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The failure of news coverage supportive of human papillomavirus vaccination: The investigation of the effects of online comments on female college students' vaccination intention

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ABSTRACT

Background: News coverage supportive of human papillomavirus (HPV) vaccination is widespread on the Internet. Meanwhile, large numbers of online comments questioning HPV vaccine safety, attacking vaccine manufacturers or providing personal experience of side effects may reduce the persuasion effect. This study explored how and under what conditions such comments influence the behavioral intention of subsequent youth female viewers or readers.

Methods: We recruited a random sample of 239 Chinese undergraduate female students from different, non-medicine-related disciplines and conducted a 2 (valence of online comments: positive vs. negative) × 2 (presentation of comments: narrative vs. descriptive) between-subjects factorial design study. After carrying two ANOVAs to examine the effects of experimental conditions, we established a simple mediation and a moderated mediation analysis to test hypothesis.

Results: Perceived risk of HPV emerged as a significant mediator in the moderated mediation model. Particularly under the negative condition, the narrative (vs. descriptive) comments increased behavioral intention to receive the vaccine (B = −0.20, SE = 0.10, 95% CI = −0.40 to −0.01) while they increased participants' perceived risk of HPV (B = −0.14, SE = 0.05, 95% CI = −0.27 to −0.06). However, under the positive condition, there was no significant difference in either risk perception or behavioral intention between the effects of narrative and descriptive comments on participants.

Conclusions: Online comments do influence participants' perceived risk of HPV and vaccination intention. Perceived risk of HPV fully mediates the effect of comments on vaccination intention. More importantly, the indirect effect of narrative (vs. descriptive) comments on behavioral intention through risk perception is moderated by the valence of comments, and significant only under the negative comments condition.

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1. Introduction

HPV vaccinations have become available on the market in mainland China from 2017. Based on clinical outcomes, China National Medical Products Administration (CMPA) has approved the bivalent vaccine for use by females aged 9–25, and quadrivalent vaccine for use by females aged 20–40 [1]. A program of universal HPV vaccination for females has yet to be implemented. Previous studies show that Chinese female' awareness and willingness to be vaccinated HPV is low [2,3]. In a meta-analysis of 53 articles with 82,813 respondents suggested that only 17.13% have heard about of HPV vaccine. Among those, nearly half declined to accept it [2]. Another research had the same result with 44% acceptance rate among female college students [3]. The primary reasons for rejection of vaccination were high cost (the total vaccination costs from US$260–360), insufficient supply (ie. The supply of bivalent vaccine is 1.07 million and the supply of quadrivalent vaccine is only 340,000 in China mainland in 2017) [4], concern of potential side effects, lack of knowledge, low awareness [5], moral obligation and sexually transmitted diseases related stigma [3]. Health communication about HPV/ HPV vaccine is an integral part of HPV vaccination promotion practice in China.

The risks of HPV vaccination are learned through information systems. Such media-based learning can lead to risk-amplification or -attenuation [6]. Although a government effort

to establish an online public opinion monitoring system against online rumors is under way [7], the online commenting system, the most common type of public online participation [8], attracts viewers' attention from the news coverage about the safety and effectiveness of the HPV vaccination. Online comments do facilitate citizen communicating their own opinions, perspectives and expertise [9]. However, it also enhances connections for online anti-vaccination communities comprising diverse geographical, political and economic contexts [10]. Confirmation bias guides individuals' attention to the comments that confirm their beliefs as well [11]. Anti-vaccination comments reinforces anti-vaccinators' predilection to avoid vaccination. Previous research suggests that the online comments influence risk perception, attitudes toward vaccinations, and behaviors, even subsequently eroding confidence in vaccinations in general [12].

The majority of work examining online commentary about HPV vaccination has been conducted using content analysis describing the public's attitude, knowledge, practice and perceptions toward HPV vaccinations [13,14,10]. However, the question of how online comments themselves might affect the public's risk perception and vaccination intention has yet to be fully investigated.

1.1. Narratives comments and descriptive comments

Previous studies on online communication found narratives is the most common way people demonstrate an attitude to HPV vaccination [13,15]. For example, after identifying 3073 comments in response to 71 HPV-based news articles, scholars found participants like to share the narratives of personal experience about adverse side effects to demonstrate what they perceive to be low vaccine efficacy [13]. Another research using data from Japan found a total 26% anti-HPV vaccination website posted narratives of those who have experienced adverse reactions to HPV vaccine to enhance their persuasiveness [15].

The mental processing of narratives is qualitatively different from the processing of descriptive messages. Readers were quickly transported into the personal story and began to empathize with its protagonists [16]. Narratives is more easily trigger the reader's emotions [17], which may inform later judgments [18] and influence opinions of risk [19], risk perception[20] and risk prevention [21]. Betsch et al. found that reading narratives about adverse events led to an increased perception of the possible risks of vaccination, which further lowered individuals' intention to vaccinate [22]. However, similar studies found somewhat inconsistent results: Steinhardt and Shapiro conducted an experiment to test how message-style influenced a participant's preference for surgery or radiation therapy and no significant difference was reported under the narrative condition and the non-narrative condition [16].

In line with previous studies of narrative messages that show that personal details and stories can easily elicit compelling imagery whereby participants visualize the occurrence of the described event, thereby developing influence risk perception [20], it was hypothesized that:

Hypothesis 1. The presentation of comments influences readers' perceived risk of HPV, such that the narrative comments induce different level risk perception from descriptive ones.

Moreover, theories in social and health psychology emphasize the role of risk perception in influencing behavioral intention [23–26]. We argue that after exposure to the narrative comments, perceived risk of HPV will increase, and that these reactions will act as mediators of risk prevention behavior, leading to the following hypotheses:

Hypothesis 2. Risk perception influences risk prevention behavior intention.

Hypothesis 3. Hypothesis 3. Risk perception functions as a mediator of the effect of narrative comments on risk prevention behavior intention.

1.2. Comments for or against news coverage

Online comment is a typical form of behavior guide for subsequent viewers [27]. Individuals are highly susceptible to follow the response most favored by others to maintain a socially acceptable, positive self-concept [28]. Valence of comments can be seen as having a powerful effect on the influence the articles beneath which they appear [22,29]. Kause et al. found that participants who viewed positive comments recommending vaccination were more likely to prefer to receive a vaccine than those who viewed negative comments against vaccination [29]. Betsch et al. illustrated the impact of the proportion of online comments on vaccine risk perception, demonstrating that a higher percentage of negative comments led to an increased risk perception and a lower intention to vaccinate [22].

Comparing to positive comments, negative comments construct a more complex information context, which requires systematic mental processing by an individual [21]. When individuals read an article describing the advantages of HPV vaccination that is followed by unsupportive comments, they are more likely to engage in systematic processing, thinking carefully about the arguments of experts and other participants. In this situation, narrative comments seem more effective than non-narrative comments on risk perception. However, when individuals read comments supporting the article, they form an attitude using superficial processing [21]. Thus, individuals process narrative and non-narrative information in comments supporting a pro-HPV vaccination article in the same, superficial manner.

As the effect of the presentation of comments may vary under different valence, it was further hypothesized:

Hypothesis 4. The valence of comments moderates the influence of presentation of comments on readers' perceived risk of HPV such that the effect of narrative comments will be strong when comments are negative(vs. positive comments)

Therefore, the current paper investigates how narratives, one of the most common features of online comment posted by laypeople, affect perceived risk of HPV and behavioral intention in the context of the HPV vaccination. We also explore whether the influence of the narrative comment depends on the valence of comments, a key factor influencing the perception, attitudes, and behavior of the subsequent viewers in risk communication.

2. Methods

2.1. Participants

Participants were recruited via messages sent to undergraduate students through the official bulletin board system of JiangHan University, Wuhan, Hubei, a public university. Participants were first invited to take a 3-minute online survey for screening. According to the screening online survey, the selection criteria for eligible participants for experimental study were that the participant must (1) be female, (2) be age 18–22 years and Han nationality, (3) non-medicine-related disciplines and no medical professional immediate family members, and (4) familiar with social media. (ie. Weibo.com, Wechat.com). Each participant received modest

monetary compensation in return for their participation in the experiment.

2.2. Experiment conditions

This study adopted a 2 (valence of online comments: positive vs. negative) × 2 (presentation of comments: narratives vs. descriptive) between-subjects factorial design. We identified four situations: a. an article that address vaccine benefits and safety, and receive positive narrative comments; b. an article that address vaccine benefits and safety, and receive negative narrative comments, c. an article that address vaccine benefits and safety, and receive positive descriptive comments; and d. an article that address vaccine benefits and safety, and receive negative descriptive comments.

4 Sina Weibo pages were created using Photoshop software. Sina Weibo microblog, Chinese version of Twitter, currently one of the most popular social media platforms in China, were used by over 500 million users by the end of 2017 [32]. Each experimental page consisted of two modules: (1) news coverage supportive of HPV vaccination. The news comprised two paragraphs from real-life media coverage, an introduction about the potential threat of HPV (ie. "Persistent HPV infections are not only found in genital tract, but also on oral mucosa") and a description of the benefit of receiving the HPV vaccine (ie. "The bivalent HPV vaccine protects against two types of HPV causing 70 percent of cervical cancer cases"), and (2) Ten online comments appended to it. Fig. 1 presents the example of the negative narratives comments' experimental page.

Comments were defined as positive if they supported HPV vaccination and were defined as negative if they criticized or were against HPV vaccination. Comments were categorized as narratives if they included a personal story or description of a case, and were categorized as descriptive if they included statistical data or scientific knowledge.

We created a sample pool of 60 online comments with 4 comment treatment conditions evenly distributed. So in the pool there were 15 positive descriptive comments (PD), 15 positive narratives comments (PN), 15 negative descriptive comments (ND) and 15

negative narratives comments (NN). All the comments were selected from Sina (Weibo.com) comment page with a high number of "Likes" and some were modified slightly to fit the treatment conditions. Box 1 presents examples of prewritten online comments.

Box 1 Message examples of comments.

Positive Narratives (PN): "My cousin is under thirty and unmarried. Cervical cancer was diagnosed at later stages and was dead within six months, at age 28. Her mother cries every day. So our best chance to avoiding these diseases is to get vaccinated."

Positive Descriptive (PD): "HPV vaccine is the first cancer vaccine in the world. HPV vaccine is cost-effective by preventing cancer."

Negative Narratives (NN): "one of my friends had a severe allergy and almost died after vacation. She has no allergic history before. Who knows?"

Negative Descriptive (ND): "According to the doctor, HPV vaccine is invalid if you already had sex or older than 9. So don't waste your money, sisters."

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10 comments were randomly generated from the comments pool according to each condition. Because it was rare to see 10 comments in a row on Weibo.com with the same valence and presentation, comments were selected in the ratio of 8/2 for valence and 8/2 for narratives (vs.-descriptive) following Shi, Messaris and Cappella method [33]. Every experiment condition had a 7:1:1:1 ratio. (e.g. the NN condition contained 7 NN comments, 1 PN comment, 1 ND comment, and 1 PD comment. See Fig. 2) The 10 comments were presented in random order (randomized via Excel). The randomization process is illustrated in Fig. 2.

2.3. Procedures

The experiment was conducted in a computer laboratory, and participants were randomly seated in separated cubicles and randomly assigned into one of 4 comment conditions (PN, PD, NN, and ND). At first, participants were told the main aim of the current experiment was to test the influence of public health news. Then, they were asked to answered questions about their knowledge of HPV and HPV vaccination. Next, the experimental page was shown on the screen and a participant was able to read the news and 10 comments below it. After reading the experimental material, the participants were asked to complete an online questionnaire about their perceived risk of HPV, their intention of getting vaccinated, and their demographic information. The experiment was conducted over approximately half an hour in the morning of December 21, 2018.

2.4. Measures

2.4.1. Manipulation checks

To verify the effectiveness of the comment valence manipulation, participants were required to rate the comments they read emphasizing the evidence in support of vaccination vs. those in opposition to vaccination (1 = object to vaccination to 5 = support vaccination). Similarly, to examine the effectiveness of the comment type manipulation, participants rated the comments they read representing their attitudes toward HPV vaccination through (a) narrative, e.g., using individual experience (b) descriptive, e.g., using statistics (1 = narrative to 5 = descriptive).
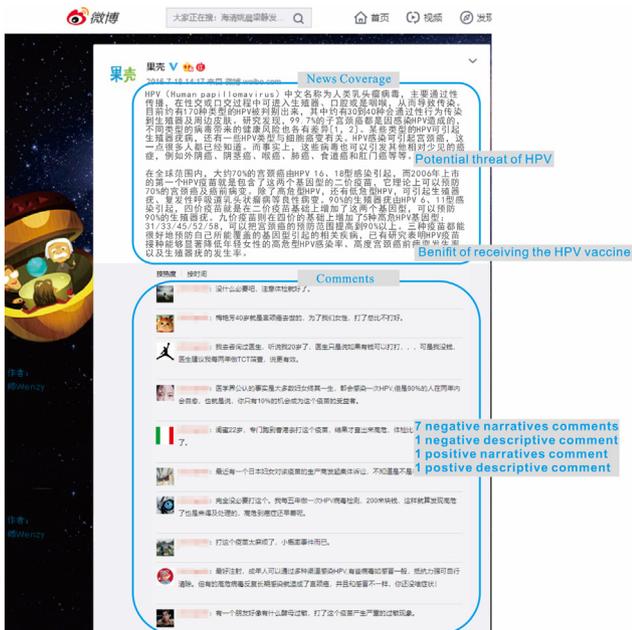

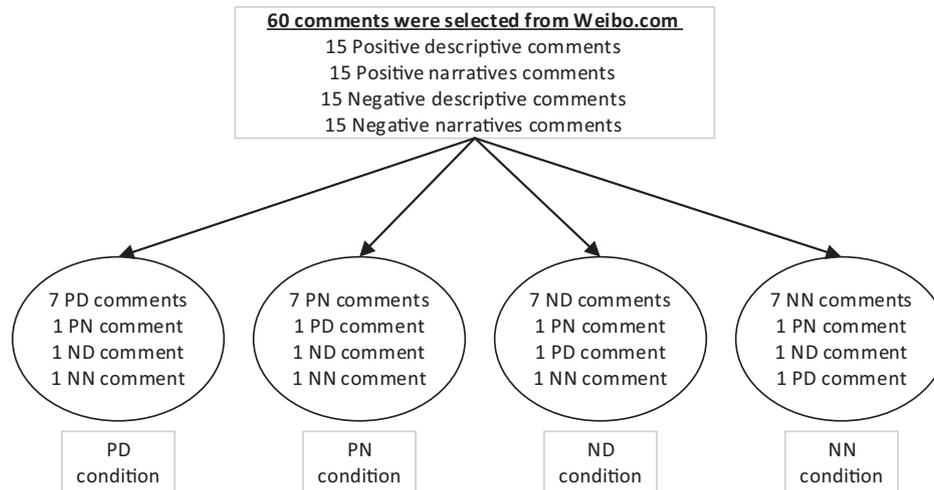**Fig. 1.** Visual example of negative narratives comments page.

60 comments were selected from Weibo.com
15 Positive descriptive comments
15 Positive narratives comments
15 Negative descriptive comments
15 Negative narratives comments

7 PD comments
1 PN comment
1 ND comment
1 NN comment

PD condition

7 PN comments
1 PD comment
1 ND comment
1 NN comment

PN condition

7 ND comments
1 PN comment
1 PD comment
1 NN comment

ND condition

7 NN comments
1 PN comment
1 ND comment
1 PD comment

NN condition

Fig. 2. The randomization process of experimental materials.

2.4.2. Behavioral intention

Following the methodology of prior research [34], participants' intention to receive the HPV vaccine were assessed in four items. Respondents were asked to indicate their position on 5-point Likert scale questionnaire (1 = not at all to 5 = very much) as to whether they would (a) try to collect more information about the HPV vaccine, (b) consider having the HPV vaccination, (c) definitely have the HPV vaccination, or (d) persuade others to have the HPV vaccination. We constructed a composite variable using the average of these four items to assess behavioral intentions for vaccination ($\alpha = 0.81$).

2.4.3. Mediator

Psychometric procedures were used to measure perceived risk. At first, nine descriptive attributes of risk were studied [35]. Then, nine attributes taped two basic dimensions of risk: unknown and dread [36]. Three frequently used psychometric dimensions that are suitable for perceived risk of HPV were chosen [37]. Participants' were assessed in terms of how they perceived the (a) overall risk level (1 = extremely low to 5 = extremely high); (b) severity of negative consequences (1 = extremely low to 5 = extremely high); (c) controllability (1 = very easy to control 5 = very difficult to control). The risk perception score was the average score of these 3 items (Cronbach's $\alpha = 0.71$).

2.5. Analysis

Firstly, we conducted a descriptive analysis of demographic, cognition of HPV/HPV vaccination variables. Then, in order to test manipulation of experiment, a dependent *t*-test was carried out to determine whether the value of a self-reported perception to comments differed from two valences of comments.

Secondly, two ANOVAs were conducted to examine the effects of experimental conditions. Comments presentation (narrative vs. descriptive), comments type (positive vs. negative), and their interaction term are the independent variables, and risk perception and behavioral intentions are the dependent variables, respectively.

Thirdly, we tested a simple mediation effect, to examine whether risk perception mediated the effects of comment presentation on behavioral intentions. Then, we conducted a moderated mediation test to examine whether risk perception mediated the conditional indirect effects of the two-way interaction between the presentation of comments condition and valence of comments condition on behavioral intention. Following Baron and Kenny [38], Hayes [39], we used the bootstrap method (10,000 resamples) with 95% bias-corrected confidence interval.

We calculated statistics using Mplus 8.1.

3. Results

3.1. Descriptive and manipulation check

The screening yielded 283 eligible participants. Power calculations were performed using G*power 3.1 [30] and according to the software, a total sample size of n = 171 (i.e. n = 43, with 4 groups) would be required to obtain a medium to large effect size of Cohan's f = 0.25 [31]. We randomly chose 280 participants from 283 eligible participants attending the study. 12 out the 280 participants correctly guessed the purpose of the experiment, 21 participants did not complete the questionnaire fully, 7 participants searched online for HPV vaccine information recently. These participants were not included in our analyses. The overall response rate was 85.36%. As a result, we ended up with an uneven number of participants in each experimental condition: positive descriptive (PD, n = 68), positive narratives (PN, n = 60), negative descriptive (ND, n = 45) and negative narratives (NN, n = 70). The sample was all female college students, with a mean age of 19.83 years (SD = 1.59). Participants reported a lower cognition of HPV and HPV vaccination than developed countries (M = 4.21, SD = 1.98; 0 = know nothing at all to 10 = know everything) [40,41].

The manipulation of comments' presentation and valence was successful. Participants under the positive condition considered the comments to be far more favorable to the HPV vaccine ($M_{positive} = 4.82, SD = 0.78$) than those under the negative condition

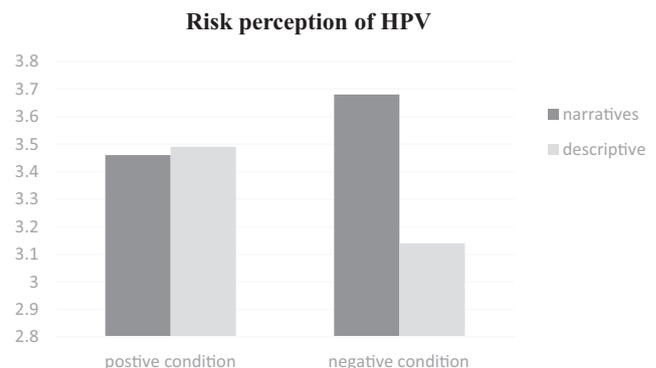**Risk perception of HPV**

Fig. 3. Effects of different valence of comments on the perceived risk of the HPV by positive and negative conditions.

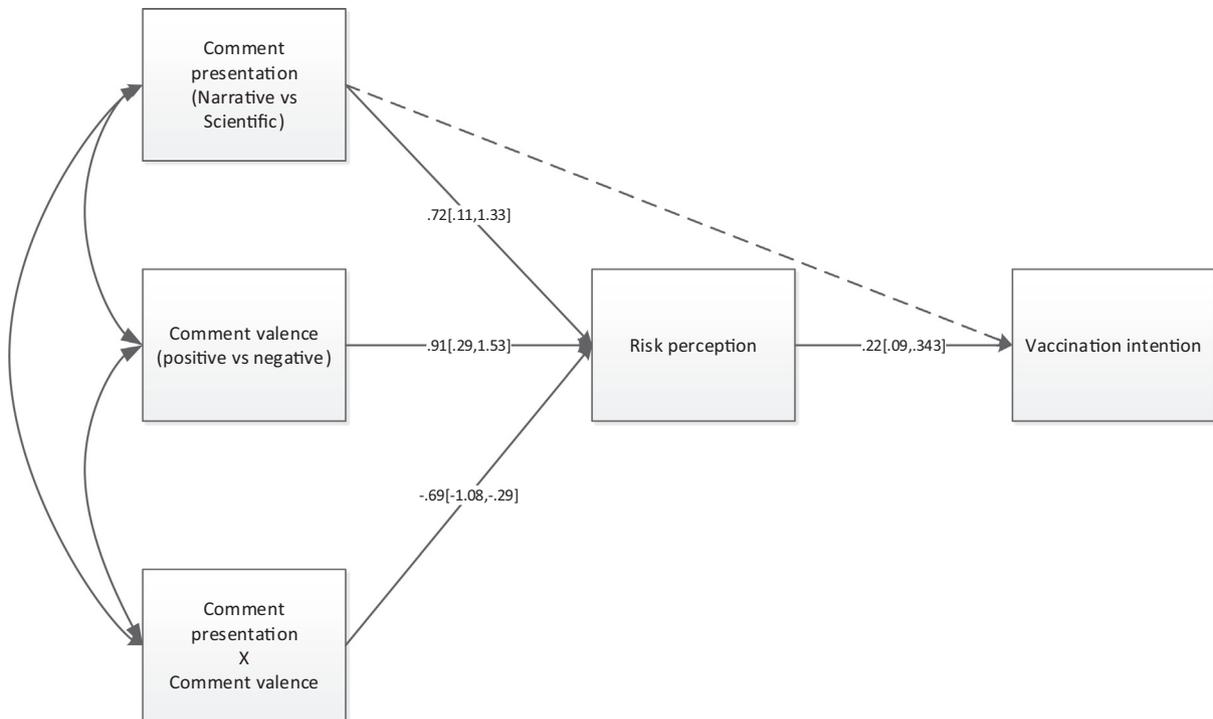**Fig. 4.** Moderated Mediation model. Note. The statistics represent unstandardized regression coefficients.

($M_{negative}$ = 1.61, SD = 0.67), P < 0.001). The same method was used to test the manipulation of presentation of comments, and the results showed that participants under the descriptive condition perceived the comments to be more scientific ($M_{descriptive}$ = 4.21, SD = 0.96) than those in the narrative condition ($M_{narratives}$ = 1.83, SD = 0.87), P < 0.001.

3.2. Effects of experimental conditions

First, we tested the perceived risk of HPV. There was a significant effect of the comment presentation condition, such that narrative comments (M = 3.58, SD = 0.79) resulted in higher risk perception than descriptive comments (M = 3.36, SD = 0.71), F (1,237) = 6.75, $p < 0.01$, $\eta_{partial}^2$ = 0.03. However, this effect was moderated by a significant two-way interaction, F (1,237) = 8.62, $p < 0.01$, $\eta_{partial}^2$ = 0.04. A post-hoc test reveal that narrative comments (M = 3.68, SD = 0.76) generated higher risk perception than descriptive comments (M = 3.14, SD = 0.63) under the negative condition only, $p < 0.001$. (Fig. 3) By comparison, it found no significant difference in risk perception between narrative comments and descriptive comments under the positive condition.

We also assessed the behavioral intention. No significant effect or interaction of behavioral intentions was observed.

3.3. Moderated mediation model

First, the results of simple mediation model revealed that risk perception mediated the effects of comments' presentation on the participant's HPV vaccination intention. More specifically, the narrative- (vs. descriptive-) comments increased participants' perceived risk of HPV (B = −0.26, SE = 0.10, 95% CI = −0.46 to −0.06), which further enhance the intentions to obtain the HPV vaccine injection (B = 0.22, SE = 0.06, 95% CI = 0.09–0.34). It is worth noting that risk perception plays a fully mediating role, and that the indirect effect is significant (B = −0.06 SE = 0.03, 95% CI = −0.13 to −0.02).

Subsequently, the moderated mediation model further indicated that indirect relationship between the presentation of online comments and behavioral intention through perceived risk of HPV was moderated by the valence of online comments. Under the negative condition, the narrative (vs. descriptive) comments increased behavioral intention to receive the vaccine (B = −0.20, SE = 0.10, 95% CI = −0.40 to −0.01) because they increased participants' perceived risk of HPV (B = −0.14, SE = 0.05, 95% CI = −0.27 to −0.06). In contrast, under the positive condition, no significant difference was observed in either risk perception or behavioral intention between the effects of narrative and descriptive comments on participants (Fig. 4).

4. Discussion

Internet and social media has broadened individuals' access to information on the HPV vaccine. Online commenting system cannot be ignored especially when trying to explain why scientific or HPV vaccination-affirmative information online has not resulted in decreasing in anti-vaccination feelings among the public. To fill in the HPV vaccine research gap, this study focuses on developing an integrated moderated mediation model connecting online comments with HPV risk perception and intention of HPV vaccination. It explored the role of narrative comments, one of the most common forms of individual participation in health communication, in increasing perceived risk and further altering intention to be vaccinated against HPV. Specifically, we explore whether the efficacy of the narratives depended on the valence of the comments. To achieve this, both the valence and the presentation of the comments were manipulated.

As expected, the results revealed that compared to descriptive comments, narrative comments caused higher levels of perceived HPV risk, made participants believe the HPV was dangerous and caused serious disease, leading to higher intention to be vaccinated. This finding is consistent with those of other research on the persuasive effect of narratives compared to non-narrative or statistical messages in risk or health communication [20].

It should be noted that the narrative comments had no direct effect on the intentions of adopting protective behaviors, and risk perception played a totally mediated role in this processing. One reason for this is that vaccine uptake is considered by individuals to be an optional behavior, not a necessary behavior. Other researches support this speculation, with no difference having been found between statistical messages and narratives in increasing readers' intentions to perform testicular self-examination [42], receive polio vaccination [43], or take steps to avoid skin cancer [44], which are all optional preventive behaviors. These observations may mean that when a behavior is perceived as optional (ie. vaccination), variations in message presentation-style (ie. narrativse vs. scientific) may not significantly differ in persuasiveness, unless producing high enough risk perception in readers. In contrast, when a behavior is seen as necessary (e.g. disease treatment), the effectiveness of narrative-based messages are significantly greater than scientific-based messages [22]. In other words, if message recipients do not think it is necessary to take the advocated action, descriptions of the consequences of taking (or not taking) the action will be unlikely to change their mind. Thus, a behavior must be perceived a necessary for narrative-style comments to have any effect. Moreover, there is a statistically significant difference between narrative- and scientific-based comments on risk perception, and thus in turn influence behavioral intention. The mediating role of risk perception can help us to understand the mental processing which influence recipients' behavioral intention.

Importantly, the valence of comments moderated the effect of narrative-based comments. The difference in risk perception between narrative- and descriptive-based comments was found only among individuals who had read negative comments which were contrary to the viewpoint espoused in the news coverage above. This significant response to only a negative condition may indicate assimilation bias exists. Compared to an unequivocal positive message context, it is more complicated when individuals are exposed to conflicting vaccine information online and requires systematic mental processing, evaluating communication with deep consideration. Lord and colleagues reported that when a mixed or ambiguous message is presented to individuals inclined to display assimilation bias, they tend to selectively dismiss or accept information in order to confirm their existing beliefs [45]. We speculate that instead of the existing beliefs of individuals influencing their response to a message, the presentation of the message plays a key role, in that certain styles of presentation of contrary evidence in comments beneath articles are subjectively evaluated and thus narrative-based comments are more likely to be accepted. Therefore, comments that are vivid and describe stressful situations, may lead to higher risk perception than statistical/scientific or non-narrative comments.

5. Limitations

There are several imitations that need to be considered. First, the participants of experiment were all female students from collage of big city, with higher education, better economic situation and wider more extensive knowledge. It is difficult to generalize the results from this study to every female. Second, self-report was used as the method of measuring behavioral intention which imposes a high burden on participants [46], and the questions were drawn from a related study but not the most famous one. Future research should consider performance based methods to reduce subjective of participants as well as increase the accuracy. Also, it is better to examine the potential longer term (ie.1 weeks) effect of online comments. Third, we only measured the perceived risk of HPV. We have no knowledge how perceived risk of HPV vac-

cination would change. Perceived risk of vaccination has been postulated to be a key mediator linking HPV vaccine massage and behavioral intention. Future studies needed. Finally, we presented the HPV information in a scientific manner, which is the most common way for information on vaccinations to be presented in mainstream Chinese media. However, more and more people are using social media as a knowledge community (e.g., ZhiHu.com, Quora.com) from which to obtain HPV vaccine information. Aside from sharing scientific messages, individuals also share their personal health experiences using narratives, whether for or against vaccination, leading to a more complex, information-rich environment. In this situation, readers have to make more effort to judge the narrative article and its narrative comments at the same time. This may conceivably mean that readers evaluate information according to the apparent credibility and authority of creators, or according to their own existing attitudes to vaccination, amongst other criteria, not only based on the presentation-style of messages or comments. Future studies should therefore compare the effects of the more complex information-rich environment of social media on individuals' views on HPV vaccination e.g. the effects of narrative-based news with narratives-based comments versus scientific news with narrative-based comments, or narrative-based news with non-narrative-based comments.

6. Conclusions

Investigating the effects of online comments on females' vaccination intention provided valuable insight into how personal information influences others' perceived risk of HPV and vaccination intention. The public has long expressed concern with the safety of vaccinations and related biologics [47]. Emotion appears to play a significant role in the public's decision-making on vaccination [48]. As a result, rather than being attracted by statistical evidence or professionally approved information, non-experts are more likely to be attracted by narrative layperson-generated reports containing personal experiences or emotions which may have questionable validity and/or reliability, suggesting the need for clinicians and government to develop "narratives information" presented as narratives containing examples of other vaccinators' experience from a vaccinator perspective, rather than information being presented an objective, descriptive format that enabled people to make sense of their situation, which may led to better decisions on vacation. Moreover, a positive article and negative comments construct a more complex information context, which requires individuals to evaluate communication with deep consideration. Narratives are more effective than non-narrative comments on risk perception. Thus, it may also valuable for interventions to use social media to deliver more persuasive narratives messages/comments to against misleading information.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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