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The Effects of Governmental and Individual Predictors on COVID-19 Protective Behaviors in China: A Path Analysis Model

Covid-19 Viewpoint

Abstract: *The COVID-19 pandemic has plunged the world into a crisis. To contain this crisis, it is essential to build full cooperation between the government and the public. However, it is unclear which governmental and individual factors are determinants and how they interact with protective behaviors against COVID-19. To resolve this issue, this study builds a multiple mediation model. Findings show that government emergency public information such as detailed pandemic information and positive risk communication had greater impact on protective behaviors than rumor refutation and supplies. Moreover, governmental factors may indirectly affect protective behaviors through individual factors such as perceived efficacy, positive emotions, and risk perception. These findings suggest that systematic intervention programs for governmental factors need to be integrated with individual factors to achieve effective prevention and control of COVID-19 among the public.*

The COVID-19 pandemic has plunged the world into a crisis, and its effect on people's physical and mental health, economic development, and social stability cannot be underestimated (van Gelder et al. 2020). China is not only one of the first countries to experience the outbreak of COVID-19 infection but also one of the few that have largely contained it. This cannot be separated from the strict governmental supervision and people's effective protective behaviors (Li, Chen, and Huang 2020). Therefore, drawing on China's experience in pandemic prevention and control can help accelerate the world's progress in defeating the disease.

The Protective Action Decision Model (PADM) was developed to explore people's actions in response to natural hazards and disaster events. According to the PADM, various sources of information cause people's attention, exploration, and comprehension to generate threat perceptions, protective action perceptions, and stakeholder perceptions, prompting them to form decisions about how to take self-protective actions (Lindell 2018; Lindell and Perry 2012). Based on this framework, the current study proposes an information-perception/consideration-action mediation model to elucidate protective behaviors during a pandemic. In this model, government emergency public information is considered to be the source of information, and the individual's emotional and cognitive perception and consideration are

considered to be an extension of perceptions in the PADM model. Additionally, protective behaviors, including preventive behaviors (i.e., wearing masks, disinfectants) (Kim et al. 2015), avoidant behaviors (i.e., stringent quarantine, avoiding public places) (Bayham et al. 2015), and management of disease behaviors (i.e., seeking professional protection or treatment information, paying for preventive and therapeutic drugs) (Hagan, Maguire, and Bopping 2008), are considered to be the actions (Bish and Michie 2010). One important issue that should be explored is how government emergency public information can persuade the public to adopt recommended protective behaviors to control the spread of COVID-19.

Government emergency public information should enhance the public's courage and determination, raise their risk awareness, and prompt people to adopt effective protections to fight the pandemic (Paek et al. 2008). The Chinese government implemented several effective emergency public information measures through detailed pandemic information, positive risk communication, and rumor refutation (Chon and Park 2019; Li, Chen, and Huang 2020; Xu et al. 2020). Detailed pandemic information includes released statistical information, such as confirmed cases, dynamic suspected cases, recovered cases, and deaths, both in accumulative numbers and daily updates, as well as tracked information, including the travel history and trains or flights taken by specific confirmed or suspected patients. During the COVID-19 pandemic, this kind of detailed

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information has become the foundation of current South Korean policy actions to combat COVID-19 (Moon 2020).

Some researchers believe that detailed information can increase people's risk perception and promote protective behaviors (French 2011; Qazi et al. 2020). Positive risk communication conveying positive educational information can result in more appropriate manners (Fewtrell and Bartram 2001). According to the report *China's Fight against COVID-19* (China Daily 2020), the achievements in the fight against the virus and the stories of frontline medical workers and volunteers reported in the mainstream media could inspire people to participate in efforts to control the pandemic. Rumors increase the uncertainty of public information and trigger conspiracy theories and pseudoscientific claims (Dredze, Broniatowski, and Hilyard 2016; Sharma et al. 2017). One important challenge in controlling the Ebola hemorrhagic outbreak was numerous rumors (Lamunu et al. 2004). Timely refutation of rumors can help the government reduce public confusion, reduce perceived risk and panic, build trust, and promote proper protective behaviors (DiFonzo and Bordia 2007; Greenhill and Oppenheim 2017).

In addition, medical supplies during a pandemic are desperately needed (WHO 2015). For example, during the 2014 West Africa Ebola epidemic, evidence suggests that earlier supplies modestly reduced mortality (Walker and Whitty 2015). Efforts to add supplies such as lifesaving medicines and trained clinicians could increase public trust and encourage people to seek clinical care (WHO Ebola Response Team 2014). During this COVID-19 pandemic, the rapid construction of Huoshenshan Hospital made people feel more concerned about the pandemic and feel that they had "warriors" in this battle (Allen 2020).

Perceived efficacy, positive emotions, and risk perception are important individual factors affecting protective behaviors (Prati, Pietrantoni, and Zani 2011). First, perceived efficacy plays a key role in positively predicting protective behaviors (Balkhy et al. 2010; Rubin et al. 2009; Seale et al. 2009). According to the protection-motivation theory (Rippetoe and Rogers 1987), perceived efficacy is made up of self-efficacy and response efficacy. Self-efficacy refers to individuals' confidence in their abilities to carry out protective behaviors, and response efficacy refers to individuals' belief in the effectiveness of protective behaviors in coping with a health threat. People with higher perceived efficacy were more likely to take precautionary behaviors and seek control during the avian influenza pandemic (de Zwart et al. 2010). Conversely, people with low perceived efficacy felt less control and thus did little to change the outcomes of the swine flu pandemic (Lo, Wei, and Herng 2013).

Second, positive emotions play a crucial role in coping with crisis situations (Folkman and Moskowitz 2016; Fredrickson et al. 2003). Individuals who experience gratitude and hope can gain resilience and perceived efficacy to cope with the crisis more effectively (Emmons and Stern 2013; Ong, Edwards, and Bergeman 2006). A study conducted during the H1N1 influenza outbreak showed that these two positive emotions, gratitude and hope, mediated the relationship between crisis responsibility and disease management behaviors (Kim and Niederdeppe 2013). Furthermore, several studies have reported a positive correlation between risk perception

and protective behaviors. Higher risk perception was associated with a higher likelihood of hand washing, personal hygiene, household disinfection, mask wearing, and avoidant behaviors during the H1N1, SARS, and the swine flu epidemics (Jones and Salathe 2009; Lau et al. 2004; Rubin et al. 2009; Wong and Tang 2005). In summary, it is crucial to identify the effects of perceived efficacy, positive emotions (such as gratitude and hope), and risk perception on anti-pandemic behaviors.

Government emergency public information and individual factors are regarded as important contributors to protective behaviors during a pandemic (Chon and Park 2019). However, it remains unclear how these factors interact with each other and whether their interaction has an impact on protective behaviors. Therefore, the current study proposes a model with seven explanatory variables (see figure 1). Detailed pandemic information, positive risk communication, rumor refutation, and supplies are postulated as government emergency public information factors. Perceived efficacy, positive emotions, and risk perception are postulated as individual perception and consideration factors. Based on these hypotheses, this study tests two hypotheses. The first is that government emergency public information will encourage people to comply with protective behaviors directly. The second is that government emergency public information will contribute to protective behaviors by increasing people's perceived efficacy, positive emotions, and perceptions of risk.

Method

Participants and Data Collection

This cross-sectional design research was approved by the Institutional Review Board of the Institute of Psychology, Chinese Academy of Sciences, and followed the Declaration of Helsinki. Data collection was conducted from February 24, 2020, to March 3, 2020. All the participants were recruited online from 33 provinces in China. After reading and signing the informed consent, we asked participants to rate government, personal, and behavior factors for 21 items on a 7-point Likert scale (see table 1). The government factors measured detailed pandemic information (Cronbach's $\alpha = 0.67$) with two items, positive risk communication and rumor refutation with a single item, and supplies (Cronbach's $\alpha = 0.84$) with five items. The personal factors measured perceived efficacy (Cronbach's $\alpha = 0.67$) with four items, positive emotions (Cronbach's $\alpha = 0.84$) with two items, and risk perception with one item. The behavior factors measured protective behaviors (Cronbach's $\alpha = 0.65$) with two preventive behavior items, one avoidant behavior item, and two management of disease behavior items. In the present study, these items were chosen to reflect the main components of these variables in the context of the COVID-19 pandemic, and most of them had good or acceptable reliabilities.

A total of 1,131 participants finished the survey. Data from 1,022 participants (90.4 percent) entered the final statistical analyses after deleting the invalid data, in which participants gave a wrong response to a question used to detect whether they answered the questionnaire carefully. Participants' demographic information is displayed in table 2. Comparison of the sample's demographic characteristics with the corresponding census data suggested that the sample overrepresented youth, higher education population, and students.

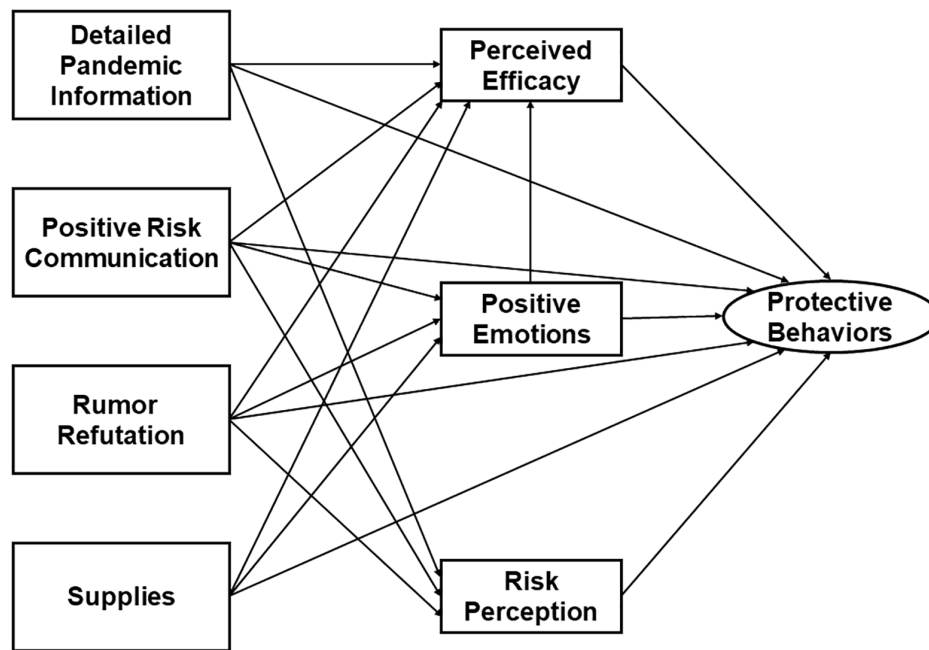


Figure 1 The Hypothesized Model for Predicting Protective Behaviors

Table 1 Survey on COVID-19

Factors	Items
<i>Governmental factors</i>	
Detailed pandemic information	Suspected numbers, infected numbers, critically ill numbers, and death toll in different regions are officially announced every day. 1 (strongly disagree) to 7 (strongly agree)
Positive risk communication	Confirmed patient's recent movements are officially published as soon as possible. 1 (strongly disagree) to 7 (strongly agree) A lot of information about medical staff and supplies brought from other areas to the front line is officially announced. 1 (strongly disagree) to 7 (strongly agree)
Rumor refutation	Fake news is officially refuted in time. 1 (strongly disagree) to 7 (strongly agree)
Supplies	Medical staff are sufficient in your current country or region. 1 (strongly disagree) to 7 (strongly agree) Medical supplies are sufficient in your current country or region. 1 (strongly disagree) to 7 (strongly agree) Living supplies are sufficient in your current country or region. 1 (strongly disagree) to 7 (strongly agree) Mental health support is sufficient in your current country or region. 1 (strongly disagree) to 7 (strongly agree) Patients are treated on time during the pandemic. 1 (strongly disagree) to 7 (strongly agree)
<i>Personal factors</i>	
Perceived efficacy	I believe the pandemic will be fully controlled in the foreseeable future. 1 (strongly disagree) to 7 (strongly agree) I am confident that the pandemic will be overcome. 1 (strongly disagree) to 7 (strongly agree) To cope with the pandemic, I can discriminate between true information and rumors about COVID-19. 1 (strongly disagree) to 7 (strongly agree) To combat the pandemic, I do not post or forward any messages that have not been officially confirmed about COVID-19. 1 (strongly disagree) to 7 (strongly agree)
Positive emotions	In the last 10 days, what intensity of gratitude have you experienced? 1 (very low) to 7 (very high) In the last 10 days, what intensity of hope have you experienced? 1 (very low) to 7 (very high)
Risk perception	In your opinion, how contagious is COVID-19? 1 (very low) to 7 (very high)
<i>Protective behaviors</i>	
Preventive	When I leave my home now, I usually wear a face mask. 1 (strongly disagree) to 7 (strongly agree) When I return home from outside, I disinfect myself with alcohol spray or sanitizer. 1 (strongly disagree) to 7 (strongly agree)
Avoidant	I will not go out until the pandemic is over unless I have to. 1 (strongly disagree) to 7 (strongly agree)
Management of illness	As soon as COVID-19 preventive and treatment medications appear on the market, I will pay for them immediately. 1 (strongly disagree) to 7 (strongly agree) I usually get medical information and prevention measures about COVID-19. 1 (strongly disagree) to 7 (strongly agree)

Data Analysis

Data were analyzed using SPSS version 20.0, Amos version 23.0, and Mplus 7.0. *T*-tests and one-way analyses of variance (ANOVAs) were used to explore whether there were gender, age, and education differences in protective behaviors. Descriptive statistics were used to describe the sample characteristics of each factor. Pearson correlation analyses were performed to examine whether associations

between factors conformed to the prerequisites for path analysis. Path analysis was conducted to test the model. The squared multiple regression correlation coefficient was estimated to identify the variance in protective behaviors that was explained by proposed factors. Bootstrap resampling was employed to test the significance of direct and indirect variable effects (MacKinnon, Lockwood, and Williams 2004).

Results

Impact of Demographic Features on Protective Behaviors

We analyzed how gender, age, and education background impact protective behaviors. A *t*-test showed that gender had a significant effect on protective behaviors, $t(1020) = 5.16, p < .001$. Females showed more protective behaviors ($M \pm SD = 29.69 \pm 3.87$) than males ($M \pm SD = 28.23 \pm 5.18$). One-way ANOVA showed that age had a significant effect on protective behaviors, $F(3, 1,005) = 5.82, p < .001$. A post hoc test indicated that participants from 18 to 25 years ($M \pm SD = 28.49 \pm 4.36$) showed significantly fewer protective behaviors than participants from 46 to 61 years ($M \pm SD = 30.13 \pm 4.73$), $p < .01$. No significant differences were found between other age groups, $p > .05$. One-way ANOVA showed that education background had a significant effect on protective behaviors, $F(3, 1,018) = 4.33, p < .01$. A post hoc test indicated that participants with high school or lower education background ($M \pm SD = 30.08 \pm 4.46$) had significantly more protective behaviors than participants with university bachelor's degree ($M \pm SD = 28.81 \pm 4.69$), $p < .05$. No significant differences were found between other groups, $p > .05$.

Descriptive Statistics and Correlations

Means and standard deviations for the predictors of protective behaviors, as well as the correlation coefficients between them, are displayed in table 3. Only the association between risk

perception and supplies was not significant ($r = .03, p > .05$).

Associations between other factors and protective behaviors reached significance ($p < .05$). Furthermore, all the proposed governmental and individual factors were positively correlated with preventive, avoidant, and management of disease behaviors ($p < .05$). These three protective behaviors were also positively correlated with each other significantly ($p < .05$). Therefore, path analysis could be performed based on the current model.

Mediational Model

The model data fit was evaluated using χ^2 , χ^2/df , root mean square error of approximation (RMSEA), standardized root mean square residual (SRMR), normed fit index (NFI), comparative fit index (CFI), and goodness of fit index (GFI). The RMSEA and SRMR should be less than .08. Regarding NFI, CFI, and GFI, values no less than .90 indicate a good model fit, whereas values above .95 indicate an excellent fit (Cohen et al. 2003). Because protective behaviors may be associated with a variety of demographic factors, the hypothesized model was performed adding gender, age, and education as control variables, which is a common statistics method considering the confounding effects of personal characteristics (e.g., Hew et al. 2018). Results of the initial hypothesized model ($\chi^2 = 336.243$, $\chi^2/df = 7.005$, RMSEA = .077, SRMR = .072, NFI = .867, CFI = .882, GFI = .950) showed that the fit of the model is suboptimal, while there were five nonsignificant pathways for age and protective behaviors ($\beta = -.01, p = .693$), education and protective behaviors ($\beta = -.06, p = .074$), rumor refutation and protective behaviors ($\beta = .06, p = .157$), supplies and protective behaviors ($\beta = .01, p = .815$), and rumor refutation and risk perception ($\beta = .03, p = .374$) in this model. After removing these five pathways, results of the measurement showed that the modified model fit the data excellently ($\chi^2 = 114.423$, $\chi^2/df = 3.814$, RMSEA = .052, SRMR = .036, NFI = .950, CFI = .962, GFI = .980). Pathway coefficients within factors are displayed in figure 2.

Governmental and Individual Predictors of Protective Behaviors

To construct a model with a more reliable confidence interval (CI), this study set bootstrapping at 5,000 as recommended to yield a 95 percent CI (MacKinnon, Lockwood, and Williams 2004). The final model accounted for 39.6 percent of the total variance of protective behaviors. Gender was found to predict protective behaviors significantly negatively ($\beta = -.22, p < .001$), indicating that males adopted fewer protective behaviors than females. Detailed pandemic information (total

Table 2 Demographics of Participants

	Sample Size (N = 1,022)	Percent (%)
Gender		
Male	409	40.0
Female	613	60.0
Age		
18–25	458	44.8
26–35	279	27.3
36–45	152	14.9
46–61	120	11.7
unknown	13	1.3
Education background		
High school or lower	136	13.3
College/technical school	81	7.9
University bachelor's degree	461	45.1
Master's degree or higher	344	33.7
Career background		
Student	470	46.0
Medical staff	53	5.2
Teacher/lawyer/civil servant	181	17.7
Manager/office clerk	140	13.7
Factory worker/agricultural worker	53	5.2
Subcontractor/service employee	31	3.0
Other	94	9.2

Table 3 Means, Standard Deviations, and Correlation Matrix of Predictive Factors

Factors	M ± SD	1	2	3	4	5	6	7	8	9	10
1 Detailed pandemic information	12.44 ± 2.13	1									
2 Positive risk communication	5.87 ± 1.32	.32**	1								
3 Rumor refutation	5.24 ± 1.57	.22**	.41**	1							
4 Supplies	21.27 ± 6.38	.08*	.30**	.41**	1						
5 Perceived efficacy	23.22 ± 3.86	.40**	.45**	.48**	.35**	1					
6 Positive emotions	10.50 ± 2.80	.20**	.37**	.35**	.24**	.44**	1				
7 Risk perception	6.36 ± 1.04	.26**	.17**	.11**	.03	.17*	.19**	1			
8 Preventive behaviors	12.61 ± 1.97	.29**	.31**	.19**	.08**	.27**	.20**	.21**	1		
9 Avoidant behaviors	5.76 ± 1.49	.25**	.38**	.25**	.14**	.24**	.24**	.16**	.42**	1	
10 Management of disease	10.74 ± 2.31	.24**	.28**	.24**	.19**	.29**	.24**	.15**	.48**	.29**	1

* $p < .05$; ** $p < .01$.

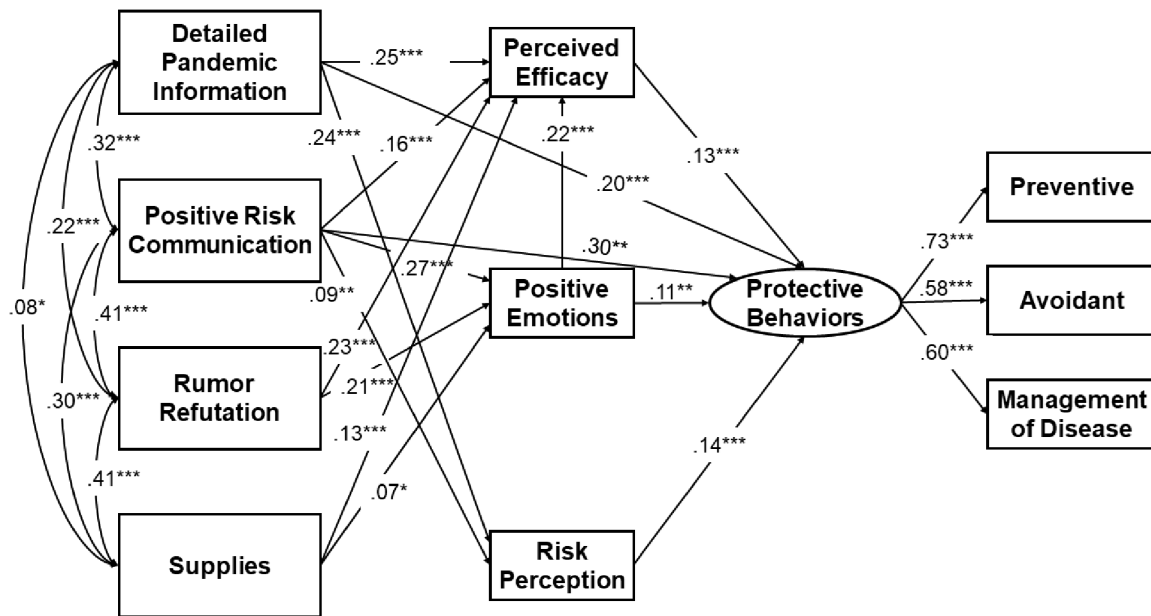


Figure 2 Standardized Estimates of the Predicting Model. * $p < .05$; ** $p < .01$; *** $p < .001$.

Table 4 Total, Direct, and Indirect Effects of Government Emergency Public Information on Protective Behaviors

Effects of Predictors	β	Bias-Correlated 95% CI
1 Detailed pandemic information		
TE	.268***	[.189, .348]
DE	.202***	[.119, .286]
IE	.066***	[.037, .101]
2 Positive risk communication		
TE	.365***	[.276, .455]
DE	.296***	[.201, .394]
IE	.069***	[.039, .104]
3 Rumor refutation		
TE	.058***	[.032, .092]
DE	—	—
IE	.058***	[.032, .092]
4 Supplies		
TE	.027***	[.012, .048]
DE	—	—
IE	.027***	[.012, .048]

Notes: All the estimates provided in the table are standardized estimates. TE = total effect; DE = direct effect; IE = indirect effect; CI = confidence interval.

* $p < .05$; ** $p < .01$; *** $p < .001$.

effect [TE] = .268, $p < .001$) and positive risk communication (TE = .365, $p < .001$) were found to affect protective behaviors more than rumor refutation (TE = .058, $p < .001$) and supplies (TE = .027, $p < .001$). Besides, all governmental factors have significant indirect influences on protective behaviors. Statistical significance was approached by all the direct and indirect effects of government emergency public information on protective behaviors on the grounds of bootstrapping results (table 4).

In addition, to further examine whether the mediating effect was significant, the indirect effects were computed using the bias-corrected bootstrapping method; if the 95 percent CI did not include 0, the mediating effect was significant (MacKinnon, Lockwood, and Williams 2004). Table 5 displays the indirect effects of individual factors. Thus, with the exception of three multiple-

Table 5 Standardized Indirect Effects and 95% Confidence Intervals

Model Pathways	β	Bias-Correlated 95% CI
Detailed pandemic information → perceived efficacy → protective behaviors	.033**	[.010, .056]
Positive risk communication → perceived efficacy → protective behaviors	.021**	[.005, .036]
Rumor refutation → perceived efficacy → protective behaviors	.030**	[.009, .051]
Supplies → perceived efficacy → protective behaviors	.017*	[.003, .032]
Positive risk communication → positive emotions → protective behaviors	.028*	[.005, .052]
Rumor refutation → positive emotions → protective behaviors	.022*	[.002, .042]
Supplies → positive emotions → protective behaviors	.008	[−.002, .017]
Positive risk communication → positive emotions → perceived efficacy → protective behaviors	.008**	[.002, .014]
Rumor refutation → positive emotions → perceived efficacy → protective behaviors	.006**	[.002, .011]
Supplies → positive emotions → perceived efficacy → protective behaviors	.002	[0, .005]
Detailed pandemic information → risk perception → protective behaviors	.033**	[.010, .055]
Positive risk communication → risk perception → protective behaviors	.013	[−.002, .027]

Note: All the estimates provided in the table are standardized estimates.

* $p < .05$; ** $p < .01$; *** $p < .001$.

mediating effects of “Supplies → positive emotions → protective behaviors,” “Supplies → positive emotions → perceived efficacy → protective behaviors,” and “Positive risk communication → risk perception → protective behaviors,” the significant mediating roles of perceived efficacy, positive emotion, and risk perception were confirmed.

Discussion

This study proposed an information-perception/consideration-action framework and used a path analysis model to elucidate the relationship between government emergency public information and individual factors and their impact on protective behaviors during the COVID-19 pandemic in China. The results showed that detailed pandemic information, positive risk communication, rumor refutation, and supplies positively predicted the protective behaviors. Meanwhile, perceived efficacy, positive emotions, and risk perception played a significant role in predicting protective behaviors. This study provides a reliable and instructive framework for governments to cope with the pandemic crisis.

In the final model, age and education background had no significant impacts on protective behaviors, except that males adopted fewer protective behaviors than females. This was consistent with a meta-analysis of the association between gender and protective behaviors (Moran and Del Valle 2016) showing that females were about 50 percent more likely than males to adopt nonpharmaceutical behaviors (e.g., hand washing, face mask use, avoidance of the public). Results suggested that government risk communication should strengthen the protective behaviors of males.

Government emergency public information had a significant positive impact on protective behaviors. First, detailed pandemic information had a significant positive effect on protective behaviors. Consistent with previous research (Kass et al. 2014), when the public was more informed about the reality of the pandemic and what the government was doing about it, people were more likely to follow the government's recommendations. Detailed pandemic information may increase the public's trust in the government and make people more willing to implement recommended protective behaviors (Siegrist and Zingg 2014). On the contrary, people may distrust the government if information is concealed or misreported, which may cause negative or hostile actions (Driedger, Michelle, and Jardine 2018).

Second, positive risk communication showed a strong positive effect on protective behaviors. Information on the transport of medical staff and supplies may reduce the sense of insecurity and strengthen public cohesion, thus encouraging the public to actively participate in controlling the spread of the coronavirus (Stockmann and Gallagher 2011). Third, rumor refutation had a positive impact on protective behaviors. According to previous research (Barrelet et al. 2013), rumors may increase the public's distrust of government (Sharma et al. 2017). Rumor refutation is beneficial and crucial for the government to establish an image of integrity, to dispel conspiracy theories and the public's unnecessary fear, and to promote confidence and protective behaviors against the pandemic (DiFonzo and Bordia 2007; Greenhill and Oppenheim 2017).

Lastly, supplies predict protective behaviors indirectly. The government's efforts to provide supplies may affect the public's perceived efficacy and positive emotions to improve protective behaviors (Allen 2020; WHO Ebola Response Team 2014). Furthermore, detailed pandemic information and positive risk communication were more predictive than rumor refutation and supplies, because the first two variables had both direct and indirect effects, whereas the latter two only had indirect effects. This

indicated that the government's active regulatory policies were more effective in improving people's protective behaviors than actual supplies such as medical treatments and material resources that were powerless to change by the government.

Government emergency public information influenced anti-pandemic behaviors through the mediation of individual factors. First, consistent with previous research (Barnett et al. 2014), this study confirmed the mediating role of perceived efficacy on the relationships between four aspects of government emergency public information and protective behaviors. These government measures could strengthen individuals' protective actions by increasing perceived efficacy, that is, their confidence in defeating the pandemic.

Second, positive emotions, including gratitude and hope, mediated the relationships of positive risk communication and rumor refutation with protective behaviors. The positive risk communication about frontline medical staff risking their lives to rescue patients filled people with gratitude and hope and increased their sense of social responsibility to comply with protective behaviors (Vaughan and Tinker 2009). Rumor refutation may decrease the level of public anxiety in uncertain situations, increase trust in the government, and promote proper anti-pandemic behaviors (Greenhill and Oppenheim 2017). In addition, positive emotions may promote protective behaviors by enhancing individuals' perceived efficacy. An interpretation of this may be that gratitude and hope increases one's resilience to perceive greater control over the crisis and stress (Abolghasemi and Varaniyab 2010; Emmons and Stern 2013; Ong, Edwards, and Bergeman 2006).

Third, risk perception played a mediating role in the prediction of protective behaviors from detailed pandemic information, which is consistent with previous research (Driedger, Michelle, and Jardine 2018; Siegrist and Zingg 2014). In the current study, the government information, including both statistical information on the overall outbreak and detailed information on the trajectory of confirmed cases, promoted individual protective behaviors. Overall, information made individuals aware of the severity of the pandemic, and detailed information strengthened individuals' risk assessments. They both contributed to promote individual protective behaviors. Rumor refutation and supplies did not show significant negative effect on risk perception, possibly indicating that people had not let their guard down about the pandemic.

The current study has several limits and future directions.

First, the sample in the current study is not representative of all demographic categories. A large number of participants were young college students with a bachelor's degree or higher, although age and education had no significant effects on protective behaviors. Thus, the applicability of the findings to other samples needs to be further explored. Second, previous studies have found that people's perceptions of authorities are different across countries and are correlated with their protective actions to pandemic (Wei et al. 2018). All participants in the current study were from China; a cross-country comparative study is needed to expand the applicability of the current findings. Third, Cronbach's alpha coefficients for detailed pandemic information, perceived efficacy,

and protective behaviors have acceptable reliabilities rather than good reliabilities in the present study, which may be caused by the limited number of items or the omission of important items (e.g., hand washing as an important protective behavior item). Future research should adopt questionnaire with more items or adding important items to improve their reliabilities.

Conclusion

To combat the COVID-19 pandemic effectively, governments should take effective measures in combination with governmental and individual factors. First, governments are encouraged to prioritize improving the implementation of detailed pandemic information and the dissemination of positive risk communication to the public and to put forth effort to refute rumors and increase supplies. Second, individuals are encouraged to increase their perceived efficacy, positive emotions, and risk perception through government emergency public information to comply with anti-pandemic behaviors. Lastly, it is highly recommended to intervene public behaviors from both governmental and individual levels to maximize the effect of intervention.

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