Perceived COVID-19 risk exposure and adoption of preventive behaviors: Social media information consumption as a moderator

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Increasing preventive behaviors is critical to mitigating the rapid spread of COVID-19, but this can be challenging as some people are reluctant to practice these behaviors. We explored the mediating role of threat appraisal in the link between perception of COVID-19 risk exposure and preventive behavior, and the moderating effect of COVID-19 information consumption through social media. We recruited 577 people in China to complete a survey. The results show that perception of COVID-19 risk exposure was positively associated with preventive behaviors and that threat appraisal partially mediated this relationship. Moreover, COVID-19 information consumption on social media moderated the mediating effect. These results provide theoretical and practical implications to increase individuals' preventive behaviors during the COVID-19 pandemic.

Article Highlights

- Perceived COVID-19 risk exposure was found to be positively related to individuals' preventive behavior.
- Threat appraisal mediated the relationship between perception of COVID-19 risk exposure and preventive behaviors.
- COVID-19 information consumption on social media moderated the mediating effect of threat appraisal in the link between perception of COVID-19 risk exposure and preventive behaviors.

The world has been affected by COVID-19, which is a highly contagious and potentially fatal disease, as there have been no definitive and effective treatments developed thus far (Aschwanden et al., 2021). Studies have shown that COVID-19 may harm not only individuals' physical health but also their mental health (Gundogan, 2021; Lu et al., 2021). Because of the transmission characteristics and negative consequences of COVID-19, *preventive behaviors* including social distancing, use of face masks, washing hands, and receiving the vaccine, remain essential as a way to limit the spread of the virus (Cvetković et al., 2020). Liu (2020) found that only 4.9% of the 511 Chinese participants in his study had been vaccinated, and that up to 31.5% did not discontinue exposure to people exhibiting symptoms. Therefore, it is vital to explore the factors for engaging in preventive behaviors to ensure their widespread adoption.

According to protection motivation theory (PMT), epidemic exposure may activate the threat appraisal process, thus improving the adoption of preventive behaviors among individuals (Rogers, 1975). In addition, social media sites have

become an increasingly important source for individuals seeking information on the COVID-19 pandemic (Cuello-Garcia et al., 2020). Thus, COVID-19 information consumption on social media may have a critical impact on individual threat appraisal and associated preventive behaviors. We examined the relationship between COVID-19 risk exposure and preventive behaviors, as well as the mediating role of threat appraisal and the moderating role of COVID-19 information consumption on social media.

COVID-19 Risk Exposure and Preventive Behaviors

COVID-19 risk exposure refers to an individual's perception of the likelihood of contracting COVID-19 or spreading it to family members, friends, and colleagues (Ge et al., 2021). There are several reasons that we conjectured COVID-19 risk exposure might have a direct impact on preventive behaviors. First, according to the health belief model proposed by Becker (1974), people want to avoid illness and will, therefore, adopt behaviors that they think will prevent them from contracting an illness, or mitigate the effects if they do so. Furthermore, if they contract COVID-19, individuals may experience physical harm, psychological harm, and adverse effects on their life and work (Sheu et al., 2020). Thus, perception of increased risk of COVID-19 exposure may encourage individuals to take appropriate preventive actions to avoid and/or mitigate infection. Second, in PMT (Rogers, 1975) it is assumed that individuals will take certain actions against health threats from self-protection motivation. Qiao et al. (2022) found that the perception of increased risk of COVID-19 exposure was associated with reduced self-efficacy and control. For self-protection, individuals tend to practice preventive behaviors. Furthermore, prior findings show that risk perception correlated significantly with individual preventive behaviors (Borges & Byrne, 2022; Li et al., 2021; Lu et al., 2021). Therefore, the following hypothesis was proposed for this study:

Hypothesis 1: Perceived COVID-19 risk exposure will be positively correlated with preventive behaviors.

Threat Appraisal as a Mediator

As proposed in the PMT model, the effect of individual and environmental factors on engagement in protective behaviors must be mediated by individual cognitive processes (Rogers, 1975). Threat appraisal is one of the main forms of the cognitive processes and forms a key component of the PMT model (Rogers, 1975). In line with this, perception of COVID-19 risk exposure may cause threat appraisal. According to the PMT model, environmental factors are the main sources of information that activate threat appraisal (Rogers, 1975). Environmental sources of information include face-to-face conversations with others (family members, neighbors, and colleagues) and social media sites as a virtual source (Clubb & Hinkle, 2015). The term *social media* refers to the Internet-based application and platforms through which users can create and exchange content (Liu, 2021). COVID-19 is a public health concern because of the highly infectious nature and high mortality rates of the disease (Aschwanden et al., 2021). In addition to environmental sources for COVID 19-related information, individuals can also obtain information about the severity of the COVID-19 pandemic within their respective regions from various social media and television news sources. In a study conducted with workers in the USA, Baker et al. (2020) found that increased risk of COVID-19 exposure resulted in an increased awareness among individuals regarding the spread of and infection with COVID-19. Furthermore, the level of threat appraisal increases with the perceived levels of vulnerability and severity of COVID-19 (Šuriņa et al., 2021).

Conversely, threat appraisal may promote preventive behaviors among individuals. According to PMT, individuals take corresponding countermeasures to mitigate risk after threat appraisal (Adunlin et al., 2021). Thus, increased preventive behaviors are observed among individuals aware of the threat caused by COVID-19 risk exposure. The relationship between threat appraisal and preventive behaviors has been supported by previous studies (Rayani et al., 2021; Šuriņa et al., 2021).

In conclusion, COVID-19 risk exposure increases an individual's perception of their vulnerability and of the severity of COVID-19, leading to threat arousal. Thus, threat appraisal, as influenced by self-protection motivation, promotes preventive behaviors. As a result, we proposed the following hypothesis:

Hypothesis 2: Threat appraisal will mediate the relationship between COVID-19 risk exposure and preventive behaviors.

COVID-19 Information Consumption on Social Media as a Moderator

Social media has increasingly become the main COVID-19 information source used by individuals (Liu, 2021). Researchers have found that social media information can influence individuals' perception of COVID-19 (Abbas et al., 2021; Cuello-Garcia et al., 2020). We surmised that COVID-19 information consumption on social media would moderate the relationships among COVID-19 risk exposure, threat appraisal, and preventive behaviors. To be specific, we theorized that the more COVID-19 information consumed on social media, the stronger would be these relationships.

According to the PMT model, different sources of information can collectively provide an individual with basic COVID-19 knowledge and potential preventive responses. Social media provides individuals with a variety of information about COVID-19 and, thus, a clear understanding of the disease is supplied. Information encountered on social media is both positive and negative, but Okon-Singer (2018) found that people are more likely to focus on negative information than positive information out of self-protection motivation. Adunlin et al. (2021) found that focusing on negative information about COVID-19 caused threat appraisal. Similarly, Hindson (2020) found that people paid more attention to negative information about COVID-19 than they did positive information. Therefore, negative COVID-19 information consumption through social media may enhance individuals' perception of their vulnerability and of the severity of the disease, and also their fear associated with COVID-19, resulting in a higher level of threat appraisal (Rayani et al., 2021). Furthermore, it has been found that individuals obtain information about preventive behavior to protect against COVID-19 from various social media platforms (Liu, 2021). As a result, COVID-19 information consumption through social media may promote preventive behaviors among individuals who perceive a high risk of COVID-19 exposure. Therefore, we proposed the following hypothesis:

Hypothesis 3: COVID-19 information consumption on social media will positively moderate the mediating effect of threat appraisal in the relationship between perception of COVID-19 risk exposure and preventive behavior.

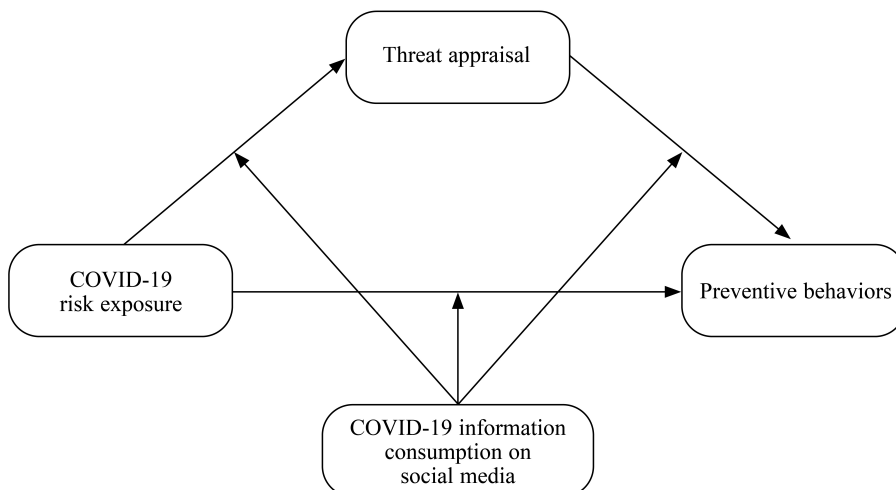The research model is shown in Figure 1.

Figure 1. *Theoretical Model*

Method

Participants and Procedure

We obtained ethical approval for our study from Luoyang Normal University's ethics committee. We recruited participants in China using convenience sampling. The survey link for the Wenjuanxing survey platform was distributed using WeChat groups. Participants included 577 people aged between 18 and 60 years ($M = 34.13$, $SD = 10.09$). Demographic statistics are shown in Table 1.

Table 1. *Sample Characteristics*

Demographic information	Categories	n	(%)
Gender	Male	281	(48.70)
	Female	296	(51.30)
Monthly income (CNY)	< 5,000	219	(38.00)
	5,000–10,000	175	(30.30)
	> 10,000	183	(31.70)
Marital status	Married	277	(48.00)
	Not married	300	(52.00)

Note. CNY = Chinese yuan. CNY < 5,000 = < USD 750; CNY 5,000–10,000 = USD 751–1,500; CNY > 10,000 = > USD 1,501.

Measures

We assessed perception of COVID-19 risk exposure using four domains (self, family, neighbors, and friends/colleagues); higher scores indicate higher COVID-19 risk exposure (Ge et al., 2021). Items are rated on a 4-point Likert scale ranging from 0 (*no*) to 3 (*somebody died*). One point is added to the score for suspicion of COVID-19 in a family member, neighbor, or friend/colleague. Two points are added when someone from any domain has been diagnosed with COVID-19. Three points are added when someone has succumbed to COVID-19. Cronbach's alpha in this study was .95.

Preventive behaviors were measured with a 15-item scale suggested by China's health authorities (Chinese Center for Disease Control and Prevention, 2020), which includes items such as "Stay away from crowds" and "Reduce use of public transport." Items are rated on a dichotomized scale of 0 (*no*) and 1 (*yes*), with higher scores indicating engagement in more preventive behaviors (Liu, 2021).

We used a 10-item scale adopted from Ezati Rad et al. (2021) to measure threat appraisal. The scale has two dimensions: perceived vulnerability and perceived severity. We used four items, including "I may also get infected with COVID-19," to assess the perceived vulnerability. We used six items, including "There is a chance of early death in the event of infection with COVID-19," to assess perceived severity. Participants rate the items on a 5-point Likert scale ranging from 1= *completely disagree* to 5 = *completely agree*. Responses are summed within each dimension. Cronbach's alpha values in this study were .94 for the perceived vulnerability subscale, .95 for the perceived severity subscale, and .97 for the total scale.

We used three questions derived from Liu and Jiang (2021) to measure COVID-19 information consumption through social media. We asked participants to indicate how often in the past month they were exposed to COVID 19-related information on three different social media platforms: Weibo, WeChat, and TikTok. Items are rated on a 5-point Likert scale ranging from 1 (*never*) to 5 (*every time I used the platform*), with higher scores indicating more COVID-19 information consumption on social media. Cronbach's alpha was .98 in this study.

Data Analysis

We used SPSS 21.0 for all analyses. First, we conducted Harman's single-factor test to assess potential common method bias. Second, we calculated means, standard deviations, Cronbach's alpha values, and Pearson's correlation coefficients of study variables. Finally, we used the SPSS PROCESS macro (Hayes, 2018) to test the moderated mediation model.

Results

Common Method Bias Test

Results of the test for common method bias show that characteristic roots of the five factors were greater than 1, and the amount of variance explained by the first factor was 35.18%, which is less than the critical value of 40% (Podsakoff et al., 2003). Thus, we observed no serious common method bias in this study.

Descriptive Statistics and Correlations

The means, standard deviations, and correlations of the main variables are displayed in Table 2. Perception of COVID-19 risk exposure, threat appraisal, and preventive behaviors were positively correlated with each other ($p <$ .01).

Table 2. *Descriptive Statistics and Correlation Coefficients*

Variable	M	SD	1	2	3	4	5	6
1. Gender	—	—	1					
2. Age	34.14	10.09	−.02	1				
3. COVID-19 risk exposure	5.69	3.91	.02	.02	1			
4. Threat appraisal	29.41	13.06	.00	.02	.43**	1		
5. Preventive behaviors	8.56	3.89	−.02	.01	.35**	.39**	1	
6. COVID-19 information consumption on social media	9.30	4.29	.08	−.08	−.04	−.05	.15**	1

Note. N = 577.
** $p <$ .01.

Moderated Mediation Model Test

We used Model 59 of the PROCESS macro to test the mediating role of threat appraisal and the moderating effect of COVID-19 information consumption on social media, in the link between perception of COVID-19 risk exposure and preventive behaviors. After controlling for gender and age, results show that the perception of COVID-19 risk exposure was significantly and positively associated with preventive behaviors (see Table 3). Thus, Hypothesis 1 was supported. Results of a bootstrapping test show that the indirect effect of threat appraisal in the relationship of perception of COVID-19 risk exposure and preventive behaviors was significant, *ab* = 0.11, Boot *SE* = 0.03, 95% confidence interval [0.06, 0.17]. Thus, Hypothesis 2 was also supported.

We added COVID-19 information consumption on social media as a moderating variable in Equation 2. The results (seeTable 3) show that COVID-19 risk exposure significantly predicted threat appraisal. The interaction between COVID-19 risk exposure and COVID-19 information consumption on social media was positively correlated with threat appraisal. Equation 3 shows that the interaction between COVID-19 risk exposure and COVID-19 information consumption on social media was positively related to preventive behaviors. Further, the interaction between threat appraisal and COVID-19 information consumption on social media was positively associated with preventive behaviors. Thus, Hypothesis 3 was supported.

Table 3. *The Moderated Mediation Effect of Perceived COVID-19 Risk Exposure on Preventive Behaviors via Threat Appraisal*

Predictive variable	Equation 1 (DV = preventive behaviors)			Equation 2 (DV = threat appraisal)			Equation 3 (DV = preventive behaviors)		
	β	SE	t	β	SE	t	β	SE	t
Gender	−.07	.08	−0.87	−.02	.07	−0.29	−.12	.08	−1.53
Age	.00	.00	0.28	.00	.00	0.04	.00	.00	0.51
RE	.27	.04	6.73***	.42	.04	11.13***	.14	.04	3.22**
TA							.24	.04	5.58***
ICSM				.01	.04	0.35	.23	.04	5.78***
RE × ICSM				.17	.04	4.73***	.09	.04	2.33*
TA × ICSM							.09	.04	2.36*
R^2	.08			.22			.18		
F	15.37***			32.99***			18.32***		

Note. DV = dependent variable; RE = COVID-19 risk exposure; TA = threat appraisal; ICSM = COVID-19 information consumption on social media.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Thereafter, we conducted a simple slope analysis to understand the moderating effect of COVID-19 information consumption on social media. First, for individuals with a high level of COVID-19 information consumption on social media, perception of COVID-19 risk exposure had a stronger positive association with threat appraisal (β = .59, $p < .001$). However, for those with low COVID-19 information consumption on social media, the positive association between perceived COVID-19 risk exposure and threat appraisal was weakened (β = .24, $p < .001$) as can be seen in Figure 2.
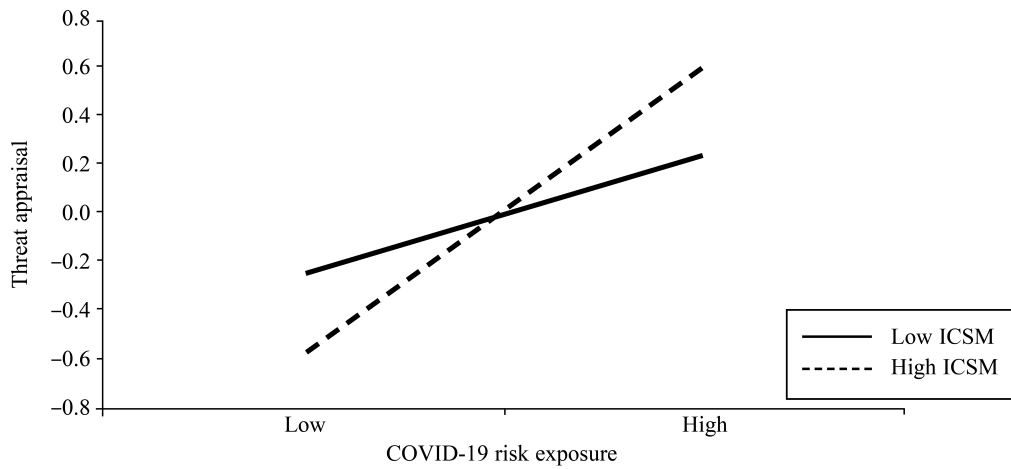
Figure 2. *COVID-19 Information Consumption on Social Media as a Moderator of the Relationship Between Perceived COVID-19 Risk Exposure and Threat Appraisal*
Note. ICSM = COVID-19 information consumption on social media.

Second, the results show that for individuals with a high level of COVID-19 information consumption on social media, perception of COVID-19 risk exposure was significantly and positively associated with preventive behaviors ($\beta = .23$, $p < .001$). However, for individuals with a low level of COVID-19 information consumption on social media, the positive association between perception of COVID-19 risk exposure and preventive behaviors became nonsignificant ($\beta = .05$, $p > .05$)
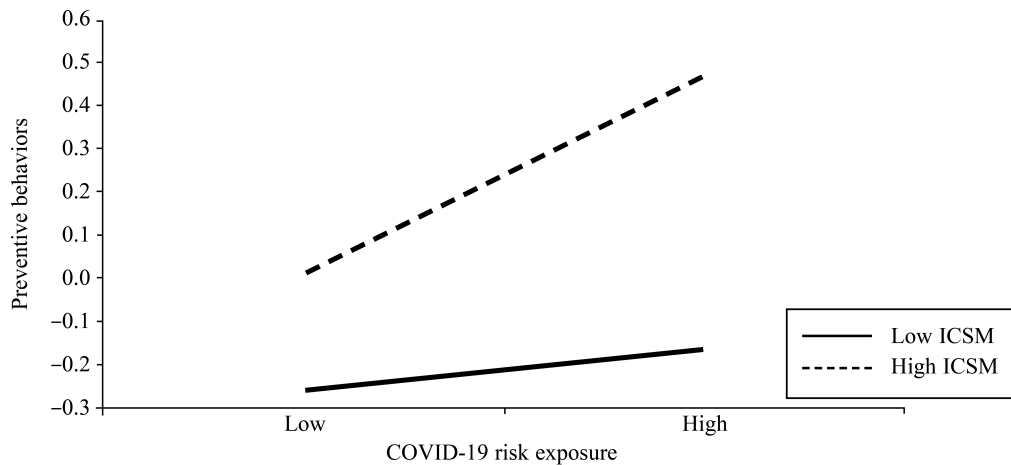

Figure 3. *COVID-19 Information Consumption on Social Media as a Moderator of the Relationship Between Perceived COVID-19 Risk Exposure and Preventive Behaviors*
Note. ICSM = COVID-19 information consumption on social media.

Finally, for individuals with a high level of COVID-19 information consumption on social media, threat appraisal had a strong association with preventive behaviors ($\beta = .33$, $p < .001$). However, for individuals with a low level of COVID-19 information consumption on social media, the association between threat appraisal and preventive behaviors was weak ($\beta = .15$, $p < .01$), as can be seen in Figure 4.
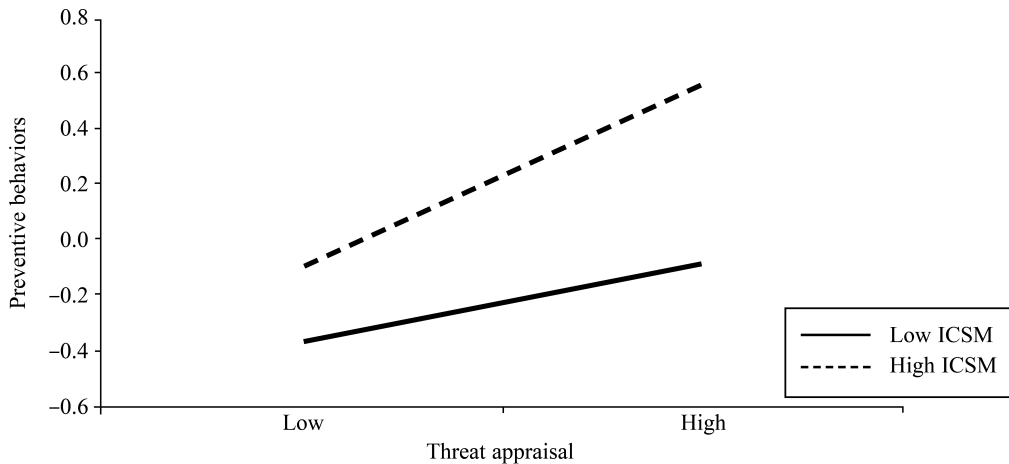

Figure 4. *COVID-19 Information Consumption on Social Media as a Moderator of the Relationship Between Threat Appraisal and Preventive Behaviors*
Note. ICSM = COVID-19 information consumption on social media.

Discussion

Using PMT, in this study we investigated the relationship between participants' perception of COVID-19 risk exposure and their preventive behaviors. Further, we explored threat appraisal and COVID-19 information consumption on social media as two potential mechanisms linking perception of COVID-19 risk exposure and preventive behaviors. Results show that threat appraisal partially mediated the effect of perceived COVID-19 risk exposure on preventive behaviors. In addition, COVID-19 information consumption on social media was a boundary condition that impacted the effectiveness of this mechanism. These findings extend prior studies by exploring the cognition process for the relationship between the role of social media exposure and preventive behavior outcomes in the context of the COVID-19 pandemic.

Theoretical Contributions

This study extends previous research in three ways. First, we explored the factors that affect preventive behaviors among individuals in regard to their perception of COVID-19 risk exposure. As hypothesized, the perception of COVID-19 risk exposure was significantly and positively associated with COVID-19 preventive behaviors. In other words, if individuals were in close contact with COVID-19, they adopted more preventive behaviors. This finding is consistent with that of Bruine de Bruin and Bennett (2020), but is inconsistent with that of Qiao et al. (2022). In a study with 1,062 North American college students, Qiao et al. found that higher perceived COVID-19 risk exposures were negatively associated with low vaccine acceptance. This contradictory result may be related to the degree of pandemic prevention and control in different societies. Since the outbreak of COVID-19, in China multiple mitigative measures have been adopted, such as early reporting, situation monitoring, home isolation, and adequate access to free medical services (Zhang et al., 2020). Overall, this timely response has provided Chinese people with a great sense of psychological safety and control over the pandemic (Xia et al., 2021). Conversely, Qiao et al. argued that the college

students in the USA had a low sense of self-controllability of the epidemic. This is inseparable from the pandemic prevention atmosphere in American society (Sarria-Guzmán et al., 2021). Thus, our study has shed light on the influence of social and cultural differences in regard to preventive behavior.

Second, the mediating mechanism of the relationship between COVID-19 risk exposure and preventive behavior was examined further. As a result, we introduced threat appraisal as a mediator based on PMT. Until now, there have been no studies that explored the mediating mechanism between perception of COVID-19 risk exposure and preventive behavior. Previously, researchers mainly investigated the effect of COVID-19 risk perception on preventive behavior (Bruine de Bruin & Bennett, 2020; Taghrir et al., 2020; Wise et al., 2020). In contrast, our study was based on the PMT model and we introduced threat appraisal as a mediator, extending the literature through a cognitive process perspective.

Finally, we introduced COVID-19 information consumption on social media as a moderator to identify precisely the type of influence on preventive behaviors mitigating risk exposure. Previous studies have mostly considered social media exposure as an antecedent variable affecting individuals' COVID-19 risk perception and preventive behavior (e.g., Nazione et al., 2021). However, there has been limited research on social media exposure as a moderator. Therefore, our study provides insight into the impact of individuals' COVID-19 information consumption via social media on their preventive behaviors.

Practical Implications

The results of this study have several practical implications for promoting individual preventive behaviors. First, our findings indicate that perception of higher risk of COVID-19 exposure promotes preventive behaviors in individuals. This highlights the importance of public awareness of COVID-19 risk exposure. Therefore, the pandemic management authorities should promptly publish relevant COVID-19 information and infection statistics. In particular, the infection rate trajectory should be accurately conveyed to the public. This will enable individuals to fully realize the psychological distance between the infected and themselves, and negative information on the infection rate may increase individual COVID-19 risk perception and adoption of preventive behaviors.

Second, because threat arousal has an indirect effect, improving awareness of the severity of the COVID-19 pandemic and susceptibility to the disease may be useful for initiating self-protection motivation and improving uptake of preventive behaviors. To increase compliance, pandemic management teams can strengthen public awareness of the harms associated with COVID-19 and how the transmission route is exacerbated by a lack of effective treatment.

Finally, we identified the moderating role of COVID-19 information consumption through social media on preventive behavior, which provided practical inspiration in this study. The results suggest that social media plays an important role in the dissemination of risk information and in forming the public's risk perception. The continuity, reliability, and accuracy of information provided in news media are important factors affecting public risk perception. Therefore, social media should be used to spread accurate pandemic information, without exaggeration or omission, and information transparency should be maintained. Furthermore, social media should enhance public awareness of COVID-19 by emphasizing aspects such as transmission routes, severity, and harm in order to increase levels of threat arousal, so that people can fully realize the importance of protective behaviors. In addition, various social media platforms should take responsibility for informing the public of correct ways of implementing effective protective behavior, so that individuals can integrate these measures successfully into their life.

Limitations and Directions for Future Research

Despite the study's implications, several limitations should be noted. First, we used a cross-sectional design, limiting the ability to make causal inferences. Future researchers could conduct longitudinal studies to explore the relationship between the variables over time. Second, we included Chinese participants only. Therefore, caution should be applied when generalizing the results of this study to other populations. As discussed above, the cultural setting may lead to

differences in associative relationships. Thus, future researchers could explore if this model can be applied in other cultural settings. Third, we explored only one mediating role, that of threat arousal, in the link between perception of COVID-19 risk exposure and preventive behaviors. In future studies, other variables could be considered, such as perceived response efficacy based on PMT.

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