The Mechanism of Governments' and Individuals' Influence on Protective Behaviors during the Second Wave of COVID-19: A Multiple Mediation Model

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Research Article

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Abstract

The SARS-CoV-2 virus continues to spread and resurge globally with signs of a second wave, despite actions by governments to curb the COVID-19 pandemic. However, evidence-based strategies to combat COVID-19 recurrence are poorly documented. To reveal how governments and individuals should act to effectively cope with future waves, this study proposed a preventive model of COVID-19 epidemic resurgence. To verify the model, we conducted an online questionnaire survey assessing government intervention, perceived efficacy, positive emotions, posttraumatic growth (PTG) and protective behaviors among 1137 residents in Beijing, where the epidemic reoccurred. Data analysis revealed that during COVID-19 epidemic resurgence, government intervention could directly and indirectly influence protective behaviors through individual factors (i.e., perceived efficacy, positive emotions), and PTG could mediate the indirect pathway to protective behaviors. These findings implied that government intervention needs to be integrated with individual factors to effectively control repeated COVID-19 outbreaks.

Introduction

The ongoing COVID-19 pandemic has led to serious damages and losses globally and caused, by 30 July 2021, a total number of 195,886,929 confirmed cases and 4,189,148 deaths[1]. During the last twelve months, most countries have actively carried out protective measures to contain the outbreak, including masking wearing, staying home, and social distancing[2]. Effective as these measures are, the endemic is not over and even shows a trend of a second wave[3]. For instance, in China, several confirmed positive cases near Xinfadi Market broke the peace in the city of Beijing, followed by Xinjiang Province and Dalian City[4]. Endemics in France and the Netherlands also encountered a more violent resurgence in August 2020 after several months of silence, with the maximum daily confirmed cases surging from 7,500 to 16,068 and from 1,988 to 3,293, respectively[5,6]. Many corners of the world are still suffering sporadic resurgences of COVID-19, which threaten human physical health and well-being. However, in the face of such a recurring disaster, effective defense mechanisms remain unclear and urgently need to be addressed.

Upon the outbreak of COVID-19, to contain its development, we conducted a study concerning the measures of the government and individuals and established a model for curtailing the pandemic[7]. The model suggests that governmental measures, such as providing positive risk communication and refuting rumors, can affect protective behaviors by improving individual perceived efficacy and positive emotions and reducing risk perception. However, this model was proposed in response to the initial COVID-19 outbreak. As COVID-19 is breaking out repeatedly and unpredictably around the world, it is urgent to further explore how the response of the government and individuals to such repeated outbreaks of the COVID-19 epidemic can be normalized with the most effective measures and the most positive attitude, respectively. To this end, we further proposed an Active Interaction of Government and Individual Promoting Preventive Behavior model (AGIB model) to elucidate protective behaviors during COVID-19 epidemic recurrence. In this model, facing repeated outbreaks, the government taking constructive measures as a positive information source may improve individuals' perceived efficacy and positive emotions. According to the posttraumatic growth (PTG) conceptual model of positive outcomes of life crises and transitions[8], individuals' perceived efficacy and positive emotions can influence them to experience positive psychological changes in a series of traumatic events, such as appreciation of life, a sense of increased personal strength and identification of new possibilities; this is termed "posttraumatic growth (PTG)[8]. In addition, the conceptualization of meaning in the context of stress and coping identifies PTG as a coping strategy that can influence people's behavior. Therefore, an important question to be explored is how this government intervention can enhance individuals' perceived efficacy and positive emotions to achieve PTG and then adopt recommended protective behaviors to control the spread of repeated outbreaks of the COVID-19 pandemic.

Positive government intervention can promote people's protective behaviors. Government intervention usually describes actions taken by the government to restrict the severity or spread of the effects of the pandemic, such as the releasing information in a timely manner, providing public opinion guidance and soliciting support from the mainstream media[9,10]. Research on COVID-19 in China revealed that government intervention measures, including providing detailed pandemic information and positive risk communication and mobilizing social forces, government assistance and psychological support, were positively related to the public's adoption of protective actions[7,9]. In contrast, a lack of information transparency can cause an increasing number of confirmed cases[11]. Although a large number of studies have examined the link between government intervention and protective behaviors, there have been few studies on the second and further waves of COVID-19. Faced with the resurgence of COVID-19, it is an urgent problem to understand what strategies the government should adopt to mobilize the enthusiasm of the public to take effective protective action to control the epidemic.

Perceived efficacy plays an important mediating role between government intervention and protective behaviors. First, existing studies indicate that government intervention regulates the public's perceived efficacy. Taking the H1N1 influenza epidemic as an example, the members of the public who approved of governmental policies, including the quarantining of hotel guests, had high self-efficacy[12]. Second, changes in perceived efficacy can promote behavioral adjustment. In an Australian study, those who reported higher self-efficacy and response efficacy were more inclined to comply with avoidance behaviors and practice more hygiene-related behaviors[13]. Whether perceived efficacy can mediate the relationship between government intervention and protective behaviors, especially in the context of repeated outbreaks of COVID-19, still requires further research.

Positive emotions are of great importance for promoting protective behaviors. First, active government intervention helps to improve people's emotional state. During the COVID-19 period, individuals who received disaster relief funds from the government had higher levels of regional belonging and pride[14]. In addition, positive emotions are important predictors of behavioral engagement. It has been demonstrated in Turkish research that dispositional hope significantly and positively predicts protective behaviors[15]. Based on existing findings, we speculate that positive emotions may serve as a mediator between government intervention and protective behaviors, as perceived efficacy does. In the case of repeated outbreaks of epidemics, how to maintain a relatively positive emotional state in individuals regarding the epidemic is a special issue that needs to be considered.

PTG may play a critical role in curbing repeated outbreaks of the pandemic. During the COVID-19 outbreak, the general public could generate a positive mental state despite adversities[16]. This positive mental state, which is defined as PTG, can be affected by individual factors and further promote health behaviors, according to theory. First, existing studies have demonstrated that efficacy and positive emotions are both determinants of PTG. Theoretically, the conceptual model of positive outcomes of life crises and transitions recognizes PTG as an outcome of confronting trauma[8]. The model proposed some predictors of positive outcomes: self-efficacy and positive emotions such as optimism and self-confidence. These factors influence the cognitive appraisal process and coping responses, which, in turn, affect the outcome of the crisis[8]. For instance, Chinese cancer survivors with higher self-efficacy are inclined to show greater PTG[17]. Even during the COVID-19 period, having a higher level of self-efficacy is predictive of a resilient outcome[18]. Additionally, positive emotions, including gratitude, hope and optimism, have a stable and general effect on PTG in the struggle with traumatic events, such as earthquakes and cancer[17,19,20]. Second, PTG is also a pivotal impetus of behavioral engagement according to the conceptualization of meaning in the context of repeated and sustained stress and coping[21]. The theory regards PTG as a coping strategy that can reconstruct beliefs through strategies including finding the benefits of the traumatic event and thereby motivate individuals' behavior[21]. PTG's effect on behaviors is reflected in some empirical studies as well. An 8-year study demonstrated that men who perceived positive changes

from their heart attack made actual behavioral changes that decreased their risk of future heart attacks, suggesting that PTG could affect changes in health behaviors[22]. These theories and studies are enlightening in that PTG probably serves as another mediator between government intervention and protective behaviors, following efficacy and positive emotions. Additionally, they pose an unresolved question that how the prediction effect works under the recurring and global COVID-19 pandemic. Hence, further studies are still required to verify PTG's mediating role.

To solve these problems, we conduct a study attempting to examine the mechanism of governments' and individuals' influence on protective behaviors in the second wave of COVID-19. According to the AGIB model (Fig. 1), which we proposed to curtail COVID-19 in the context of repeated outbreaks, we assume that despite repeated outbreaks of COVID-19, correct guidance from the government and active cooperation from the public will effectively promote protective behaviors. Specifically, hypothesis 1 states that government intervention may positively predict the public's protective behaviors; hypothesis 2 states that perceived efficacy mediates the relationship between government intervention and the public's protective behaviors; hypothesis 3 states that positive emotions mediate the association between government intervention and the public's protective behaviors; hypothesis 4 states that government intervention positively predicts the public's protective behaviors through the chain mediating pathway of perceived efficacy and PTG; and hypothesis 5 states that government intervention positively predicts the public's protective behaviors through the chain mediating pathway of positive emotions and PTG.

Method

Data Collection

This cross-sectional study was conducted from June 25th to 29th, 2020, by issuing an online questionnaire to the public, and a total of 1137 eligible participants living in Beijing completed the survey. The questionnaire started only after the subjects read and signed the informed consent form. The whole questionnaire collects demographic information and information on government intervention, perceived efficacy, positive emotions, PTG and protective behaviors. The demographic characteristics are displayed in Table 1.

Table 1
Demographic characteristics of 1137 participants

Factors	Sample Size (N = 1137)	Percent (%)
Gender		
Female	486	42.7
Male	651	57.3
Age		
18 ~ 25	397	34.9
26 ~ 35	484	42.6
36 ~ 45	229	20.1
46 ~ 59	27	2.4
Marital status		
Married	640	56.3
Other	497	43.7
Educational background		
High school or lower	173	15.2
College/Technical school	269	23.7
University bachelor's degree	552	48.5
Master's degree or higher	143	12.6
Income		
No income	106	9.3
Below 4000	183	16.1
4000 ~ 10000	528	46.4
10001 ~ 20000	253	22.3
Above 20000	67	5.9

Government intervention. Four subscales adapted from a well-established questionnaire were used to measure the public's perception of government intervention[7]. The subscales are rumor refutation ("Rumors are officially refuted in time", "Rumors are convincingly refuted", "Rumormongers are punished seriously"), transparent information ("Suspected cases, infected cases, critically ill cases and the death toll in Beijing are officially announced every day", "Recent movements of confirmed patients in Beijing are officially published in time"), positive communications ("News about the responsibility and professionalism of the workers defending against the pandemic are often published", "The officials often announce that the epidemic trends are improving", "Information about medical staff and supplies coming from Wuhan and other areas to Beijing is often published"), and governmental supplies ("Medical staff, medicine, living sustenance and mental support in Beijing are sufficiently supplied"). These nine items were rated on a 7-point Likert scale (1 = strongly disagree; 7 = strongly agree). The higher the overall score is, the more adequate the government measures are (Cronbach's α = 0.946).

Perceived efficacy. In defining perceived efficacy, we consulted the protection-motivation theory of efficacy[47]. It is recognized that perceived efficacy describes individuals' confidence in their abilities to adopt behaviors and beliefs in the effectiveness of the protective behaviors they adopt; these are termed "self-efficacy" and "response efficacy", respectively. The subscale of self-efficacy is adapted from a widely recognized scale of generalized self-efficacy (GSES)[50]. To elucidate, it includes three items in our study: "I am able to cope with the repeated outbreak calmly", "I have experience in defending against the pandemic in Beijing", and "I am confident in defeating the recurrence of COVID-19". The subscale of response efficacy is established based on previous studies[13,26,27] and includes the items "I believe that my protective behaviors are of great effectiveness", "I adopt protective behaviors as well as others", and "The pandemic will be contained soon if other people comply with protective behaviors as I do." Participants rated their approval of these 6 items from 1 (strongly disagree) to 7 (strongly agree). A high overall score represents stronger perceived efficacy (Cronbach's α = 0.910).

Positive emotions. Being characterized as approach-related, positive emotions was measured with items assessing gratitude, hope, responsibility, confidence, acceptance and adaptation[51]. To avoid memory bias within the long term and interactive effects with negative emotions within the short term[52], we made a compromise and set the time instruction as 10 days. As an example, with the end points defined as 1 = "very low" and 7 = "very high", the item for hope reads, "In the past ten days when repeated outbreaks reoccurred in Beijing, I felt hopeful." A higher overall score on all 6 items suggests that participants are experiencing stronger positive emotions (Cronbach's α = 0.935).

Posttraumatic growth (PTG). PTG level was measured with a modified version of the posttraumatic growth inventory (PTGI), which includes five observed variables: New Possibilities, Relating to Others, Personal Strength, Spiritual Change, and Appreciation of Life [53]. The subjects evaluated these factors on a 7-point Likert scale (1 for strongly disagree and 7 for strongly agree) using the items "I am learning to cope with difficulties from many perspectives", "I cherish my social relationship with others more", "I realize that trust, cooperation and altruism can defeat difficulties", "I am learning to regulate my emotions", and "I realize the significance of a harmonious coexistence between human and nature". Participants with a higher score on this scale are inclined to experience more positive psychological change (Cronbach's α = 0.917).

Protective behaviors. Based on previous studies, the questionnaire includes 6 items rated on a 7-point Likert scale (1 = strongly disagree, 7 = strongly agree), with each subscale (avoidance behavior, precautionary behavior, disease management) containing 2 items to measure compliance with behaviors[7,27,54,55]. Avoidance behavior was assessed by "I will stay at home as much as I can during the pandemic" and "I will avoid trips to relatives and friends". The items for precautionary behavior include "I will wear a mask when going out" and "I will disinfect myself and wash my hands when returning home from the outside". Disease management was measured by "I usually acquaint myself with medical knowledge related to COVID-19" and "I will improve my immune system by exercising, resting and adding nutrition". Individuals with a higher total score for all 6 items were considered to adopt more protective behaviors against COVID-19 (Cronbach's α = 0.904).

Taken together, all the items in the whole questionnaire were created based on previous measurements and theories, exhibiting excellent reliability. Therefore, the questionnaire adequately reflects the relevant variables we need in the context of the COVID-19 pandemic.

Data Analysis

Data analyses were conducted by SPSS version 24.0 and Mplus version 7.4. We used one-way analyses of variance (ANOVAs) to examine the effect of gender, age and other demographic variables on protective behavior adoption. Pearson correlation analyses were performed to verify the associations between factors to facilitate structural equation

model (SEM) analysis. The SEM analysis was conducted in two steps. First, we tested the measurement model to examine whether the observed variables were properly chosen to indicate each of the latent variables. Second, we tested the structural model to evaluate the proposed links between the latent variables. The SEM is evaluated by indexes including χ^2, χ^2/df, Root Mean Square Error of Approximation (RMSEA), comparative fit index (CFI), Tucker-Lewis index (TLI), and Standardized Root Mean Square Residual (SRMR). The RMSEA and SRMR values less than 0.08 are considered indicators of a good model fit. Regarding CFI and TLI, values no less than 0.90 suggest a good model fit, whereas values above 0.95 indicate an excellent fit. In addition, a χ^2/df value less than 5 implies a fair model fit. Given that χ^2/df is problematic with large samples, the adequacy of the model is more dependent on other statistics. In addition, indirect effects were also calculated using bias-corrected bootstrapping (5000 bootstrap samples) with 95% confidence intervals (CIs). When the 95% CI does not include zero, this indicates a significant effect.

Results

Impact of Demographic Features on Protective Behaviors

We analyzed the influence of demographic variables on the adoption of protective behaviors using ANOVA. In detail, gender's effect is significant, $F(1, 1{,}135) = 18.55$, $p < 0.001$. Females (M ± SD = 38.44 ± 4.84) tended to adopt more protective behaviors than males (M ± SD = 37.02 ± 5.99). Age significantly predicts the adoption of protective behaviors, $F(3, 1{,}133) = 4.09$, $p = 0.007$. A post hoc test demonstrated that participants aged 26 to 35 years (M ± SD = 37.99 ± 5.47) and 36 to 45 years (M ± SD = 38.21 ± 4.91) engaged in more protective behaviors than participants aged 18 to 25 years (M ± SD = 36.85 ± 5.93), $p < 0.05$. No significant difference was found between other age groups. Marital status has a significant influence on compliance with protective behaviors, $F(1, 1{,}135) = 19.18$, $p < 0.001$. Participants who were married (M ± SD = 38.26 ± 5.03) showed more protective behaviors than other participants (M ± SD = 36.81 ± 6.10). Educational background was significantly associated with protective behaviors, $F(3, 1{,}133) = 8.02$, $p < 0.001$. A post hoc test indicated that participants at university with a bachelor's degree (M ± SD = 38.30 ± 4.74) were inclined to adopt more protective behaviors than participants in high school or lower (M ± SD = 36 ± 7.43), $p < 0.001$. There were no significant differences between other educational groups. Income was also a significant predictor of protective behaviors, $F(4, 1{,}132) = 4.73$, $p = 0.001$. A post hoc test demonstrated that participants who had an income ranging from 4000 to 10000 RMB (M ± SD = 38.12 ± 5.25) engaged in more protective behaviors than participants with an income below 4000 RMB (M ± SD = 36.36 ± 6.58), $p = 0.008$. Differences between other income groups are not significant.

Correlations for All Variables

Correlations among these factors are displayed in Table 2. The matrix shows that the correlation between any two factors is significant ($p < 0.01$). Specifically, governmental factors are positively associated with individual factors ($p < 0.01$). Both of them relate to the adoption of protective behaviors, including precautionary behaviors, avoidance behaviors and disease management ($p < 0.01$). The three types of protective behaviors are correlated with each other significantly as well ($p < 0.01$).

Table 2
Correlation matrix of the variables

Factors	1	2	3	4	5	6	7	8	9	10	11
1 transparent information	1										
2 rumor refutation	0.80**	1									
3 positive communications	0.81**	0.81**	1								
4 governmental supplies	0.73**	0.72**	0.76**	1							
5 self-efficacy	0.54**	0.58**	0.58**	0.54**	1						
6 response efficacy	0.61**	0.60**	0.62**	0.57**	0.81**	1					
7 positive emotions	0.58**	0.62**	0.64**	0.60**	0.68**	0.70**	1				
8 posttraumatic growth	0.57**	0.58**	0.63**	0.55**	0.69**	0.75**	0.75**	1			
9 avoidance behaviors	0.55**	0.56**	0.58**	0.56**	0.60**	0.66**	0.66**	0.67**	1		
10 precautionary behaviors	0.53**	0.52**	0.56**	0.54**	0.55**	0.63**	0.62**	0.63**	0.78**	1	
11 disease management	0.49**	0.53**	0.55**	0.51**	0.58**	0.61**	0.68**	0.68**	0.70**	0.67**	1

Note: $^{**}p < 0.01$.

Mediational Model

The hypothesized measurement model contains 5 latent variables: government intervention, perceived efficacy, positive emotions, PTG and protective behaviors. Each latent variable is measured by several indicators constructed based on existing theories or subscales. The latent construct of government intervention comprises transparent information, rumor refutation, positive communications and governmental supplies. The observed variable of perceived efficacy uses self-efficacy and response efficacy. Indicators of positive emotions include gratitude, hope, responsibility, confidence, acceptance and adaptation. PTG is measured through new possibilities, relating to others, personal strength, spiritual change, and appreciation of life. Protective behaviors have 3 observed variables: avoidance behaviors, precautionary behaviors and disease management. The results indicated that all the values were within reasonable ranges (χ^2 = 705.654, χ^2/df = 4.410, RMSEA = 0.055, CFI = 0.974, TLI = 0.969, SRMR = 0.026); thus, the statistical analysis revealed a good model fit. Furthermore, we calculated the factor loading of government intervention, perceived efficacy, positive emotions, PTG and protective behaviors. The results show that the factor loading is optimal, with all the values being no less than 0.805, $p < 0.001$.

When evaluating the structural model, we analyzed the significance of the entire AGIB model as well as the significance of the relationships and variance among the multiple factors in the model. According to the fit standards, our model fits well with the empirical data (χ^2 = 848.938, χ^2/df = 3.329, RMSEA = 0.045, CFI = 0.971, TLI = 0.967, SRMR = 0.042). Further, after controlling for the influence of gender, age and other demographic variables, we found that 73.7% of the

variance in protective behaviors could be explained by this model. All the direct and indirect effects on protective behaviors reached significance according to the bootstrapping results. The pathway coefficients within factors are displayed in Fig. 2. First, government intervention has a direct effect on compliance with protective behaviors (β = 0.167, p < 0.001). Second, the total indirect effect in this model is significant (β = 0.527, p < 0.001). The results in Table 3 indicate that government intervention can influence engagement in behaviors through the mediation of perceived efficacy and positive emotions. Moreover, government intervention has an impact on behavior adoption through multiple variables, with PTG mediating these paths. Specifically, government intervention was associated with behavior adoption indirectly through perceived efficacy and PTG successively (β = 0.102, p = 0.01). Government intervention predicts behavioral engagement through the multiple mediators of positive emotions and PTG (β = 0.076, p = 0.003).

Table 3
Standardized indirect effects and 95% confidence intervals

Pathways	β	Bias-Corrected 95% CI
Government intervention → Perceived efficacy → Protective behaviors	0.153**	[0.036, 0.270]
Government intervention → Positive emotions → Protective behaviors	0.196***	[0.098, 0.294]
Government intervention → Perceived efficacy → PTG → Protective behaviors	0.102**	[0.025, 0.180]
Government intervention → Positive emotions → PTG→ Protective behaviors	0.076**	[0.026, 0.125]

Notes: **p < 0.01; ***p < 0.001. CI = Confidence interval; PTG = Posttraumatic growth.

Discussion

This research innovatively investigated the roles of the government and individuals in curbing recurrence, based on which we proposed an AGIB model in response to the resurgence of COVID-19. Specifically, current government interventions are essential to improving individual perceived efficacy and positive emotions for combating repeated outbreaks, which, in turn, stimulate a positive mental state – PTG – and promote protective behavior compliance. These results revealed a sound mechanism to curtail the resurgence of COVID-19 and verified the proposed AGIB model. Practically, we are also enlightened that under unavoidable and repeated disasters, the government is expected to reinforce active guidance and inspire individual potential so that society can cope to the best of its ability.

First, subgroups tend to differ in their engagement in protective behaviors. Compared to groups of male, younger and unmarried, being female, older and married was associated with a higher chance of complying with behaviors during repeated outbreaks, which is consistent with previous research[2,23,24]. This could be ascribed to the higher risks that older females perceive[25], which drives them to engage in more protective behaviors. Married people shoulder heavier family responsibilities than unmarried people and therefore may adopt more behaviors to keep themselves and other family members from being infected. Moreover, those with a bachelor's degree and with an income ranging from 4000 to 10,000 reported more frequent engagement in protective behaviors than subgroups with a higher school or lower education level and an income below 4000 RMB, as previous studies found[26,27]. One possibility is that people with higher education and higher income levels may be more concerned about the potential health and life risks of the epidemic, leading them to engage in more protective behavior. These results suggest that the government ought to intensify measures and formulate specific actions targeting those people in defending the pandemic. Supervising their behaviors closely will facilitate the mitigation of COVID-19.

Second, government intervention can promote protective behaviors in the context of pandemic recurrence. In the current study, we observed that when the government refutes rumors in a timely manner, discloses information on the suspected and infected individuals, conveys positive messages and provides sufficient supplies, protective behaviors are engaged in more frequently by the public, including behaviors such as avoiding trips, washing hands, and gathering medical knowledge. Our result is consistent with previous research, in which government prevention and control and government rescue increased the likelihood of the public adopting recommended actions[9]. Furthermore, another study, which was conducted in eight countries, including the U.S., revealed that government measures were not predictors of behavioral adherence by the public[28]. The reason may partly lie in the optimistic bias of the public, which could undermine individuals' motivation to engage in protective behaviors by decreasing both perceived risk and subsequent affective responses[29].

As the AGIB model suggested, we recommend that the government maintain an active coping position in defending the recurrence of COVID-19. For example, from the very beginning of the pandemic recurrence at Xinfadi Market in Beijing, the government has constantly announced the number of confirmed cases and carried out contact tracing[30], which may increase the government's credibility and make people more willing to adopt protective behaviors[31]. When a false message was spread that nearly 3,000 positive results were linked to Xinfadi Market, the creator and spreader was detained by the police in Beijing to refute the rumor[32]. Actions such as this help the government foster a righteous image, promote confidence in the public, and motivate them to comply with protective behaviors[33]. Additionally, after the suspension of operations at Xinfadi Market, which provides large amounts of food products, six other large wholesale markets across the city moved quickly to increase their vegetable supply, and some cities in Hebei Province have taken steps to increase supplies of agricultural products to Beijing[34,35]. Such measures of ensuring sufficient governmental supplies and engaging in positive communications can encourage members of the public to actively improve their behavior adoption by eliciting positive emotions[36,37], reducing the sense of insecurity and reinforcing public cohesion[38].

Afterwards, in early March and May 2021, a devastating second wave of COVID-19 broke out in Bangladesh and India, respectively, which were overwhelmed by a number of daily confirmed cases twenty times than the previous average[39,40]. The Bangladesh government implemented a nationwide intervention to fight against the second wave and closed public transport, educational institutions and other gathering sites[41]. India received timely support from the WHO and other countries[42]. At present, the situations have improved in these two countries, with the number of new cases gradually decreasing. Under such circumstances, it is advised that the government continue to engage in active interventions, identify and quiet rumors, keep information transparent, keep the public informed of positive messages and offer supplies. In this way, the government can establish a sound image and increase trustworthiness to encourage frequent adherence to protective behaviors so that the resurgence can be contained effectively.

Third, government intervention could predict the adoption of protective behaviors by enhancing perceived efficacy and positive emotions in subsequent waves of the pandemic. According to the stimulus-organism-response model (SOR)[43], external environmental factors and conditions affect emotions and perceptions that drive individuals' behavioral responses. It is indicated that not only governmental factors but also individual factors play an important role in the control of repeated outbreaks.

First, as far as emotions are concerned, people become panicked, anxious and depressive when confronting disasters such as COVID-19[44–46]. As subjects scored higher in these negative emotions, their mental health proved to be seriously damaged. Notwithstanding, active government interventions can mobilize the public's positive emotions, such as hope, gratitude and confidence, which drive them to adopt more protective behaviors. In addition, both self-

efficacy and response efficacy facilitate engagement in more adaptive coping[47]. Believing that one can perform protective behaviors (self-efficacy) can reduce feelings of hopelessness. Believing that the coping response will be effective in protecting them from infection (response efficacy) will strengthen people's intentions to engage in behaviors[47].

Taking the repeated outbreaks in Beijing as an example, under the government measure of imposing a partial lockdown in the vicinity of the infected market, the public demonstrated strong belief in the government and displayed a sense of responsibility toward the collective good. They strengthened the management in residential communities regarding getting people in and out, suspended the operation of gathering places for entertainment and stayed decisively at home in this city[48]. Many residents volunteered to provide assistance to the locked-down communities to help maintain normalcy[49]. Therefore, it is recommended that the public place more emphasis on positive emotions and cultivate their efficacy to the fullest, which is beneficial to both enhancing their mental health and slowing the spread of the pandemic.

Last, government intervention can promote individuals' perceived efficacy and positive emotions to achieve greater PTG, which, in turn, is associated with more behavior adoption in response to the resurgence of COVID-19. This result is consistent with the conceptualization theory of PTG as the outcome of traumas and as a coping strategy. First, as the outcome of struggling with a crisis, PTG is predicted by self-efficacy and positive emotions. Such personal resources can exert their influence on cognitive appraisal and coping responses. Active cognitive-coping processes help people concentrate on the beneficial aspects of the resurgence of COVID-19 by employing strategies such as cognitive redefinition and positive comparisons to emphasize adaptive and favorable values. Especially in situations like this one that are not easily resolved, the cognitive process can not only minimize the traumatic aspects of the pandemic but also bolster individuals' mood and self-esteem and confer PTG[8]. In addition, PTG can serve as a coping strategy influencing individuals' protective behaviors in the recurrent pandemic. With the meaning-making process being completed after the traumatic event, people's behavior is likely to be motivated by perceived positive outcomes in direct relation to damaged and reconstituted beliefs[8]. Since PTG is central to promoting behavioral adherence and fighting the pandemic, it is recommended that individuals promote their posttraumatic growth as they face repeated outbreaks of COVID-19.

Although the research yielded significant progress theoretically and practically, there are still several limitations. First, considering the cross-sectional nature of the study, we are not in a position to empirically establish causal relationships between government intervention and protective behaviors. Thus, a cross-lagged model may be further employed to reveal a clear cause-and-effect conclusion. Second, since the results were obtained at a fixed time point, whether the relationships in the model are still effective in the long run remains questionable. Future research should retest the model and examine its robustness. Third, the results were reached on the basis of a limited sample of subjects living in Beijing. However, given that the COVID-19 pandemic is resurging worldwide, further research is required to ascertain whether the conclusions can help to contain the global pandemic on a wide scale. Accordingly, an international investigation may be needed.

Conclusion

In short, our study tested the mechanism of the promotion of protective behaviors, revealing the integrative role of active governmental and individual factors in the context of COVID-19 recurrence. It provides potential pathways to cope with recurrent events and has significance for theoretical innovation. Practically, this research shows that the unity of the government and individuals in actively responding to repeated outbreaks is an effective strategy for curbing the pandemic and defeating it. In conclusion, governments should devote greater effort to reinforcing rumor

refutation, keeping pandemic information transparent and accurate, conveying positive anti-pandemic messages and supplying sufficient resources to the public. Second, individuals are encouraged to enhance their positive emotions, self-efficacy and PTG, which will facilitate their defense against the pandemic under government guidance.

Declarations

Ethics declarations

This research was approved by the Institutional Review Board of Tianjin Medical University and followed the Declaration of Helsinki. Informed consents were acquired from each participant.

Data availability

The data supporting the research are available from the corresponding author upon request.

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Author contributions

B.D. and Q.L. developed the study concept. G.M. collected the data. B.D. analyzed the data. X.Z. interpreted the data and drafted the manuscript. Y.Z. and K.H. reviewed and edited the manuscript. X.L. supervised the study. All authors have made substantial contributions to the final manuscript, and reviewed it.

Competing interests

No potential conflict of interest was reported by the author(s).

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Figures

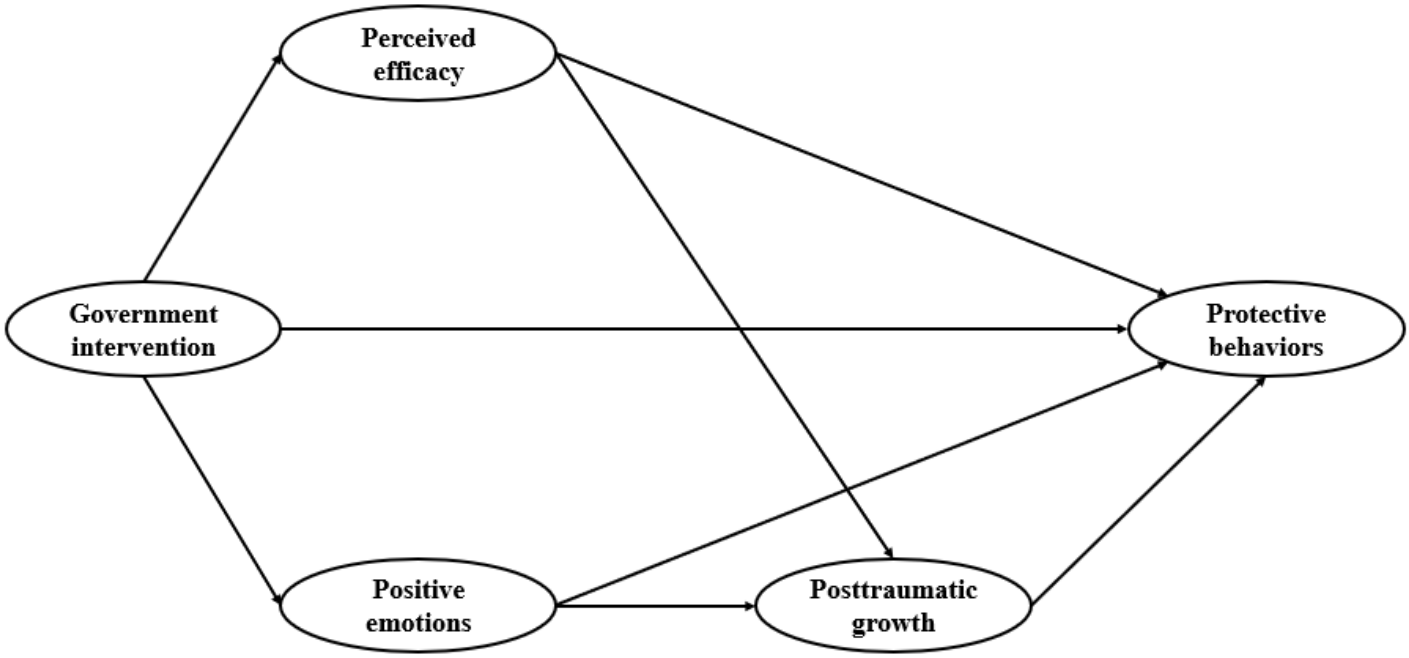

Figure 1

The hypothesized model of Active Interaction of Government and Individual Promoting Preventive Behavior

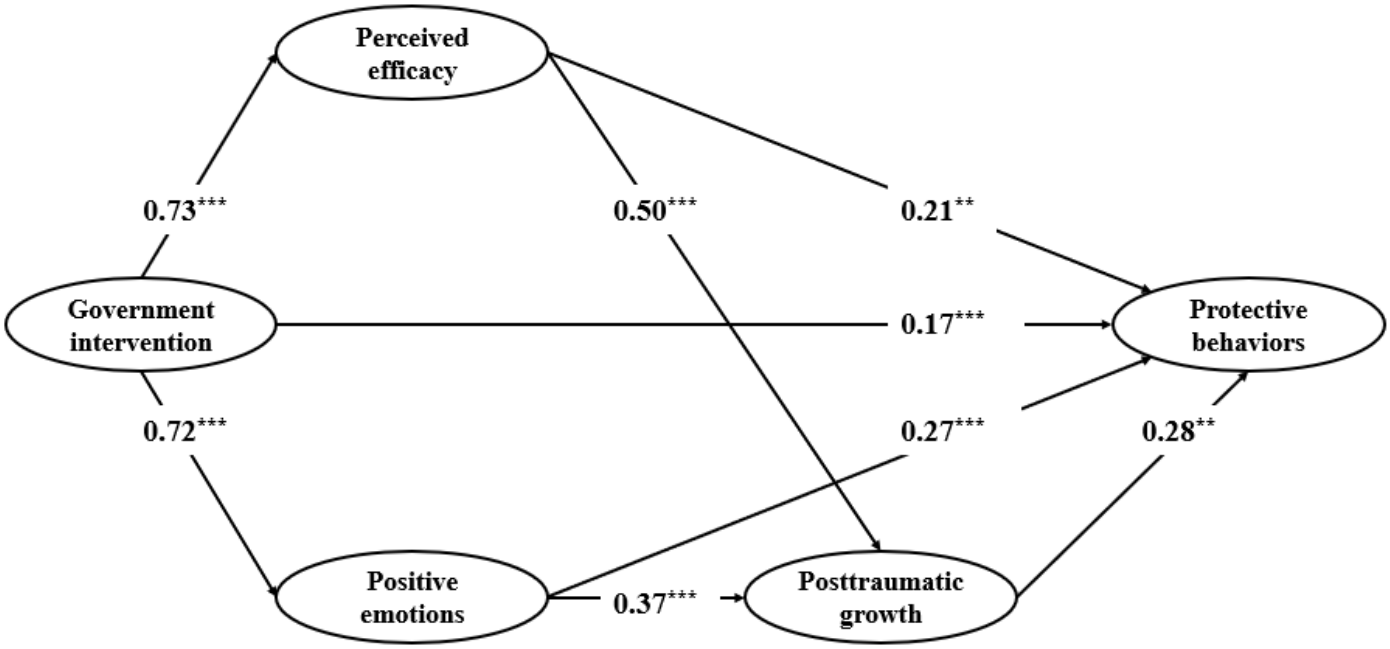

Figure 2

Standardized Estimates of the Predicting Model. **p < 0.01; ***p < 0.001.