values, Weibo is saliently regarded to function as an ideological arena enabling collective witness and a tool for social movements, particularly the empowerment of grassroots advocacy (Han, 2019, 2020; Huang & Sun, 2014; Liu, 2015). Significantly, Weibo is event-oriented, therefore it can be deployed as a research site (Han, 2016, 2019). In particular, Weibo allows all kinds of users to share opinions and exchange information, which enables the posts to reflect perceptions and concerns about health issues from different social groups (Wang et al., 2020a).

A Python spider programme was created by the authors to collect the search results of the term “HPV vaccine” on Weibo. With the Weibo search engine, posts that simultaneously included the keywords “HPV” and “vaccine” or were identified as relevant to “HPV vaccine” by Weibo algorithms were gathered. A pilot data collection was firstly conducted to locate the peak of Weibo posts after the event, namely the release of the domestic HPV vaccine on 21st April 2020, which suggested the majority of HPV vaccine-related Weibo posts were published within the first week after launch. Accordingly, posts published in the first week after the event (from 21st April 2020 to 27th April 2020) were collected. Then, to better examine the changes in public discussion brought about by the event, a week of posts that were published a month after the event (from 19th May 2020 to 25th May 2020) were also collected. Additionally, two weeks
of posts published before the event were included correspondingly (from 17th March to 23rd March 2020, and from 14th April 2020 to 20th April 2020), which enables the comparison of Weibo discourses before and after the event. After eliminating duplicate and irrelevant posts, a total of 6,917 posts were included in the sample (see Table 1).

**Measurement and Data Analysis**

The research is divided into two stages (see Fig. 1).

**Content Analysis**

In the first stage, both quantitative and qualitative content analysis are used. We randomly selected 691 of the 6,917 posts (~10%) to create a subsample for content analysis. The variables in the codebook consisted of author groups and HBM components. When designing the codebook, the components of the HBM were adopted. There are eight primary codes in this study (see Appendix 1). Among the primary codes, “Author”, “Perceived barriers” and “Self-efficacy” were redacted in the inductive coding process. To determine the subcategories of author groups, a number of posts (~20% of the sample) were randomly selected for inductive coding. Meanwhile, regarding “Perceived barriers” and “Self-efficacy”, we summarised different factors that contribute to the difficulty or individual’s confidence of successfully getting HPV vaccinated. The codebook was then revised and tested on a new set of posts to ensure categories could fully meet the demand. After discussing the data and the codes with reliability coders, the codebook was finalised (see Appendix 1). Finally, the content analysis of 691 Weibo posts was completed by two coders with high intercoder reliability (Cohen’s Kappa=0.82). The codes were validated by data validation tools using Microsoft Excel.

The qualitative content analysis was used in this study to complement the quantitative analysis, which can provide a comprehensive view of public discussions on the HPV vaccine. According to Altheide (1996), qualitative content analysis enables researchers “to capture the meanings, emphasis, and themes of messages and to understand the organization and process of how they are presented” (p. 33). With the qualitative content analysis, the presentation of HPV information on Weibo can be examined in detail and important patterns of expression that may be ignored in quantitative analysis can be identified, which could further reveal the characteristics of content posted by different groups of Weibo users. To conduct the analysis, we extracted posts that are good indicators for the expression of HPV vaccine-related information and views on Weibo. The posts are originally written in Chinese and translated into English by authors for textual analysis. The content analysis is completed before proceeding to RQ3.

**Word Cloud Analysis**

Next, the word cloud analysis was conducted to answer RQ3. Word clouds are useful for demonstrating the content of a large number of social media texts,
| Time period | Sampling time frame | Number of original posts identified by Python | Numbers of posts in the final sample | Number of posts included in subsample A | Number of posts included in subsample B |
|-------------|---------------------|---------------------------------------------|--------------------------------------|----------------------------------------|----------------------------------------|
| Before      | 17/03/2020–23/03/2020 | 1305                                       | 1080                                 | 108                                    | 20                                     |
|             | 14/04/2020–20/04/2020 | 1544                                       | 1204                                 | 120                                    | 20                                     |
| After       | 21/04/2020–27/04/2020 | 3247                                       | 2410                                 | 241                                    | 20                                     |
|             | 19/05/2020–25/05/2020 | 2915                                       | 2223                                 | 222                                    | 20                                     |
| Total       |                     | 9011                                       | 6917                                 | 691                                    | 80                                     |
and they can efficiently summarize the most salient issues in a given context (Hubert et al., 2020). This study adopts word cloud analysis to identify topics that are most frequently discussed on Weibo before and after the launch of domestically produced HPV vaccine, which can reveal the issues that receive the most public attention. The top 20 most reposted posts in the four weeks from 17th March 2020 to 25th May 2020 were respectively collected to form another subsample for word cloud analysis (see Table 1). As reposting enables the post to be exposed to more users, frequently reposted posts can indicate contents that receive a larger amount of public attention. The posts in the subsample were then visualised through word clouds in Python to identify the frequently occurred keywords, which suggested the topics that Weibo users cared about the most. Through the analysis, four word cloud visualisations (see Fig. 2) were generated, reflecting the salient keywords mentioned in Weibo posts by weeks.

**Analysis**

The vast majority of the sampled Weibo posts were created by ordinary users \((n = 579, 83.8\%)\), while the remaining Weibo discourse came from media organisations \((n = 22, 3.2\%)\), governmental accounts \((n = 25, 3.6\%)\), and health organisations \((n = 65, 9.4\%)\). Among the HBM components, cues to action \((26.8\%)\) and self-efficacy \((18.8\%)\) were mentioned the most frequently, followed by perceived susceptibility \((13.3\%)\), perceived barriers \((12.4\%)\), perceived benefits \((11.1\%)\) and perceived severity \((8.1\%)\).
RQ1: The Different Narratives of Post Authors

RQ1 asked about the presentation of HBM components in different author groups. A frequency table was generated to illustrate the frequency of different author groups mentioning HBM components (Table 2). In posts created by ordinary users, cues to action (29.7%) could be most frequently found, which prompted other people to have the HPV vaccination. However, only a small number of ordinary users mentioned the susceptibility (6.9%) and severity (4.3%) of HPV infection. Both media organisations and governmental accounts often disseminated information about self-efficacy, which could be useful for the public to receive the HPV vaccine. Compared to other author groups, the health organisations and professionals tended to share more information about the susceptibility (67.7%) and severity (43.1%) of being infected by HPV, meanwhile suggesting the benefits (41.5%) of getting HPV vaccinated. Additionally, while a number of ordinary users mentioned barriers to vaccination in their Weibo posts (14.5%), media organisations (4.5%), governmental accounts (0.0%) and health organisations or professionals (1.5%) barely published posts about perceived barriers.
| Author Groups                    | HBM components | perceived susceptibility | perceived severity | perceived benefits | perceived barriers | self-efficacy | cues to action |
|---------------------------------|----------------|--------------------------|--------------------|--------------------|--------------------|---------------|----------------|
| Media organisations (N = 22)    |                | 2 (9.1%)                 | 1 (4.5%)           | 4 (18.2%)          | 1 (4.5%)           | 14 (63.6%)    | 4 (18.2%)      |
| Governmental accounts (N = 25)  |                | 6 (24.0%)                | 2 (8.0%)           | 9 (36.0%)          | 0 (0.0%)           | 11 (44.0%)    | 8 (32.0%)      |
| Health organisations or professionals (N = 65) | | 44 (67.7%)             | 28 (43.1%)         | 27 (41.5%)         | 1 (1.5%)           | 8 (12.3%)     | 1 (1.5%)       |
| Ordinary users (N = 579)       |                | 40 (6.9%)                | 25 (4.3%)          | 37 (6.4%)          | 84 (14.5%)         | 97 (16.8%)    | 172 (29.7%)    |
| Total (N = 691)                |                | 92 (13.3%)               | 56 (8.1%)          | 77 (11.1%)         | 86 (12.4%)         | 130 (18.8%)   | 185 (26.8%)    |
Qualitative analysis of the posts further illustrates the way that different author groups present HBM constructs and the distinct features in their narratives. One post published by an official media account sharing self-efficacy information writes:

**Extract 1:** Tomorrow is the time for booking 4v and 9v vaccination slots in Shanxi Province! According to the schedule, the number of 4v HPV vaccination slots available is 23,000, and the 9v HPV vaccination is available for 1,000 citizens. The vaccination will be held in 20 medical institutions in Shanxi Province. The booking can only be made through the Shanxi disease control WeChat official account, neither offline booking nor phone call will be accepted. [posted by a media organisation]

Original text: 明天拼手速!陕西四价、九价疫苗线上预约啦! 本次计划预约四价人乳头瘤病毒疫苗23000人，九价人乳头瘤病毒疫苗10000人，在陕西省20个接种单位进行预约接种。市民可选择自己方便的接种单位进行预约并接种。全部通过陕西疾控公众号实行网络预约, 不接受电话和现场预约。

The extracted post indicates that the media organisation plays the role of disseminating information about the vaccine booking and vaccination locations, which serves as a crucial information channel that connects the medical institutions and the public that needs the HPV vaccine.

**Extract 2:** The first domestically produced HPV vaccine is available for booking from May! Women aged from 9 to 45 can receive the vaccination! Please take preventative measures. [Posted by a governmental account]

Original text: 国产HPV疫苗5月起可以预约接种啦! 9到45岁女性均可接种! 防患于未然。

**Extract 3:** Doctor Zhang Wenhong suggests that there will be serious outbreaks of influenza every winter. This year’s outbreak of COVID-19, combined with the outbreak of influenza, will pose a great threat to the health of the elderly and adults. Adults should receive influenza vaccination, and young women should be best vaccinated with the HPV vaccine before adulthood. [Posted by a governmental account]

Original text: 张文宏医生表示，每年冬季都会有流感的大爆发, 今年新冠的爆发，再夹杂流感的爆发，对老年人、成年人都是极大的风险。成年人应该打流感季节的疫苗，青年女性在成年之前最好打预防宫颈癌的HPV疫苗。

**Extract 2** and **Extract 3** are posted by governmental accounts. Similar to the media organisations, governmental accounts also share efficacy information, which includes suitable age for vaccination and the booking information. Additionally, both of the extracts indicate that governmental accounts recognise the importance of getting HPV vaccinated, considering it as a preventative health behaviour that should be performed. By quoting the popular medical expert, the effectiveness and urgency of HPV vaccination were highlighted, which aims to make the cues to action more powerful.

**Extract 4:** Explaining HPV in a few sentences

Firstly, as a DNA virus, the human papillomavirus has a variety of variants.

Secondly, cervical cancer is caused by continuous and long-term affection of high-risk HPV, which usually takes up 3 to 5 years... [Posted by a health organisation]
Original text: 几句话说清HPV: 1.作为一种DNA病毒, HPV的全称是人乳头瘤病毒, 分型特别多。2.宫颈癌是高危型HPV反复、长期感染的结果。时间往往需要3-5年...

Extract 4 is representative of the post published by medical organisations. From the post, the professional knowledge of HPV is presented briefly and logically. The HBM components of perceived susceptibility and perceived severity can be found, which remind the public of the threat of HPV infections.

Compared to the persuasive and informative narratives of organizational users, the ordinary users tend to share their personal stories and worries more often on Weibo, which can be learned from the extracts as follows:

Extract 5: I will receive HPV vaccination this afternoon. Just saying based on my experience: if you are at a suitable age, go and get vaccinated. The earlier you have it, the earlier you benefit from it. Advice from someone who has cervical cancer lesions. [Posted by an ordinary user]

Extract 6: About how I successfully got 9vHPV vaccination in Beijing on 22nd April 2020...I have been making appointments by calling the local hospitals since last month, but I need to wait for at least six months...Fortunately, someone in the local community told me that the prevention and healthcare branch in our hospital had the HPV vaccine. So, I just asked the hospital and successfully booked a slot today. Tips: you can try to call the local hospitals, do not just rely on online appointment platforms. [Posted by an ordinary user]

Extract 7: The HPV vaccine is just too expensive! And it is so hard to book a vaccination slot...Is it really possible for me to receive a vaccination by the end of this year? [Posted by an ordinary user]

Extracts 5, 6 and 7 suggest that ordinary users actively share their personal experiences and feelings related to HPV vaccination. In Extract 5, the author encouraged others to get vaccinated based on her experience of suffering from cervical cancer, which forms cues to action. In Extract 6, a possible way to book a vaccination slot was recommended by the author, which could be helpful for others to get the HPV vaccine. Extract 7 is from an ordinary user complaining about the current barriers that existed, which include the difficulty in reservation and the high price of the HPV vaccine.

RQ2: The Changes Brought by the Release of Domestic Vaccine

RQ2 was concerned with changes in the proportion of HBM components included in Weibo posts before and after the launch of the domestic HPV vaccine. To answer
RQ2, a cross-tabulation test was conducted. Table 3 displayed the difference in the media presentation of HBM components in different time frames. Cues to action remained to be the most frequently mentioned HBM component after the launch of the domestic HPV vaccine. The proportion of Weibo posts that mentioned cues to action ($\chi^2 = 24.4, P < 0.001$) and perceived benefits ($\chi^2 = 15.7, P = 0.003$) had significantly increased. This indicates that more people were encouraged to take HPV vaccines and were informed about the efficacy of vaccination after the launch of the domestic HPV vaccine. Moreover, self-efficacy ($\chi^2 = 10.1, P = 0.018$) and perceived susceptibility ($\chi^2 = 4.2, P = 0.04$) were also more frequently included in Weibo posts. This means the Weibo users were more aware of the likelihood of HPV infection and had shared more information that might be helpful for vaccination. However, there was no significant difference between the percentage of perceived severity ($\chi^2 = 2.7, P = 0.102$) and perceived barriers ($\chi^2 = 2.9, P = 0.714$) included in posts in different time frames.

The qualitative analysis of Weibo posts published after the launch of the domestic HPV vaccine can also reflect features in Weibo narratives.

**Extract 8**: The vaccination of domestically produced HPV vaccine has started. A ten-year-old girl in Wuhan becomes the first domestic vaccine recipient... [Posted by a media organisation]

Original text: 国产疫苗开打。10岁武汉女孩成国内第一个接种者...

**Extract 9**: Recently, the first batch in a total of 93,643 doses of the domestic HPV vaccine, authorised with the certificate issued by the National Medical Products Administration, will be available for reservation from May. Females aged from 9 to 45 are qualified for vaccination, the price is 329 yuan per dose. Females aged from 9 to 14 need to get two doses for a total of 658 yuan. Older than 14 years old need three doses, for a total of 987 yuan. Prices for all types of vaccines are less than half of the price of imported vaccines. [Posted by a media organisation]

Original text: 近日，首批共计93,643支国产人乳头瘤病毒疫苗，获国家药品监督管理局的生物制品批签发证明， 5月起可预约接种。9到45岁女性都可接种, 价格为329元/针。9至14岁打两针，全程658元; 超14岁的打三针，全程987元, 价格都不到进口疫苗一半。

Both Extract 8 and 9 included information that is closely related to the vaccination of domestic HPV. Extract 8 is reposted by many different organisational accounts. It reports the story of a girl getting domestic HPV vaccinated, prompting
parents to take their daughters who are of suitable age to receive the HPV vaccination. Meanwhile, it also indicates the safety and trustworthiness of the HPV vaccine, as a girl of young age is actively accepting the vaccination. **Extract 9** publishes information about the cost of the domestic HPV vaccine and clarifies the recommended dosage, which could make the public more informed about the vaccination and guide them to receive the proper dosage. Such a detailed presentation of information can hardly be found before the launch of domestic HPV vaccine.

The narratives in the two posts suggest that the public is increasingly exposed to a media environment that encourages them to practice the behaviour of getting vaccinated after the release of the domestic HPV vaccine.

**RQ3: The Salient Themes in Public Discussions**

RQ3 asked about topics related to the HPV vaccine that received the most attention on Weibo. Word cloud analysis was conducted to answer the question. Figure 2 shows the word clouds generated from the most reposted Weibo posts in four calendar weeks from 17th March 2020 to 25th May 2020 respectively. In the word cloud, words with a higher degree of frequency are larger. To further clarify the changes in the heated topics, ten keywords with the highest occurrence every week were translated and listed in Table 4. The most common keywords contained in the sample posts were “vaccine” and “vaccination,” as they both occurred in all the word clouds. The salient keywords in word cloud (a) and word cloud (b) were similar, with terms including “virus,” “cervical cancer,” “booking,” and “prevent.” This indicates topics related to the effect of the HPV vaccine and the ways to get the vaccination had received special attention from Weibo users before the launch of the domestic HPV vaccine. Word cloud (c) was generated based on posts collected in the week after the launch of the domestic HPV vaccine. Keywords including “domestic,” “launch,” and “price” can be found, which were related to the event. After a
month of domestic HPV vaccine release, “suggest,” “Two Sessions,”¹ “proposal,” “country,” and “whole city” became the frequently used keywords (word cloud d). This suggests the heated topics related to HPV vaccine started to connect with the policymaking process. Moreover, compared to the previous three weeks, the number of posts mentioning the keyword “female” in HPV vaccine discussions increased, which indicates the public had become more aware of the significance of the HPV vaccine in protecting women’s health. More importantly, several posts perceived the HPV vaccination also to be important for males.

**Extract 10:** Why are only girls getting vaccinated? Boys also need the HPV vaccination! [Posted by an ordinary user]

Original text: 为什么打HPV的都是女孩子? 男生也要打!

**Extract 11:** The HPV vaccine is not only targeted at diseases that females have, it can also benefit males. Of course, now the supply of HPV vaccine is not sufficient, so recommending all males to get vaccinated is not realistic, but after all, it will be safer for both genders if we could reduce risks from the origin. [Posted by an ordinary user]

Original text: HPV疫苗并不仅仅针对于宫颈癌, 对于男孩子也会有帮助。当然现在疫苗数量并不充裕, 所以没法做到推荐男性接种, 毕竟从源头上降低风险, 对于男性女性来说都会更安全。

Both Extract 10 and 11 calls for males to get HPV vaccinated and points out the exclusive focus on females in HPV vaccination is problematic. This suggests that a number of people had recognised the importance of stopping the spread of HPV from its origin, which indicates that they are well-informed about HPV infections and prevention. However, the posts showing such awareness only took up a very small proportion of the Weibo discussion.

**Discussion**

This study analysed Weibo posts to learn more about the public’s perception and knowledge of the HPV vaccine in China. The theoretical framework of HBM provides a specified collection of variables that mediate individual’s adoption of preventive health behaviours, which has the advantage of identifying indicators of public perceptions (Abraham & Sheeran, 2005). Through the lens of HBM, how different groups of Weibo users view the HPV vaccination and the media narratives on Weibo were examined, which revealed the current stage of public perceptions and conversations encompassing HPV vaccination.

Several studies have examined the dissemination of HPV vaccine-related information on Weibo (Chen et al., 2020; Zhou et al., 2021). However, only the highly influential posts on Weibo were selected in their sample, which tends to exclude the posts published by ordinary users and therefore limits the scope of public

---

¹ “Two Sessions” denotes annual political gatherings of the National People’s Congress and the Chinese People’s Political Consultative Conference, which are China’s most predominant plenary meetings of the top legislature and political advisory bodies (Two Sessions, 2022).
Investigating Media Coverage and Public Perceptions of the…

perception examined. In this study, the original posts created by all author groups were included, which could better reflect public participation in the Weibo discussion and the changes in their perception of the HPV vaccine. According to Li et al., (2020), there are serious concerns about the circulation of biased and fabricated knowledge revolving around the HPV vaccine’s safety. Exposure to real-time information stems from governmental media networks and Chinese medical agencies in addition to disparate interpersonal viewpoints, which makes it harder for participants to identify or correctly interpret the diverse narratives. Weibo users in our study appear receptive to absorbing as much knowledge as possible from different sources. Our study pervades how they seem to be keen not to just scan and seek information, but also to engage in broader discussion on this issue on social media.

Diverse Narratives and Different Perceptions of HPV Vaccination

The quantitative and qualitative analysis show that different groups of Weibo users emphasise different aspects of the HPV vaccine in their posts. The distribution of HBM constructs in posts published by different groups of Weibo users varies, which indicates the diversity in the public’s perception of HPV vaccination. The ordinary users often showed their knowledge in strategies to access HPV vaccination, posting about their faith in getting HPV vaccine while also identifying barriers of it. The media organisations and governmental accounts were actively advocating the vaccination, as they often called for confidence in one’s ability of receiving vaccination along with mentioning benefits and helpful information of vaccination. As for health professionals on Weibo, the threat of HPV infections and the benefits of receiving HPV vaccination are mentioned most frequently. This resonates with the findings in previous research that different social groups play different roles in social media dialogues (Mou, 2014). The health professionals, due to their expertise in medicine, usually describe the threat of HPV and the benefits of receiving HPV vaccination. For media organisations and governmental accounts, providing information on how people can get the HPV vaccine is within their interest of gaining credibility and showing social responsibility. The way that ordinary users talk about HPV vaccine shows that they value the efficacy information of HPV vaccination on Weibo, which motivates them to share helpful information or seek help from others.

However, the unequal distribution of HBM constructs also indicates different groups have disparities in viewing the issue of the HPV vaccine, which could be problematic. Social media posts on vaccine-related matters may increase active participation around vaccine enthusiasm, but it has also been found that such posts may take a seat back with regards to the consumption of the vaccine (Jiang et al., 2021). Moreover, on the one hand, the difficulties and cost of having the vaccination tend to be ignored by all types of organisational users. The proportion of perceived barriers remained unchanged after the launch of the domestic vaccine, indicating the difficulty in accessing the HPV vaccine is not receiving enough attention from the government and other organisations. Accordingly, while the ordinary users care most about the policymaking level of HPV vaccination, the organisations lack awareness of responding to the public’s practical need and their content remains on
the informative level. On the other hand, the threat of HPV infections and medical knowledge are mentioned predominantly in health professionals’ posts, which enriches the seeking of knowledge with regard to higher quality vaccine-related information (Liu, 2022). However, there is a lack of coverage on susceptibility and severity of HPV infections in the posts created by health professionals. This could limit the scope of the population that recognises the importance and urgency of being HPV vaccinated. Moreover, the deferral of the vaccine testing authorisation is also another impediment to obtaining relevant information on time in an already restricting media environment (Li & Zheng, 2020). Therefore, even with a large number of posts disseminating efficacy information and prompting people’s readiness to take actions, a great number of people tend to remain unaware of the necessity to receive HPV vaccination and unable to acquire timely information.

**Increased Public Awareness after the Launch of Domestic HPV Vaccine**

The launch of the domestic HPV vaccine increases public awareness of receiving the vaccination and has attracted the attention of policymakers in China. While Chen et al. (2020) identify a decrease in Weibo posts mentioning perceived threats and perceived benefits when the HPV vaccine was introduced in China, this study finds that the launch of the domestic HPV vaccine has witnessed an increased occurrence of perceived susceptibility and perceived benefits in Weibo posts. Such growth in the frequency of the two HBM variables suggest that an increasing number of Weibo users have recognised the pervasiveness of HPV infections and the effectiveness of HPV vaccination as prevention. As the construct of perceived benefits in the HBM are recognised as the most influential predictors of health behaviours (Carpenter, 2010), it can be inferred that the HPV vaccination has been more widely accepted after the launch of the domestic vaccine. Additionally, the HBM constructs of cues to action and self-efficacy are also mentioned more frequently after the launch, suggesting a more supportive and encouraging media environment has been established. Such increase could be due to the rise in detailed media coverage of the HPV vaccine along with the different types of HPV vaccine being licensed for use. As the qualitative analysis of posts suggests, the domestically produced HPV vaccine enables the vaccine-related information to be gathered and published on social media in a more comprehensive and detailed way, including the cost and requisite dosage, which can be more valuable to individuals who are inadequately informed or seeking help. The health professionals are also making efforts in tailoring HPV vaccine-related messages to be more accessible, which could add to the public’s knowledge of HPV vaccine. Indeed, China’s medical and healthcare agencies are well aware of the impact of posting information, knowing that such greater institutional endeavours are likely to be reposted with more responsiveness, assertiveness and knowledge of the HPV vaccine in social media (Ortiz et al., 2019). There is always a danger that some sanctioned information about HPV immunization can be framed to create political strategies of specific conduct to become normalized. This top-down normalization can be promoted in social media to instil norm-based messages that can avoid risk perceptions on HPV-vaccine related attitudes (Zheng et al., 2009).
Moreover, compared to the findings from the study of Chen et al. (2020), the most active group in the discussion of Weibo posts has changed from governmental accounts to ordinary users, and the cues to action have replaced the perceived barriers to become the most frequently mentioned HBM construct. This could be due to the developments in public health services and policies. As time goes by, more and more medical institutions are also available for the public to receive HPV vaccination, which perfects the practical conditions for performing the health action. This contributes to an increasing number of individuals getting HPV vaccinated and have further recognised the effectiveness of the HPV vaccine, therefore actively shared their own experience and encouraged others to receive HPV vaccination on social media. Additionally, after a month of the launch of the domestic HPV vaccine, it was proposed to be included in the national immunisation programme during the Two Sessions. This is possibly helped by the fact that the domestically produced HPV vaccine enables the vaccination to be popularised at a lower cost. The word cloud indicates the proposal in the Two Sessions has attracted a large amount of public attention, which constitute massive external prompts that favour the promotion of HPV vaccination. As the HPV vaccine has become part of the policy-making process in public perception, the public tend to further recognise the necessity of having the HPV vaccination. Evidence demonstrates the effectiveness of horizontal dissemination among multiple online media outlets, interpersonal interactions of individuals, and medical professionals, can consequently encourage collaborative learning and increase users’ vaccine eagerness (Chen and Wong, 2019). We have focused more on personal perceptions, but this might also be explained in part by the fact that Chinese people, as a collective culture, are more receptive to uncertainty avoidance (Hofestede, 2001). Therefore, with enhancements in media narratives, vaccination infrastructure and public health policies, a societal environment that better promotes the vaccination behaviour is being built, making the public awareness of receiving HPV vaccination increase significantly.

The Lagging Grasp of HPV Related Knowledge

While the public is increasingly active in getting the HPV vaccination, their knowledge about HPV remains inadequate. Only a small proportion of ordinary users included the HBM constructs of perceived susceptibility and perceived severity in Weibo posts. As these two HBM constructs constitute the threat perception of a disease, it is likely that the public lacks a realistic perception of the likelihood and consequences of being infected by HPV. Moreover, the results of the word cloud analysis also indicate that HPV related knowledge is communicated inappropriately. Cervical cancer is frequently mentioned by the highly reposted posts, while other diseases caused by HPV infections are overlooked, which is also found in previous studies (see Li et al., 2018; Chen et al., 2020). As sexually transmitted diseases are also caused by HPV, lacking knowledge of HPV infections may particularly prevent males from recognising the importance of having the HPV vaccination, which is also crucial in HPV prevention. These one-sided public perceptions of HPV infections could be caused by disproportionate media messages and cues to action that
can be always related to the interiorized of subjective norms and risk beliefs, which have been normalized in social media (Pan et al., 2020). Though the qualitative analysis has captured several posts that notice the problem of treating HPV vaccination as a female issue and advocate that the HPV vaccination should be an important issue across genders, such awareness remains to be limited in scope.

The pervasive media narratives that promote HPV vaccination have encouraged a large proportion of the public to accept the health behaviour. Cues to action is the most frequently mentioned HBM construct in Weibo discussions of HPV vaccine, which indicates that the Weibo users are exposed to a large number of external cues, including personal suggestions and organisational advocacy that encourages them to take HPV vaccination. However, the dissemination of HPV related knowledge seems not to keep up with the rise in vaccination willingness, therefore contributing to the outdated depiction of the HPV vaccine as a female issue and the insufficient public knowledge of HPV infections. As the establishment of appropriate health beliefs are the prerequisite for cues to action to prompt a health behaviour (Rosenstock, 1966), the popularisation of HPV related knowledge should be valued. Previous studies have shown that social media is more influential in promoting an individual’s health beliefs than traditional media (Yang et al., 2022). Therefore, the social media can be a crucial channel to reshape the promotion of HPV vaccination, by emphasising more on learning adequate and accurate HPV knowledge. This coincides with studies that have insisted that pertinent health sectors should make greater efforts in their attempts to expose more logically their HPV themes such as ‘infection’ and ‘prevention’ to target more powerfully the Chinese reception on social media (Xiang et al., 2021). Therefore, public health practitioners should design HPV vaccine-related content more carefully and include a more comprehensive and clearer presentation of HPV infections, thus fully unleashing the potentials of social media in health communication messages.

**Conclusion and Limitations**

By applying quantitative and qualitative content analysis, this study has investigated public perception of the HPV vaccine on Chinese social media by examining Weibo posts through the lens of HBM constructs. Overall, along with the launch of the domestic HPV vaccine, the health behaviour of receiving HPV vaccination has become an increasingly salient topic on Weibo, as a large number of social media narratives have constituted a supportive and encouraging online space. Diverse
narratives can be found on Weibo, which are created by different groups of Weibo users and also demonstrate the disparities in public perceptions of the HPV vaccination. Developments in media narratives and public health practices have greatly promoted public awareness of HPV vaccination. However, though various progress has been made, there are still places that need improvement. This study has also found that the public generally lacks adequate knowledge of the severity and susceptibility of HPV infections, failing to recognise HPV vaccination as an issue across genders. Therefore, in future health communication practices, there is a need for the health advocates in China to promote the popularisation of HPV related knowledge and communicate professional messages in a more comprehensive and responsive way.

The media organisations and governmental department may cooperate with medical professionals to better tailor the HPV vaccine-related information, including the susceptibility and severity of HPV infections. The organisational accounts on Weibo should also pay more attention to the barriers to vaccination that are perceived by the ordinary users, thus providing the information that better meet the public’s needs. Lastly, the potential of social media platforms in establishing a more active learning environment for health education should be taken advantage of, which is essential in reshaping public perception and establishing appropriate health beliefs.

Finally, this study acknowledges several limitations. Firstly, the study only included the Weibo posts in a limited time frame, which ignored the long-term changes in Weibo discussions of the HPV vaccine after the launch of the domestic vaccine. Secondly, future research could explore other popular social media platforms, e.g., WeChat, Zhihu, and RED, to further examine the public opinions of HPV vaccines, bringing more insight into the interaction between social media and preventative health behaviour educations.

**Appendix**

See Table 5.
| Variable name        | Definition                                                                 | Operationalisation                                                                                                                                 |
|----------------------|-----------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 Author             | The creator of the post                                                     | 1: Media organisations  
2: Governmental accounts (government or governmental departments)  
3: Health organisations or professionals  
4: Ordinary users |
| 2 Time period        | The time of the post published on Weibo                                      | 1: Before the release of domestic vaccine  
2: After the release of domestic vaccine |
| 3 Perceived susceptibility | The likelihood of being infected by HPV-related diseases                      | 0: No susceptibility mentioned  
1: Susceptibility mentioned |
| 4 Perceived severity  | The severity of getting HPV-related diseases                                  | 0: No severity mentioned  
1: Severity mentioned |
| 5 Perceived benefits | The benefits of injecting HPV vaccine                                        | 0: No benefits mentioned  
1: prevent cervical cancer  
2: prevent STDs  
3: prevent cancer in general  
4: prevent diseases caused by HPV in general |
| 6 Perceived barriers | Difficulty one may encounter in getting HPV vaccine                         | 0: No barriers mentioned  
1: Difficulty in booking a vaccination slot  
2: Side effects  
3: Price too high  
4: Fake vaccine  
5: COVID-19 pandemic (travel restrictions and control policies) |
| 7 Self-efficacy      | The faith in one’s ability to get HPV vaccine                               | 0: no efficacy included  
1: Ways to get the vaccine (by appointment/visit the hospitals)  
2: Vaccine information (cost, suitable age for vaccination, producer, etc.)  
3: both the ways to get vaccine and vaccine-related information are mentioned |
| 8 Cues to action     | The information or strategies that prompt one’s readiness to receive HPV vaccination | 0: no cues to action included  
1: Statement or proposal from policy makers or government  
2: Personal experience of getting vaccinated |
Funding  The authors have not disclosed any funding.

Declaration

Conflict of interest  The authors declare that there is no conflict of interest.

References

Abraham, C., & Sheeran, P. (2005). The Health Belief Model. In M. Conner & P. Norman (Eds.), Predicting Health Behaviour: Research and practice with Social Cognition Models (pp. 28–80). Open University Press.

Abramson, K., Keefe, B., & Chou, W.-Y. (2015). Communicating About Cancer Through Facebook: A Qualitative Analysis of a Breast Cancer Awareness Page. Journal of Health Communication, 20(2), 237–243. https://doi.org/10.1080/10810730.2014.927034

Altheide, D. L. (1996). Process of Qualitative Document Analysis. Qualitative Media Analysis., 2, 39–74.

Becker, M. H. (1974). The Health Belief Model and Sick Role Behavior. Health Education Monographs, 2(4), 409–419. https://doi.org/10.1177/109019817400200407

Briones, R., Nan, X., Madden, K., & Waks, L. (2012). When vaccines go viral: An analysis of HPV vaccine coverage on YouTube. Health Communication, 27(5), 478–485. https://doi.org/10.1080/10410236.2011.610258

Carpenter, C. J. (2010). A meta-analysis of the effectiveness of health belief model variables in predicting behavior. Health Communication, 25(8), 661–669. https://doi.org/10.1080/10410236.2010.521906

Chen, L., Ling, Q., Cao, T., & Han, K. (2020). Mislabeled, fragmented, and conspiracy-driven: A content analysis of the social media discourse about the HPV vaccine in China. Asian Journal of Communication, 30(6), 450–469. https://doi.org/10.1080/01292986.2020.1817113

Chen, Y., & Liu, X. (2021). Determinants of Beijing Residents’ Intentions to Take Protective Behaviors against Smog: An Application of the Health Belief Model. Health Communication. https://doi.org/10.1080/10410236.2021.1956036

Chou, W. Y. S., Gaysynsky, A., & Cappella, J. N. (2020). Where we go from here: Health misinformation on social media. American Journal of Public Health, 110, S273–S275. https://doi.org/10.2105/AJPH.2020.305905

Cui, Cu. (2021). 普及HPV疫苗接种，让女性彻底告别宫颈癌 Puji HPV yimiao jiezhong, rang nvxing chedi gaobie gongjingai [Promotion of HPV vaccination can protect women from cervical cancer]. China Women’s News. 01 December 2021. http://www.nwccw.gov.cn/2021-12/01/content_296910.htm.

Didi, Pr., & Lundy, L. (2017). Organizational Twitter Use: Content Analysis of Tweets during Breast Cancer Awareness Month. Journal of Health Communication, 22(3), 243–253. https://doi.org/10.1080/10810730.2016.1266716

Glanz, K., Rimer, B. K., & Lewis, F. M. (2002). Health behavior and health education theory, research and practice. Wiley & Sons.

Han, E. L. (2016). Micro-blogging Memories: Weibo and Collective Remembering in Contemporary China. Palgrave Macmillan.

Han, E. L. (2019). The discourse of Chinese social media: The case of Weibo. In C. Shei (Ed.), The Routledge Handbook of Chinese Discourse Analysis (pp. 379–390). Routledge.

Han, E. L. (2020). Journalism and mnemonic practices in Chinese social media: Remembering catastrophic events on Weibo. Memory Studies, 13(2), 162–175.

He, Z., Kou, Z., & Xu, A. (2018). HPV infection and immune prevention. Chinese Journal of Preventive Medicine, 52, 106–112.

Hofstede, G. (2001). Culture’s consequences: Comparing values, behaviors, institutions, and organizations across nations. Sage.

Hong, Y., Zhang, C., Li, X., Lin, D., & Liu, Y. (2013). HPV and cervical cancer related knowledge, awareness and testing behaviors in a community sample of female sex workers in China. BMC Public Health, 13, 696–703. https://doi.org/10.1186/1471-2458-13-696
Hu, D., Martin, C., Dredze, M., & Broniatowski, D. A. (2020). Chinese social media suggest decreased vaccine acceptance in China: An observational study on Weibo following the 2018 Changchun Changsheng vaccine incident. *Vaccine, 38*, 2764–2770. https://doi.org/10.1016/j.vaccine.2020.02.027

Hu, S., Xu, X., Zhang, Y., Liu, Y., Yang, C., Wang, Y., & Zhao, F. (2021). A nationwide post-marketing survey of knowledge, attitude and practice toward human papillomavirus vaccine in general population: Implications for vaccine roll-out in mainland China. *Vaccine, 39*(1), 35–44.

Huang, R., & Sun, X. (2014). Weibo Network, Information Diffusion and Implications for Collective Action in China. *Information, Communication & Society, 17*(1), 86–104.

Hubert, R. B., Estevez, E., Maguitman, A., & Janowski, T. (2020). Analyzing and visualizing government-citizen interactions on Twitter to support public policy-making. *Digital Government: Research and Practice, 1*(2), 1–20. https://doi.org/10.1145/3360001

Janz, N. K., & Becker, M. H. (1984). The health belief model: A decade later. *Health Education Quarterly, 11*(1), 1–47.

Jiang, S. P., Wang, P. L., Liu, A. N., & Xingtong, Wu. (2021). Social Media Communication about HPV Vaccine in China: A Study Using Topic Modeling and Survey. *Health Communication. https://doi.org/10.1080/10410236.2021.1983338

Kim, J. (2018). The relationship of health beliefs with information sources and HPV vaccine acceptance among young adults in Korea. *International Journal of Environmental Research and Public Health, 15*(4), 673.

Kirscht, J. P. (1988). The health belief model and predictions of health actions. In D. S. Gochman (Ed.), *Health behaviour: Emerging research perspectives* (pp. 27–41). Plenum Publishing Corporation.

Lama, Y., Dian, Hu., Jamison, A., Quinn, S. C., & Broniatowski, D. A. (2019). Characterizing Trends in Human Papillomavirus Vaccine Discourse on Reddit (2007-2015): An Observational Study. *JMIR Public Health and Surveillance, 5*(1), e12480. https://doi.org/10.2196/12480

Li, J., & Zheng, H. (2020). Coverage of HPV-Related Information on Chinese Social Media: A Content Analysis of Articles in Zhihu. *Human Vaccines & Immunotherapeutics, 16*(10), 2548–2554. https://doi.org/10.1080/21645515.2020.1729028

Li, W., Nowak, G., Jin, Y., & Cacciatore, M. (2018). Inadequate and incomplete: Chinese newspapers’ coverage of the first licensed Human Papillomavirus (HPV) vaccine in China. *Journal of Health Communication, 23*(6), 581–590. https://doi.org/10.1080/10810730.2018.1493060

Liu, J. (2021). 二价、四价、九价HPV疫苗怎么选? Erjia sijia jujiu yimiao zenme xuan [How to choose from three types of vaccination?]! *Shanghai Municipal Health Commission*. 30 December 2021. https://wsjkw.sh.gov.cn/yfjz/20211205/c53763de06c14767ab64a6d4eba8a5.html

Liu, H. (2022). Official social media and its impact on public behavior during the first wave of COVID-19 in China. *BMC Public Health. https://doi.org/10.1186/s12889-022-12803-y

Liu, R., Huang, Y.-H.C., Sun, J., Lau, J., & Cai, Q. (2022). A Shot in the Arm for Vaccination Intention: The Media and the Health Belief Model in Three Chinese Societies. *International Journal of Environmental Research and Public Health, 19*, 3705.

Liu, Y. H., Rui, P., Dou, Z. D., & Zhang, G. J. (2019). Investigation and analysis of the awareness, attitudes and practice on HPV vaccine among female college students. *Journal of Qiqihar Medical University, 40*(23), 2988–2991.

Liu, Y. (2015). Tweeting, Re-tweeting, and Commenting: Microblogging and Social Movements in China. *Asian Journal of Communication. https://doi.org/10.1080/01292986.2015.1013971

Loft, L. H., Pedersen, E. A., Jacobsen, S. U., Søborg, B., & Bigaard, J. (2020). Using Facebook to increase coverage of HPV vaccination among Danish girls: An assessment of a Danish social media campaign. *Vaccine, 38*(31), 4901–4908. https://doi.org/10.1016/j.vaccine.2020.04.032

Massey, P. M., Kearney, M. D., Hauer, M. K., Selvan, P., Koku, E., & Leader, A. E. (2020). Dimensions of misinformation about the HPV vaccine on Instagram: Content and network analysis of social media characteristics. *Journal of Medical Internet Research, 22*(12), e21451. https://doi.org/10.2196/21451

Mo, X. & Y. Xie. (2022). 接种HPV九价疫苗, 非得抢在26岁之前吗? Jiezhong HPV jiujia yimiao feide qiangzai 26 sui zhiqian ma [Whether the HPV vaccination has to be done by the age of 26]. *Xinhua Daily Telegraph*. 22 March 2022. http://www.news.cn/mrdx/2022-03/22/c_1310524667.htm.

Mou, Y. (2014). What can microblog exchanges tell us about food safety crises in China? *Chinese Journal of Communication, 7*(3), 319–334. https://doi.org/10.1080/17544750.2014.926952
Norman P, Brain K. (2005). An application of the health belief model to the prediction of breast self-examination in a national sample of women with a family history of breast cancer. userpage.fu-berlin.de/~health/materials/normanb.pdf. [Accessed August 20, 2022]

Orji, R., Vassileva, J., & Mandryk, R. (2012). Towards an effective health interventions design: an extension of the health belief model. Online Journal of Public Health Informatics. https://doi.org/10.5210/ojphi.v4i3.4321

Orr, D., Baram-Tsabari, A., & Landsman, K. (2016). Social media as a platform for health-related public debates and discussions: The Polio vaccine on Facebook Israel. Journal Health Policy Res, 5(1), 34. https://doi.org/10.1186/s13584-016-0093-4

Ortiz, R. R., Smith, A., & Coyne-Beasley, T. (2019). A systematic literature review to examine the potential for social media to impact HPV vaccine uptake and awareness, knowledge, and attitudes about HPV and HPV vaccination. Human Vaccines & Immunotherapeutics, 15(7–8), 1465–1475. https://doi.org/10.1080/21645515.2019.1581543

Pan, S., Zhang, D., & Zhang, J. (2020). Caught in the Crossfire: How Contradictory Information and Norms on Social Media Influence Young Women’s Intentions to Receive HPV Vaccination in the United States and China. Fronties of Psychology, 3(11), 548365. https://doi.org/10.3389/fpsyg.2020.548365

Rosenstock, I. M. (1966). Why people use health services. The Milbank Memorial Fund Quarterly, 44(3), 94–127. https://doi.org/10.2307/3348967

Rosenstock, I. M. (1974). Historical origins of the health belief model. Health Education Monographs, 2(4), 328–335. https://doi.org/10.1177/109019817400200403

Santhanes, D., Yong, C. P., Yap, Y. Y., Saw, P. S., Chaiyakunapruk, N., & Khan, T. M. (2018). Factors influencing intention to obtain the HPV vaccine in southeast Asian and Western Pacific regions: A systematic review and meta-analysis. Scientific Reports, 8, 3640–3650. https://doi.org/10.1038/s41598-018-21912-x

Two Sessions. (2022). 2022 Two Sessions. NPC & CPPCC: Annual legislative and political advisory sessions. http://english.www.gov.cn/2022special/2022npcandccpc.

Shi, J., & Salmon, C. T. (2018). Identifying opinion leaders to promote organ donation on social media: Network study. Journal of Medical Internet Research, 20(1), e7. https://doi.org/10.2196/jmir.7643

Su, X. (2020). Content Analysis of HPV Vaccine Messages on Chinese Social Media. Journal The Messenger, 12(1), 63-73. http://dx.doi.org/https://doi.org/10.26623/themessenger.v12i1.1814

Thackeray, R., Neiger, B. L., Smith, A. K., & Van Wagenen, S. B. (2012). Adoption and use of social media among public health departments. BMC Public Health, 12(1), 242. https://doi.org/10.1186/1471-2458-12-242

Vraga, E. K., Stefanidis, A., Lamprianidis, G., Croitoru, A., Crooks, A. T., Delamater, P. L., Dieter, P. F., O. S. E. R., Radzikowski, J. R., & Jacobsen, K. H. (2018). Cancer and Social Media: A Comparison of Traffic about Breast Cancer, Prostate Cancer, and Other Reproductive Cancers on Twitter and Instagram. Journal of Health Communication, 23(2), 181–189. https://doi.org/10.1080/10810730.2017.1421730

Wang, J., Zhou, Y., Zhang, W., Evans, R., & Zhu, C. (2020a). Concerns expressed by Chinese social media users during the COVID-19 pandemic: Content analysis of Sina Weibo microblogging data. Journal of Medical Internet Research, 22(11), e22152. https://doi.org/10.2196/22152

Wang, Q., Zhang, W., Cai, H., & Cao, Y. (2020b). Understanding the perceptions of Chinese women of the commercially available domestic and imported HPV vaccine: A semantic network analysis. Vaccine, 38(52), 8334–8342.

Wang, S. M., Zhang, S. K., Pan, X. F., Ren, Z. F., Yang, C. X., Wang, Z. Z., Gao, X. H., Li, M., Zheng, Q. Q., Ma, W., Zhao, F. H., Qiao, Y. L., & Sivasubramaniam, P. (2014). Human papillomavirus vaccine awareness, acceptability, and decision-making factors among Chinese college students. Asian Pacific Journal of Cancer Prevention, 15(7), 3239–3245. https://doi.org/10.7314/apjcp.2014.15.7.3239 PMID: 24815477.

Wang, S. M., Zhang, S. K., Pan, X. F., Ren, Z. F., Yang, C. X., Wang, Z. Z., Gao, X. H., Li, M., Zheng, Q. Q., Ma, W., Zhao, F. H., Qiao, Y. L., & Sivasubramaniam, P. (2014). Human papillomavirus vaccine awareness, acceptability, and decision-making factors among Chinese college students. Asian Pacific Journal of Cancer Prevention, 15(7), 3239–3245. https://doi.org/10.7314/apjcp.2014.15.7.3239 PMID: 24815477.

Wang, Q., Zhang, W., Cai, H., & Cao, Y. (2020b). Understanding the perceptions of Chinese women of the commercially available domestic and imported HPV vaccine: A semantic network analysis. Vaccine, 38(52), 8334–8342.

Wong, L. P., Alias, H., Wong, P. F., Lee, H. Y., & AbuBakar, S. (2020). The use of the health belief model to assess predictors of intent to receive the COVID-19 vaccine and willingness to pay. Human Vaccines & Immunotherapeutics, 16(9), 2204–2214.

Wong, L. P., Han, L., Li, H., Zhao, J., Zhao, Q., & Zimet, G. D. (2019). Current issues facing the introduction of human papillomavirus vaccine in China and future prospects. Human Vaccines & Immunotherapeutics, 15(7–8), 1533–1540.
Xiang, J., Han, L., Fan, Y., Feng, B., Wu, H., Hu, C., Qi, M., Wang, H., Liu, Q., & Liu, Y. (2021). Prevalence and genotype distribution of human papillomavirus among attendees at a sexually transmitted diseases clinic in urban Tianjin, China. *International Journal of General Medicine, 14*, 1983–1990. https://doi.org/10.2147/IJGM.S308215

Xue, Y. (2019). Knowledge: HPV vaccine. Retrieved from http://www.gov.cn/fuwu/2019-07/17/content_5410452.htm. [Accessed August 20, 2022]

Yang, W., Zhang B. & Yang, Z. (2018). HPV疫苗, 不建议女性超龄接种 HPV yimiao bu jianyi nvxing chaoling jiezhong [HPV vaccine is only for women of certain ages]. *Changsha Daily*. 06 February 2018. http://m.xinhuanet.com/hn/2018-02/06/c_1122374451.htm.

Yang, X., Wei, L., & Liu, Z. (2022). Promoting COVID-19 Vaccination Using the Health Belief Model: Does Information Acquisition from Divergent Sources Make a Difference? *International Journal of Environmental Research and Public Health, 19*(7), 3883.

Yang, Z. J. (2015). Predicting young adults’ intentions to get the H1N1 vaccine: An integrated model. *Journal of Health Communication, 20*(1), 69–79. https://doi.org/10.1080/10810730.2014.904023

Yoo, S. W., Kim, J., & Lee, Y. (2018). The effect of health beliefs, media perceptions, and communicative behaviors on health behavioral intention: An integrated health campaign model on social media. *Health Communication, 33*(1), 32–40.

Zhang, L., Jung, E. H., & Chen, Z. (2020). Modeling the pathway linking health information seeking to psychological well-being on WeChat. *Health Communication, 35*(9), 1101–1112. https://doi.org/10.1080/10410236.2019.1613479

Zhang, X., Baker, K., Pember, S., & Bissell, K. (2017). Persuading me to eat healthy: A content analysis of YouTube public service announcements grounded in the health belief model. *Southern Communication Journal, 82*(1), 38–51. https://doi.org/10.1080/1041794X.2016.1278259

Zhang, Y., Wang, Y., Liu, L., Fan, Y., Liu, Z., Wang, Y., & Nie, S. (2016). Awareness and knowledge about human papillomavirus vaccination and its acceptance in China: A meta-analysis of 58 observational studies. *BMC Public Health, 16*, 216–230. https://doi.org/10.1186/s12889-016-2873-8

Zhou, F., Zhang, W., Cai, H., & Cao, Y. (2021). Portrayals of 2v, 4v and 9vHPV vaccines on Chinese social media: A content analysis of hot posts on Sina Weibo. *Human Vaccines & Immunotherapeutics, 17*(11), 4433–4441. https://doi.org/10.1080/21645515.2021.1971016

**Publisher’s Note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Springer Nature or its licensor holds exclusive rights to this article under a publishing agreement with the author(s) or other rightsholder(s); author self-archiving of the accepted manuscript version of this article is solely governed by the terms of such publishing agreement and applicable law.