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Does Exposure to Risk Communication About Novel Coronavirus Pneumonia (COVID-19) Predict Protective Behaviors? Testing the Moderating Role of Optimistic Bias

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Originating at the end of 2019, the outbreak of the novel coronavirus disease (COVID-19) shocked the world. Drawing on the health belief model, the current study investigates how risk communication influences public perceptions about the disease and adoption of preventive behaviors. Analyzing the data from 1,591 Chinese respondents from 31 provinces in the context of the COVID-19 epidemic, this study found that exposure to media risk communication contributed to lower perceived barriers, which in turn, increased engagement in the uptake of preventive behaviors. Compared with the information released by nongovernment organizations, medical providers, and Internet users, information from government sources exerted greater influence over individuals' perceptions and behavioral change. Interpersonal risk communication was found to be effective in promoting preventive behaviors. Moreover, optimistic bias moderated the effects of knowledge about COVID-19 and perceived barriers on preventive behaviors. The findings provided implications about how to better engage the public to adopt preventive measures.

Keywords: COVID-19, media risk communication, information sources, optimistic bias, preventive behaviors

Since early December 2019, the outbreak of a novel respiratory disease has captivated the world. This coronavirus strain (or COVID-19) was first detected in Wuhan, China and then impacted many locations internationally within five months (Jung et al., 2020). Knowledge about and treatments for the novel COVID-19 pneumonia were very limited in the early stages (Li, Zeng, Liu, & Yu, 2020). Most infected patients experience mild symptoms and full recovery, but those with chronic diseases are at higher risk (Li et al.,

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2020). As a large number of the first cases were visitors to an open seafood market, the common-source zoonotic exposure, direct contact, and exposure to patients' respiratory droplets were considered as likely to be the major means of spread (Jung et al., 2020).

Although the World Health Organization (WHO, 2020) challenged dour projections that the pandemic could infect 60% of the global population, it estimated that morbidity rates could reach 2%, or roughly ten times that of common flu strains (WHO, 2020). COVID-19 quickly grew into a pandemic rivaling that of the 1918 Spanish flu, prompting the suspension of live school classes, sporting events, church services, and public gatherings across the globe. By January 2021, confirmed cases reached 100 million, with the death toll surpassing two million (WHO, 2021).

To curb the viral spread, health risk communication thus plays an important role. At the disease's epicenter in Hubei China province—where the number of daily cases dropped from 1,000+/day to zero—officials recently lifted travel restrictions after successfully halting the flow of new infections (Noack et al., 2020). A valuable lesson learned from prior pandemic virus outbreaks is that the restriction of information to the public increases people's concerns and inhibits their adoption of protective measures (Vong & Feng, 2013). Rumor management, audience analyses, timely media updates, and presentation of expert analyses effectively facilitated outbreak responses (Frost, Li, Moolenaar, & Xie, 2019). The level of information transparency was positively associated with increased public awareness and government trust (Goodwin & Sun, 2014).

Moreover, coordination with health care providers, WHO/private sector, and engagement with impacted sites help lower the viral spread. As the cause of the virus remains uncertain—and distribution of vaccines and treatment drugs remains limited—virus transmission can be discouraged more effectively by following social distancing norms and hygiene practices. China's disease control efforts benefited from effective public risk communication. The early Chinese response thus provides an opportunity to assess how risk communication from different sources influences one's adoption of preventive behaviors, which could in turn provide guidance for effective pandemic control worldwide.

The majority of behavioral change theories evolved in the context of chronic disease prevention and discontinuance of unhealthy behaviors (e.g., McComas, 2006). For instance, the health belief model (HBM) suggests that a person's beliefs in the threat of a disease and beliefs in the effectiveness of recommended behavior determine his or her intention to adopt the behavior (Carpenter, 2010). However, HBM does not account for people's biased perceptions that may dictate their decision to accept a healthy behavior (Champion & Skinner, 2008). For instance, prior research found that smokers held unrealistic optimistic beliefs that decreased their willingness to quit (Mantler, 2013). Also, HBM does not account for the influence of the diversity of information exposure that may prohibit or promote the recommended behavior. While personal existing beliefs and prior experiences may not be strong predictors of preventive behaviors in the face of novel diseases with uncertain pathologies, risk communication via the Internet, traditional mass media, and interpersonal channels remains key to enhancing public understanding about COVID-19. To fill the gaps in HBM literature, the current study aims to explore the effects of variety of media risk communication exposure, different information sources, and interpersonal interactions on the intention to adopt preventive behaviors. Moreover, unlike a prior study that tested optimistic bias as a predictor of HBM cognitive constructs (Clarke, Lovegrove, Williams, & Machperson, 2000), our study examined the moderating effect of optimistic bias on the association between HBM constructs and behavioral intention.

Literature Review

Creating Behavioral Change via Risk Communication

Risk communication refers to the exchange of live information—among individuals, organizations, and groups—with the purpose of improving the perceptions and management of risks (Yoo, 2019). Well-designed risk communication can reduce the harm presented by an infectious disease outbreak. Research on media effects has shown that both traditional media—such as radio, pamphlets, television—and emerging digital platforms were effective in promoting healthy behavioral changes (Free et al., 2013; Naugle & Hornik, 2014). Research suggests that public risk communication increases public responses to infectious disease outbreaks and preparedness for protective measures (Karan, Aileen, & Leng Elaine, 2007; Taylor-Robinson, Elders, Milton, & Thurston, 2010). In crisis situations, media represent the public's primary information source on health risk threats and appropriate behavioral responses (e.g., Veil & Sellnow, 2014).

The emergence of social media and mobile applications has accelerated the circulation of health information. For example, in the H1N1 virus event of 2009, social media proved effective in heightening situational awareness and behavioral changes (Veil & Sellnow, 2014). The new media platforms can convey the latest information in seconds and provide audiences with updated numbers and potential hazards (Steiger, De Albuquerque, & Zipf, 2015; Yoo, 2019). In China, even though a large number of citizens acquire information from Web-based platforms, traditional mass media—especially the state-owned media organizations (e.g., China Central Television)—are still pivotal in communicating the details of the real-time crisis event (Sethi, 2019). The older generation, in particular, continues to rely on television news to keep up with pressing issues.

During this epidemic wave, misinformation and rumors have prevailed on new media. The state-owned media broadcast live updates the latest numbers, supportive policies, in-depth interviews, and expert analyses to minimize the public's misconceptions about the COVID-19. Additionally, risk communication was conveyed via radio, texts, websites, social media, and other online communities to promote preventive behaviors. When people are exposed to various media outlets, they are more likely to correct the misconceptions about the disease and become knowledgeable about its current status (e.g., Frost et al., 2019). The core aim of risk communication about COVID-19 has been to raise people's awareness and follow the health experts' recommendations. The association between media risk communication and audience risk perception has been confirmed in past works (McComas, 2006; Yoo, Choi, & Park, 2016).

HBM has been widely used to explain the process of healthy behavioral change. HBM proposes that the engagement of health promotion behavior is a function of personal beliefs about health threats (i.e., perceived susceptibility and severity), perceived benefits of or barriers to taking action, and health motivation (Champion & Skinner, 2008; Janz & Becker, 1984). Moreover, external cues from media, friend recommendations, or health provider suggestions—as well as internal physiological cues—promote the adoption of health promotion behaviors (Carpenter, 2010). This theory has been applied to the study of chronic disease prevention (Ma et al., 2007) and the promotion of healthy lifestyles (Eshah, 2013). However, the value of applying the HBM in the prevention of emergent contagious diseases like COVID-19—wherein behavioral change is urgently mandated to ensure public health—remains unclear.

In the context of chronic diseases, people could reach an understanding about the disease from internal cues (i.e., physical pain and treatment experiences) or external advice. In the early stage of a pandemic, as little is known about the virus and few individuals have direct contact with patients, the exposure to health risk communication on the media is the primary source to accumulate related knowledge (e.g., Dam, Borsai Basaran, & Atkin, 2021). During the current outbreak, key facts involving population vulnerabilities, case fatality rates, and the cause of the virus were updated quickly. Consequently, people's perceptions about their susceptibility and severity of the cases changed dramatically over the course of the pandemic. The main goal of public risk communication involves explaining the benefits of—and lowering the barriers to—engaging in preventive strategies, such as staying at home as long as possible, washing hands frequently, and wearing face masks in public. In the current study, perceived benefits refer to people's perceived effectiveness of recommended preventive measures. Perceived barriers represent the costs, pain, and inconvenience associated with preventive behaviors. Exposure to different media channels is likely to help viewers verify the truthfulness of such information and enhance their understanding of preventive measures.

Drawing from the HBM conceptualization and research reviewed above, the current framework assumes that exposure to media risk communication is impactful; that is, it should influence COVID-19 knowledge and perceived benefits of (as well as barriers to) preventative behaviors. We assume that every channel of media risk communication matters. The combination of different media channels can help audiences assess the veracity of health information, correct misinformation, and enhance their understanding of health risk mitigation practices. Exposure to a diversity of sources is thus likely to facilitate greater knowledge about the virus and preventative behaviors. To put these assumptions in more formal terms in the context of COVID-19, we propose the first hypothesis:

H1a: *Variety of media risk communication exposure is positively associated with knowledge about COVID-19.*

H1b: *Variety of media risk communication exposure is positively associated with perceived benefits of preventive behaviors.*

H1c: *Variety of media risk communication exposure is negatively associated with perceived barriers to preventive behaviors.*

Types of Information Sources

Given the recent media convergence in China, the merging of both old and new media platforms has become widespread. The traditional newspaper and television organizations have also stepped forward to distribute media content using new technologies (Yin & Liu, 2014). Therefore, the comparison between different media channels become valueless, and what matter more are the sources and verification of the information.

Information about the COVID-19 outbreak emerged primarily from government agencies, including national and local governments, nongovernment organizations (NGOs) specializing in health promotion, medical providers (i.e., medical research centers and hospitals), and netizen-generated content. The current study aims to explore the differential impacts of different information sources on individuals' cognitive appraisal and knowledge about COVID-19. Given the dearth of prior studies in this area, we pose the following research question:

RQ1: What are the effects of different information sources (government, NGO, medical providers, and netizen-generated content) on knowledge about COVID-19, perceived benefits of preventive behaviors and perceived barriers to preventive behaviors?

In addition to media, interpersonal risk communication represents another key source for people to exchange information about COVID-19. Past work has conveyed mixed results on the effects of interpersonal interactions. Some studies indicate a link between interpersonal risk communication and risk-reduction intention (Cho, Lee, & Lee, 2013) whereas others report nonsignificant effects (Lin & Lagoe, 2013). It is argued that interpersonal interactions are less organized than information from media sources and can direct the discussions to deviant topics and nonadaptive behavior rationalization, which resulted in mixed research findings (Cho et al., 2013). In this outbreak, citizens and public officials alike possess limited understanding of the novel disease and are exposed to limited media content about COVID-19 (e.g., Noack et al., 2020). Given that interpersonal communication can help strengthen social knowledge and practices related to healthy lifestyle behaviors (e.g., Rimal & Real, 2003), information exchanged interpersonally is likely to expand one's understanding of COVID-19 and related preventive measures. Based on that assumption, the current framework posits that:

H2a: Interpersonal risk communication is positively associated with knowledge about COVID-19.

H2b: Interpersonal risk communication is positively associated with perceived benefits of preventive behaviors.

H2c: Interpersonal risk communication is negatively associated with perceived barriers to preventive behaviors.

Following the logic of HBM, we expect that both the variety of media risk communication exposure and interpersonal risk communication increase preventive behaviors via the mediation of knowledge about COVID-19, perceived benefits, and perceived barriers (e.g., Willis, 2018). We addressed three types of preventive behaviors—wearing face masks, staying at home to avoid meeting infectious sources, and frequent handwashing—which were highly recommended by medical experts from China and the WHO. Based on the media and interpersonal influence dynamics outlined above, we expect that:

H3: Variety of media risk communication exposure is positively associated with intention to adopt preventive behaviors via the mediation of knowledge about COVID-19, perceived benefits of preventive behaviors, and perceived barriers to preventive behaviors.

H4: Interpersonal risk communication is positively associated with intention to adopt preventive behaviors via the mediation of knowledge about COVID-19, perceived benefits of preventive behaviors, and perceived barriers to preventive behaviors.

Although exposure to risk communication is expected to increase risk behaviors, the precise magnitude of influence across each modality remains unclear, particularly in this novel coronavirus context. It is useful, then, to pose the following research question:

RQ2: What are the effects of different information sources (government, NGO, medical providers, and netizen-generated content) on intention to adopt preventive behaviors via the mediation of knowledge about COVID-19, perceived benefits of preventive behaviors, and perceived barriers to preventive behaviors?

The Moderating Role of Optimistic Bias

Behavioral theories like HBM, theory of planned behavior (TPB), and protection motivation theory (PMT) assume that people are highly rational and logical, as risk-reduction behavioral change is an outcome of related attitudes and psychological appraisal (e.g., Champion & Skinner, 2008). However, prior studies find that individuals are optimistic for their own good most of the time (Cho et al., 2013; Popova & Halpern-Felsher, 2016). In particular, the optimistic bias conception refers to an incorrect belief that one's chances of encountering negative and unfortunate events are lower than those of peers (Trumbo, Lueck, Marlatt, & Peek, 2011).

Kos and Clarke (2001) define optimistic bias as "the pervasive phenomenon of perceiving oneself as being less likely than an *average* other to experience negative events"; they add that, on an aggregate level, "it's logically impossible for everyone's chances of the occurrence of a negative event to be below average" (p. 533). Their work suggests that optimistic bias may be beneficial to the extent that it helps maintain high levels of esteem, as when subjects are confronted with a challenge to their health (see Perloff & Fetzer, 1986). Individuals desire to see themselves as invulnerable, which is probably a result of an anxiety-reduction mechanism. The expression of a naïve optimism can, however, present an "illusion of control and optimism about health" (Harris & Middleton, 1994)—prompting one to bypass appropriate precautions—which can endanger one's health (e.g., Trumbo et al., 2011).

In the context of the present pandemic, we assume that this bias encourages individuals to believe that they are less likely to be infected by COVID-19 because of their confidence in their general health status and healthy lifestyles (e.g., Cho et al., 2013; Popova & Halpern-Felsher, 2016). Moreover, since very few people have direct contact with diagnosed patients, they tend to believe that the risk of infection is far away from themselves, which may not comport with reality. People with optimistic bias are likely to think that they are healthier than average people and thus unlikely to be infected. If infected by the virus, individuals with high optimistic bias are likely to think they will remain asymptomatic and will not experience any complications or sequela. Even though individuals receive rich information from media and interpersonal interactions, the presence of optimistic bias is expected to mitigate the effects of knowledge about COVID-19. Moreover, people with optimistic bias tend to be content with their self-made protections, which could mitigate the effects of perceived benefits of and amplify the impact of perceived barriers to recommended measures. In summary, the biased perception could interfere with the logical sequence of HBM and decrease one's perceived need for adopting preventive measures. More formally, based on the theory and literature reviewed above, we posit that:

H5: Optimistic bias moderates the effects of knowledge about coronavirus pneumonia and perceived benefits of and perceived barriers to preventive behaviors.

Figure 1 provides a more panoramic representation of the model components outlined above.

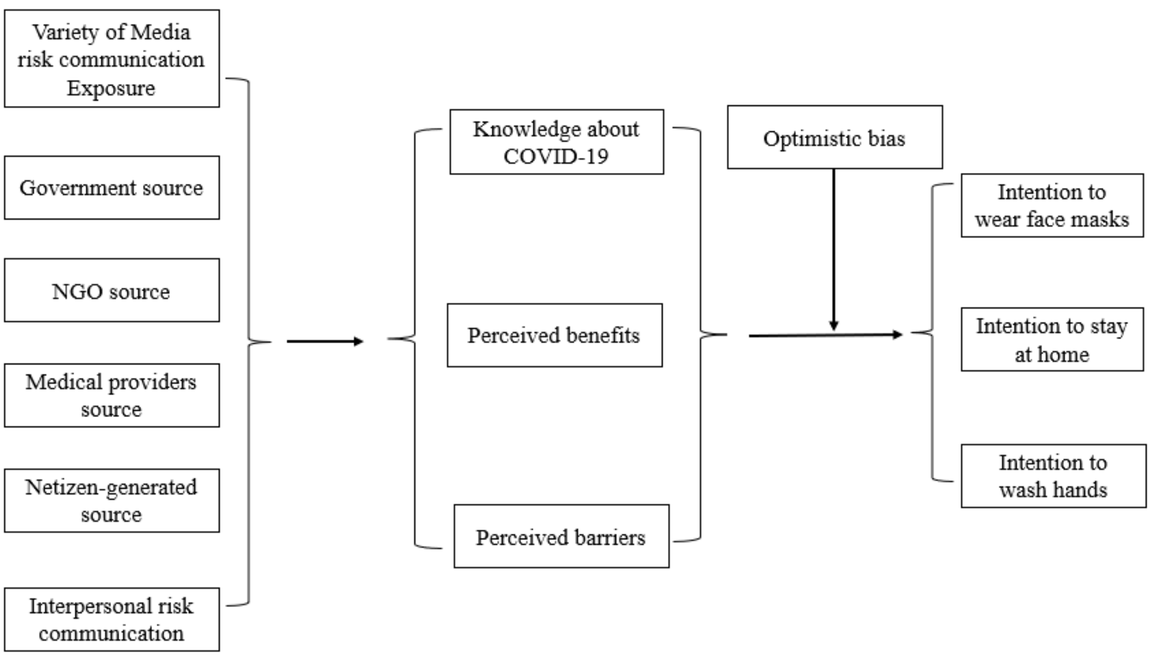

Figure 1. Theoretical framework of the current study.

Methods

Sampling

The data were collected between January 31 and February 4, 2020, when the COVID-19 began to spread throughout China. During that time interval, multiple media platforms released updates to the public, as the subject was widely discussed. The online survey platform, SoJump, was used in this study to recruit respondents (aged 16+ years) living in mainland China (excluding Macau and Hong Kong). SoJump is the largest online survey platform in China, claiming to have more than 2.6 million registered members (Wu, Hu, & Xiong, 2020). We sent invitations to the registered users who were eligible for this study. After nonvalid responses—including repetitive submissions from the same IP address and failed responses to three attention checkers—were dropped, a valid sample size of 1,591 was finalized.

This study measured age, sex, household income, and education as control variables. Respondents came from 31 provinces of China. The average respondent age was 31, and gender representation was evenly distributed (50.01% male). Most respondents claimed to have some education including elementary school (0.1%), middle school (1.1%), high school (3.9%), professional school (2.26%), associate's degree (13.6%), bachelor's degree (69.3%), master's degree (9.1%), doctorate or post-doctoral degree (0.7%). The average monthly household income was between 8,001 RMB and 10,000 RMB; specific responses include no income (2.0%), 1,000 and below (1.3%), 1,001–3,000 (4.7%), 3,001–5,000 (10.1%), 5,001–8,000 (16.3%), 8,001–10,000 (14.6%), 10,001–15,000 (21.2%), 15,001–20,000 (15.7%), 20,001–50,000 (12.5%), and 50,001 and above (1.5%). The educational attainment of respondents was higher than the national average. See the descriptive statistics in Table 1.

Measurements

Variety of media risk communication exposure was measured using 11 items tapping the frequency of respondents' exposure to the content about COVID-19 on newspapers, television, radio, text messages, portal websites, social media, news apps, video apps, online knowledge-sharing communities, search engines, and education apps. Responses were given with a five-point scale ranging from 1 (never) to 5 (very often) (M = 3.31, SD = 0.60, Cronbach's α = .72).

We examined four types of sources that respondents used to acquire information about COVID-19, including government sources, NGO sources, medical providers, and the Internet users' self-generated content. Responses ranged from 1 (never) to 5 (very often) (*Government source*: M = 3.75, SD = 0.85; *NGO source*: M = 2.79, SD = 1.30; *Medical providers*: M = 2.88, SD = 1.18; *Netizen-generated content*: M = 3.06, SD = 1.19).

Interpersonal risk communication was measured with six items reflecting respondents' interpersonal interactions with relatives, friends, coworkers, medical professionals, community members, and other contacts about the progress of the COVID-19 outbreak. Responses ranged from 1 (never) to 5 (very often) (M = 2.71, SD = 0.71, Cronbach's α = .75).

Knowledge about COVID-19 was measured with five factual statements about the vulnerable population, the progress of disease outbreak, general symptoms, and its means of spread. All items were developed based on the latest research profiles for COVID-19 (Chen et al., 2020; Pan et al., 2020). Respondents were asked if a statement was right or wrong. The correct answers were coded as 1 while the wrong ones were coded as 0. The items were summed up to create an index (M = 4.58, SD = 0.62).

Perceived benefits of preventive measures were measured with a single item asking respondents about the effectiveness of preventive measures. Responses ranged from 1 (strongly disagree) to 5 (strongly agree) (M = 4.12, SD = 0.82). *Perceived barriers* were measured with six items, including the perceived difficulty in applying related measures, time conflicts, monetary expenses, and doubts about the effectiveness of related measures (M = 2.02, SD = 0.62, Cronbach's α = .74).

Intentions to adopt three preventive measures were examined, including wearing face masks, staying at home as long as possible, and washing hands frequently, which were recommended by WHO experts (WHO, 2020). Respondents were asked to report their willingness to adopt the recommended preventive behaviors, on a scale ranging from 1 "strongly disagree" to 5 "strongly agree" (*intention to wear face masks*: M = 4.55, SD = 0.74; *intention stay at home*: M = 4.64, SD = 0.58; *intention to wash hands*: M = 4.49, SD = 0.67).

Previous studies have explored the differential values between perceived risks to others and self (each was measured with a single item) to represent *optimistic bias* (Cho et al., 2013). The major limitation of such a measure is that it only reflects the estimated generic chances of disease infection. In the current study, we used a five-item scale to measure *optimistic bias* in broader ways, including items like "compared with other people, I feel that my chance of getting COVID-19 is very low because I am healthy overall"; " . . . because when I was sick, I often got well very soon"; and " . . . because my lifestyle is very healthy." Responses were given from 1 (strongly disagree) to 5 (strongly agree) (M = 3.53, SD = 0.76, Cronbach's α = .80).

Table 1. Descriptive Statistics (N = 1,591).

Variables	Mean	*SD*	Min	Max
Control variables				
Gender (male)[a]	50.01%			
Household income	6.30	1.95	1	10
Education	6.76	0.91	2	9
Age	31.01	8.94	16	71
Independent and dependent variables				
Variety of media risk communication exposure	3.31	0.60	1.27	5
Interpersonal risk communication	2.71	0.71	1	5
Information source (government)	3.75	0.85	1	5
Information source (NGO)	2.79	1.30	1	5
Information source (medical providers)	2.88	1.18	1	5
Information source (netizen-generated content)	3.06	1.19	1	5
Knowledge about COVID-19	4.58	0.62	0	5
Perceived benefits	4.12	0.82	1	5
Perceived barriers	2.02	0.62	1	4.5
Intention to wear face masks	4.55	0.74	1	5
Intention to stay at home	4.64	0.58	1	5
Intention to wash hands	4.49	0.67	1	5

[a] Represents the frequency of a dichotomous variable.

Statistical Procedures

Structural equation modeling (SEM) was performed to test the proposed model using STATA 13. The indirect effects were examined using the nonlinear combination method (Preacher & Hayes, 2008). As the dependent variables (intention to wear face masks, intention to stay at home, and intention to wash hands) violated the normality assumption according to the Shapiro-Wilk and Kolmogorov-Smirnov tests, we computed log transformations for the dependent variables for further analysis, which was consistent with a previous study (Feng, Wang, Lu, & Tu, 2013). We used the following threshold values to assess the model fit: Root Mean Square Error of Approximation (RMSEA) < .06, Comparative Fit Index (CFI) > .95, Standardized Root Mean Squared Residual (SRMR) < .05 (Hu & Bentler, 1999). The control variables of age, sex, education, and household income were added into the SEM as exogenous variables. We followed modification indices to add suggested paths that could be theoretically justified. The final model reported an excellent fit with the data: $\chi^2(81) = 784.06$, $p < .001$; RMSEA = .027; CFI = .965; SRMR = .011. The moderating effect of optimistic bias was assessed using a series of moderated mediation SEM models, holding constant for age, sex, education, and household income. As SEM is not free from multicollinearity, we used regression models to test the variance inflation factors (VIF) of same-stage variables. The values of all the VIFs loaded in an acceptable range (between 1.0 and 2.0; Vaz & Mansori, 2013).

Results

Figure 2 displays the standardized results after trimming the insignificant paths from RQ1. The effects of control variables are included in Table 2. The larger prediction model explained 4.4% of the variance in knowledge about COVID-19; proportions of explained variance for other dependent measures were as follows: perceived benefits (2.9%), perceived barriers (5.6%), wearing face masks (10.3%), staying at home (3.0%), and washing hands (10.49%).

Regarding H1, the effect of media risk communication variety on knowledge about COVID-19 was negative and significant ($\beta = -.08$, $p < .05$), and the effect on perceived benefits was not significant ($\beta = .01$). This left H1a and H1b without support. Moreover, the effect of media risk communication variety on perceived barriers was negative and significant ($\beta = -.06$, $p < .10$), leaving H1c with support.

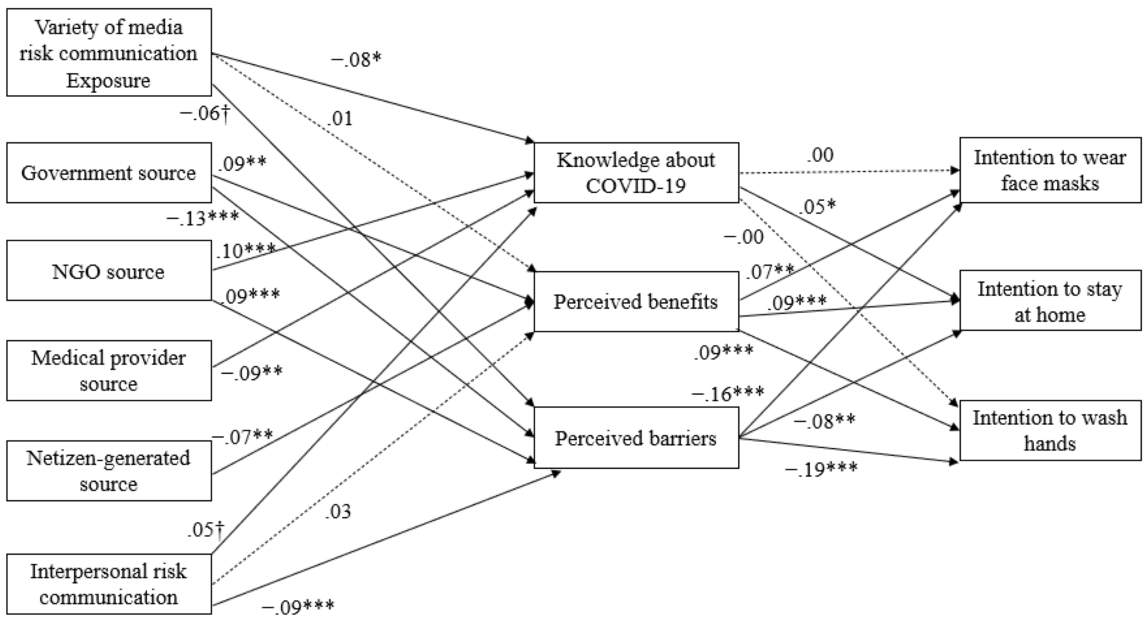

Figure 2. SEM results of hypothetical model.

Note. Age, gender (male), education, and household income were entered as exogenous controls but not displayed here.
†$p < .10$, *$p < .05$, **$p < .01$, ***$p < .001$.

Table 2. Effects of Control Variables on Endogenous Variables in SEM (N = 1,591).

	Age	Education	Household Income	Gender (male)
Knowledge about COVID-19	−.06*	.11***	.02	−.01
Perceived benefits	.00	−.01	.10***	−.02
Perceived barriers	.01	−.02	−.09***	−.04
Intention to wear face masks	.01*	.01	.01***	.01
Intention to stay at home	.00	.00	.00	.02**
Intention to wash hands	.01*	.00	.00	.02**

Note. *$p < .05$, **$p < .01$, ***$p < .001$.

RQ1 examined the effects of different information sources (government, NGO, medical providers, and netizen-generated content) on knowledge about COVID-19, and perceived benefits of and perceived barriers to preventive behaviors. Briefly, SEM results suggest that the following paths were statistically significant: (Government source→ Perceived benefits: $\beta = .09$, $p < .01$; Government source → Perceived barriers: $\beta = -.13$, $p < .001$; NGO source → Knowledge about COVID-19: $\beta = .10$, $p < .10$; NGO source → Perceived barriers: $\beta = .09$, $p < .001$; Medical provider source → Knowledge about COVID-19: $\beta = -.09$, $p < .01$; Netizen-generated source→ Perceived benefits: $\beta = -.07$, $p < .01$). Skipping to H2, the effect of interpersonal risk communication on knowledge about COVID-19 was positive and significant ($\beta = .05$, $p < .10$), supporting H2a. This effect was not significant for perceived benefits of preventative behaviors (β =

.03), leaving H2b without support. However, the effect on perceived barriers was negative and significant ($\beta = -.09$, $p < .001$), supporting H2c.

Regarding H3, we proposed that a variety of media risk communication positively predicted wearing face masks, staying at home, and washing hands via the mediation of knowledge about COVID-19, and perceived benefits of and perceived barriers to preventive behaviors. Results shown in Table 3 reveal that the variety of media risk communication exposure positively predicted wearing face masks and washing hands, which provides support for H3. For H4, interpersonal risk communication positively predicted all three behaviors via the mediation of perceived barriers. Thus, H4 was supported. The results indicated that perceived barriers and perceived benefits played central mediating roles while the mediation via knowledge about COVID-19 was mostly insignificant.

RQ2 queried about the effects of different information sources (government, NGO, medical providers, and netizen-generated content) on preventive behaviors via the mediation of knowledge about COVID-19, perceived benefits, and perceived barriers. Results suggest that government sources positively predicted preventive behaviors, NGO sources yielded mixed results, netizen-generated sources negatively predicted preventive behavior. The effect of medical provider sources was not significant.

Table 3. Indirect Effects of the Variety of Media Risk Communication, Types of Information Sources, and Interpersonal Risk Communication on the Intention to Adopt Preventive Behaviors.

	Paths	Estimates
H3	Variety of media risk communication exposure → Perceived barriers → Intention to wear face masks	.017*
	Variety of media risk communication exposure → Perceived barriers → Intention to wash hands	.017*
RQ2	Government source → Perceived benefits → Intention to wear face masks	.009*
	Government source → Perceived barriers → Intention to wear face masks	.024***
	Government source → Perceived barriers → Intention to wash hands	.025***
	Government source → Perceived benefits → Intention to stay at home	.005*
	Government source → Perceived barriers → Intention to stay at home	.009**
	Government source → Perceived benefits → Intention to wash hands	.008*
	NGO source → Perceived barriers → Intention to wear face masks	−.011**
	NGO source → Knowledge about COVID-19 → Intention to stay at home	.003*
	NGO source → Perceived barriers → Intention to stay at home	−.004*
	Netizen-generated source → Perceived benefits → Intention to wear face masks	−.005*
	Netizen-generated source →Perceived barriers → Intention to wear face masks	−.008*
	Netizen-generated source → Perceived benefits → Intention to stay at home	−.003*
	Netizen-generated source → Perceived benefits → Intention to wash hands	−.004*
	Netizen-generated source →Perceived barriers → Intention to wash hands	−.008*
H4	Interpersonal risk communication→ Perceived barriers → Intention to wear face masks	.020**
	Interpersonal risk communication→ Perceived barriers →Intention to stay at home	.007*
	Interpersonal risk communication→ Perceived barriers →Intention to wash hands	.019**

Note. $^*p < .05$, $^{**}p < .01$, $^{***}p < .001$.

Next, we tested H5's postulation about the moderating role of optimistic bias with moderated mediation SEM models. The results related to H5 are presented in Tables 4–6 (irrelevant coefficients are omitted in these tables). Results indicate that the presence of optimistic bias strengthened the negative link between perceived barriers and face mask wearing ($\beta = .25$, $p < .05$). Such bias also lowered the positive association between knowledge about COVID-19 and face mask wearing ($\beta = -.39$, $p < .10$). Similarly, moderating effects of optimistic bias were found in the links between knowledge about COVID-19 and staying at home ($\beta = -.59$, $p < .01$), between perceived barriers on washing hands ($\beta = .20$, $p < .10$). H5 was thus supported.

Table 4. Standardized OLS Regression Predicting Intention to Wear Face Masks (N = 1,591).

	Model1	Model2	Model3	Model4	Model 5
Main effects					
Optimistic bias (A)	.02	.35†	.03	−.13†	.15
Knowledge about COVID-19 (B)	.00	.22†	.00	.01	.22†
Perceived benefits (C)	.10***	.10***	.10	.09***	.05
Perceived barriers (D)	−.19***	−.19***	−.19***	−.42***	−.43***
Interactions					
A × B		−.39†			−.40†
A × C			−0.01		.08
A × D				.25*	.26*
Controls					
Gender (male)	.02	.02	.02	.02	.02
Household income	.08**	.08**	.08**	.08**	.08**
Education	.03	.03	.03	.04	.04
Age	.08**	.08**	.08**	.08**	.08**
R^2	.08***	.09***	.08***	.09***	.09***

Note. †*p* < .10, **p* < .05, ***p* < .01, ****p* < .001.

Table 5. Standardized OLS Regression Predicting Intention to Stay at Home (N = 1,591).

	Model1	Model2	Model3	Model4	Model5
Main effects					
Optimistic bias (A)	.01	.51**	.14	−.02	.59*
Knowledge about COVID-19 (B)	.06*	.38**	.06*	.06*	.37**
Perceived benefits (C)	.08**	.08***	.20†	.08**	.18
Perceived barriers (D)	−.09***	−.19***	−.09***	−.14	−.12
Interactions					
A×B		−.59**			−.58**
A×C			−0.19		−.16
A×D				.05	.03
Controls					
Gender (male)	.07**	.07**	.07**	.07**	.07**
Household income	.01	.01	.01	.01	.01
Education	.01	.01	.01	.01	.01
Age	.00	.00	−.01	.00	−.00
R^2	.03***	.03***	.03***	.03***	

Note. †*p* < .10, **p* < .05, ***p* < .01, ****p* < .001.

Table 6. Standardized OLS Regression Predicting Intention to Wash Hands (N = 1,591).

	Model1	Model2	Model3	Model4	Model5
Main effects					
Optimistic bias (A)	.07**	.15	.16	−.05	.07
Knowledge about COVID-19 (B)	.00	.05	.00	.00	.05
Perceived benefits (C)	.09***	.09***	.16	.08***	.12
Perceived barriers (D)	−.20***	−.20***	−.20***	−.38***	−.37***
Interactions					
A×B		−.09			−.09
A×C			−0.12		−.06
A×D				.20†	.19†
Controls					
Gender (male)	.06*	.06*	.06*	.06*	.06*
Household income	.00	.00	.00	.00	−.00
Education	−.01	−.01	−.01	−.01	.01
Age	.15***	.15***	.15***	.15***	.15***
R^2	.10***	.10***	.10***	.10***	.10***

Note. †*p* < .10, **p* < .05, ***p* < .01, ****p* < .001.

Discussion

This study investigated the effects of risk communication based on HBM. Perceived severity and perceived susceptibility were central to predicting intention to adopt recommended behaviors in HBM. However, during an outbreak of a novel contagious disease, doubts and uncertainty about its nature pose challenges for individuals to appraise its severity and susceptibility. To better reflect individuals' perceived threat of such a disease, we introduced knowledge about COVID-19 that represented people's understanding of its symptoms, progress, means of transmission, and preventive measures into the HBM framework. Consistent with prior studies in other health contexts (Mehta, Sharma, & Lee, 2014; Oh, Alqahtani, Chang, & Cox, 2021), the current study found that exposure to health communication increased one's knowledge about coronavirus. Moreover, previous studies drawing from HBM had widely tested the effectiveness of health communication via different media platforms (Guidry et al., 2019; Jones et al., 2015; Yoo, Kim, & Lee, 2018), but very few studies have examined the influences of the variety of media exposure, the sources of media information, and interpersonal interactions. This study addressed the influences of diverse media exposure and interpersonal risk communication on the intention to behavioral change, and further explored differential impacts of four types of media information sources. Furthermore, regarding the absence of biased perceptions that strongly influence one's health behavior intention in HBM, we explored the moderating role of optimistic bias. This study expanded HBM in a way that better fits the research of behavioral change in the face of a novel contagious virus.

This research investigated how risk communication via media and interpersonal channels influences one's perceptions of preventive measures and the actual engagement in behavioral change. Given China's success in staunching the growth of COVID-19, now is a particularly critical time to explore how their mitigation efforts worked—and in what contexts—across the variegated channels explored here. Results from a national Chinese sample provided general support for the extended HBM framework. Because of the limited knowledge regarding the virus, the key task of risk communication was to persuade average individuals to wear face masks while going out, stay at home as long as possible to avoid face-to-face contacts, and apply hygiene measures frequently. The findings of this study underscore the value of risk communication in changing individuals' perceptions about the coronavirus and the adoption of preventive measures.

In particular, results of the current study extend past work (e.g., Rimal & Real, 2003), suggesting that being exposed to various media risk communication reduced perceived barriers and increased healthy behaviors (in this case, wearing face masks and washing hands). This influence operated via the mediation of perceived barriers. Unlike previous studies comparing the effects of different media channels (Cho et al., 2013), this study focused on the variety of media to which audiences were exposed. In China, information released on different media channels remains under strict surveillance, such that event updates in multiple channels are similar. The use of various media risk communication is thus likely to improve the audience's perceptions about preventive measures and correct misconceptions about COVID-19.

However, contrary to study expectations, the variety of media risk communication exposure was found to be negatively associated with knowledge about COVID-19. This finding indicated that the speed and variety of information released could potentially perplex individuals about the event. Although research on this virus has developed tremendously because of the accessibility to patient data, the means of viral transmission, the typical symptoms, and potential treatments are ever-changing. Uncertainty over such matters impairs the audience's ability to stay tuned to a given event. Growing challenges in verifying the truthfulness of information—and distrust in the emerging media platforms—are likely to impair the outcome of media risk communication. In the Chinese context, audiences listening to one modality are likely to receive less reliable information than those exposed to various sources. Chinese broadcast outlets tend to be state-run and thus more deferential to government positions than online outlets, which are more privately held (Frost et al., 2019).

Then, we further explored the effects of different information sources about the COVID-19 outbreak. Information released by the government was found to be effective in promoting perceived benefits and lowering perceived barriers, which in turn increased individuals' preventive measures. Exposure to NGO information sources positively predicted knowledge about COVID-19 and indirectly predicted staying at home, but the effect on perceived barriers was contrary to study expectations. These inconsistencies involving perceived barrier effects could be explained by the difference in themes of coverage between government sources and NGO sources. The government information focused on the latest updates and expert views about COVID-19 prevention. In contrast, NGO content focused more on the observations about the shortage of face masks and hand sanitizers, which increased people's concerns about the practicality of preventive measures.

Moreover, the netizen-generated content lowered individuals' adoption of preventive measures, and the information from medical providers negatively predicted knowledge about COVID-19, both of which were contrary to prior studies (Yang, 2017). The results indicate that in China, a country with a strict media censorship system, risk communication conducted by government agencies is most successful in influencing people's adoption of risk-reduction behaviors. The rumors and misinformation generated by Internet users—combined with the Chinese people's long-existing distrust in medical providers—dwarfed the role of hospitals, netizens, and other nonauthoritative sources during the outbreak of this novel pneumonia.

Next, interpersonal risk communication proved to be a strong predictor of changing people's perceptions and behaviors about the disease and engagement in preventive measures. Since late January 2020, the Chinese government has enforced strict controls to suppress the spread of COVID-19. These rather draconian measures include limitations on the frequency of going out or shutting down the service businesses such as restaurants, shopping centers, and parks. As a result, individuals are likely to spend more time staying with family members, which increases the frequency of information exchange about the event. Compared with media content, interpersonal communication is likely to be about the news around the local community, direct contact with medical professionals, and fears about the disease, which might exert greater influence on behavioral change (e.g., Frost et al., 2019).

Moreover, as predicted, the moderating role of optimistic bias between perceptual constructs and actual preventive behaviors was significant. Consistent with prior studies (Cho et al., 2013; Popova & Halpern-Felsher, 2016), this study found that optimistic bias lowered the effect of knowledge about COVID-19 on preventive behaviors and strengthened the negative impact of perceived barriers on behavioral change. In the battle against this novel disease, the self-serving bias is likely to lower people's concerns and increase risky face-to-face contacts.

A better understanding of these biases will be needed in other cultural contexts—particularly as more individualistic Western democracies grapple with the pandemic—and its successive waves. Yong (2020) notes that the United States, in particular, has been ill-served by a sluggish response borne of a particular brand of hubris, hedonism, and exceptionalism that could undermine mitigation efforts in more libertarian societies. The early assumption that the pandemic would not be severe helped escalate the worldwide crisis. Taking the United States as an example, the inconsistencies between such optimistic political messaging and the more sobering assessments of public health officials contributed to an American response that was far worse than many had anticipated (e.g., Noack et al., 2020). As the pandemic continues to diffuse globally, it will be important to craft and assess more uniform messaging as the pandemic (re)emerges over time.

Implications

The present study deepened current understandings about how risk communication changes individuals' behaviors during the outbreak of an acute infectious disease pandemic based on HBM. Past explorations of the HBM have focused on the prevention of more familiar chronic and contagious diseases (Willis, 2018; Yang, 2017). Importantly, this study extends HBM to enhance our understanding of a novel disease with very high uncertainty. Moreover, the current study contributes to the literature by testing variegated risk communication exposure and comparing the effects of different information sources. This study also documented firm support for the moderating role of optimistic bias, which should be incorporated into behavioral change analysis.

Regarding the study's practical implications, findings suggest that the authoritative information released during the disease outbreak should be consistent and timely, as delivered via credible sources. The overwhelming information spread over multiple channels is likely to confuse individuals and lead to counterproductive behavior. Moreover, study findings reinforce the need to incorporate interpersonal communication into a larger program focused on public health education. Finally, as optimistic bias is one of the major barriers to engaging in risk-reduction behaviors, future risk communication programs should consider how to correct such misperceptions.

Limitations

The present study is based on a cross-sectional survey, which limited the capacity to draw causal inferences. Later work should consider collecting data during such outbreaks at multiple time points and using more representative samples. Second, the current study used a single item to represent perceived benefits, which may not fully reflect people's perceptions of preventive measures. Third, knowledge about COVID-19 was measured with five factual statements, but the choice of "don't know yet" was not given. Compared with those who gave wrong answers, if some selected "don't know yet," it may have meant that they were still in the process of learning about relevant issues. Future studies measuring knowledge should provide such choices to the respondents. Fourth, as this investigation uncovered differential effects of different media channels, it will be necessary to explore further successful examples involving traditional and emerging media in changing public behaviors, which can yield practical implications about future risk communication designs. Finally, as studies show, there is plenty of misinformation about COVID-19, and later work should further explore the impacts of rumors and misinformation during a disease outbreak (Yong, 2020).

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