



# Exposure to COVID-19 and aggression: the mediating role of anxiety and the moderating role of rumination

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## Abstract

The pandemic of COVID-19 is now posing a worldwide hazard to one's health. Exposure to COVID-19 may cause negative emotions like anxiety, which is one of recognized risk factors for aggressive behaviors. This study looked into the effect of exposure to COVID-19 on aggression and how anxiety may act as a mediating factor, as well as lastly how rumination could moderate a variety of indirect paths during the epidemic of COVID-19. According to the current study's findings, which included a sizable sample of Chinese college students (N=1,518), being exposed to COVID-19 showed a positive connection with aggression and anxiety, as well as rumination. These findings clarify the role that mediators play in the relationship between anxiety and exposure to COVID-19. The results are also helpful for personalizing treatments and putting preventative measures in place to decrease the aggression brought on by exposure to COVID-19. It is explored how lowering rumination and anxiety may be useful in the context of COVID-19 to lessen the psychopathological effects of the condition.

**Keywords** Exposure to COVID-19 · Anxiety · Rumination · Aggression

## Introduction

For more than two years, COVID-19 has compelled a significant section of the world's population to swiftly adopt a new way of life (Peltz et al., 2020). Those impacted by the epidemic have experienced substantial psychological stress as a result (Song, 2020). When confronted with health risks, people have demonstrated predictable threat reactions such as fear, anxiety and aggression, etc. (Shultz et al., 2015).

Among these outcomes, aggression is typically thought of as a motivated behavior that frequently aims to harm, either physically or psychologically, others or oneself (Sadock & Sadock, 2007). Inappropriate management practices, coercion, intimidation, and verbal aggression are a few examples of such activities that may have a detrimental psychological impact on individuals. Aggression can be mainly caused by the combination of internal factors (heredity, personality, mode of thinking as rumination, etc.) and external factors (stimuli from the external environment like exposure to COVID-19, emotional arousal as anxiety, etc.) (Geen, 1990). Although aggression frequently takes the form of deliberate social exclusion of others and can occasionally result in competitive benefits, modern people tend to exhibit maladaptive types of aggression that can have a variety

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of negative social, physical, and psychological effects on victims and their families, as well as offenders; the effects of which should not be underestimated for the individuals involved (Sadock & Sadock, 2007). Given the potential harm of aggression, an exceptional chance to investigate the functions of anxiety and rumination as precursors to aggression in a naturally high-stress social ecology was made possible by the continuing COVID-19 epidemic.

## Exposure to COVID-19 and aggression

Although the government has implemented various isolation measures in the current COVID-19, people may still be at danger of being exposed to COVID-19 (Guo et al., 2020). Exposure to COVID-19 is more like an environmental risk perception, which can be classified as a source of stress not the anxiety itself (Vieira et al., 2022). People may experience this type of tension while thinking about COVID-19 and how it may affect how they view their risk of infection. The accompanying reactions become clearer as the perception becomes stronger (Carlucci et al., 2018). This is also consistent with a large body of existing researches that excessive stress can lead to a range of outcomes (emotional or behavioral) of individuals (not limited to specific groups), such as anxiety, depression or aggression (Wang et al., 2022). According to the general aggressive model (GAM), environmental factors have a considerable effect on the occurrence of aggressive conduct (Anderson & Bushman, 2002). Despite the lack of studies that specifically examined the connection between aggression and exposure to COVID-19, other research has acknowledged the association between trauma exposure and aggression (Mattern & Marshall, 2020), which could provide a theoretical support for predicting the correlation between exposure to COVID-19 (as a certain kind of similar trauma exposure) and aggressive behavior.

## Anxiety as a mediating variable

A negative emotional and motivational condition known as anxiety occurs when there is a threat to one's safety (Eysenck et al., 2007). When individuals perceive threats in the environment, they can automatically trigger their stress response (e.g. anxiety) (Cohen et al., 2007), which would directly affects the formation of their behavioral response pattern (Koolhaas et al., 2011). Drawing from GAM, environmental factor (e.g. exposure to COVID-19) can evoke aggressive behavior through emotional factor (e.g. anxiety). Specifically, individuals in stressful situations breed the possibility of negative emotions (Li et al., 2020), which in turn, alters their behavioural patterns and may even prompt violent conduct (Marsee et al., 2008). The possibility that

anxiety would act as a mediator between environmental factors is feasible, even if this has not been established. (e.g. exposure to COVID-19) and aggression.

Previous studies have tested the relationship between risk exposure and anxiety, finding that individuals at high risk for anxiety are related to the psychosocial effects of risk exposure (Chung et al., 2019). Moreover, those with high levels of anxiety are more prone to exhibit aggressive conduct. Anxiety as an unpleasant experience for most people may be relieved through aggressive behavior (Duan et al., 2014).

## Rumination as a moderating variable

Rumination is referred to as a distress reaction approach that entails repeatedly and passively focusing on distress symptoms as well as the causes and effects of these symptoms (Nolen-Hoeksema, 1991, 2000). According to Response Style Theory, rumination is a technique of coping with unfavorable occurrences that is too focused on thinking, lacks required action, and is harmful to the settlement of genuine problems while also intensifying an individual's circumstance.

Although exposed to COVID-19 provides a crucial factor that allows us to analyze the likelihood of anxiety and aggression. Rumination is inherently a flexible concept along with a way of coping with negative events, may further facilitate negative returns of COVID-19 in increasing anxiety and aggression. For instance, when exposed to COVID-19, individuals with a response style of rumination have difficulty realistically facing problems and are more likely to develop more negative emotions like anxiety, thereby aggravating their aggression.

## The present study

In general, the current study has two goals. First, recent researches looked at the possibility that anxiety might act as a mediating factor in the association between exposure to COVID-19 and aggressive behavior. Second, we investigated the role of rumination in moderating the direct and indirect link between exposure to COVID-19 and aggression via anxiety (Fig. 1). Based on our review of the literature, we propose the moderated mediation model described below.

Figure 1 and our research of the literature led us to propose the following hypotheses in relation to COVID-19:

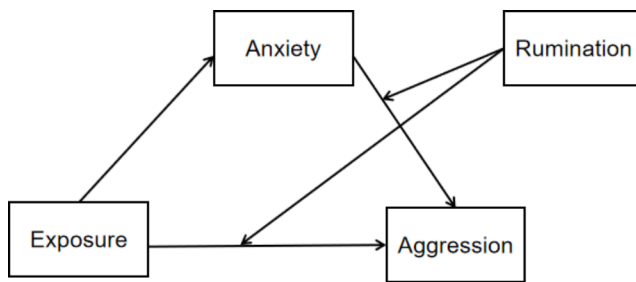


Fig. 1 The suggested moderated mediation model

**Hypothesis 1** Aggression is positively correlated with exposure to COVID-19.

**Hypothesis 2** Aggression and exposure to COVID-19 are positively correlated with anxiety.

**Hypothesis 3** The impact of exposure to COVID-19 on aggression is moderated by anxiety.

**Hypothesis 4** The correlation between exposure to COVID-19 and aggression, as well as the relationship between aggression and anxiety, would be moderated by rumination.

## Method

### Participants

All participants gave their informed consent, and the first author's institution's ethical committee gave the study its approval. From February 1 through February 10, 2021, 1,552 college students from China in total who were randomly chosen from 3 districts in China took part in the survey (i.e., China's Hebei Province had the second small wave of COVID-19). Participants took approximately 20 min to complete an online battery of questionnaires, which was disseminated in the following ways. Prior to creating the QR code images for the web questionnaire, which was prepared on the questionnaire star website. Finally, these QR code images were uploaded to WeChat or QQ groups, and the participants in the groups could answer the questionnaire by scanning the QR code. By excluding with invalid data (i.e., missing values or other errors), 1518 participants were included. Among them, freshmen, sophomores, and seniors account for 69.3%, 13.6% and 17.1%, the average age was 18.34 (SD = 1.52, ages 18 to 24), 63.37% of the participants was female, and 55.73% of those came from rural regions.

## Instruments for research

### Exposure to COVID-19 scale

Since the COVID-19 is a new public health event, the measurement of exposure to COVID-19 needs to be achieved via the self-compiled scale, which consists of three items (e.g., "Worried about being infected by the COVID-19 or not") and includes only one single-dimension index. Each item is scored from 1 (infection has been confirmed) to 4 (no worries),  $\alpha = 0.773$ . Moreover, the scale is one-dimensional with only three items, which is not suitable for confirmatory factor analysis. In order to determine if the common method deviation interfered with the findings, the fitting index of the Harman single factor model was utilized.: KMO = 0.619, Eigenvalues = 2.11 > 1, and the explanation rate of variance after one factor rotation was 70.35%. The scale fit the data well.

### Aggression scale

The Aggression Questionnaire is a self-compiled scale for measuring the aggressive tendency in the past week. This scale is made up of ten items (e.g., "I've threatened people I know") that were scored from 1 (not like me at all) to 5 (almost like me) across two dimensions: aggressive cognition (5 items) and aggressive behavior (5 items),  $\alpha = 0.856$ . The data fit the 2-factor model effectively:  $\chi^2/df = 2.237$ , TLI = 0.881, CFI = 0.910, RMSEA = 0.094, SRMR = 0.063.

### Anxiety scale

A revised version of the Anxiety Questionnaire, with sixteen items (such as "I've been worrying too much about all kinds of things in the past two weeks"), was used to evaluate anxiety in the previous two weeks during COVID-19. (1 = *Never*, 4 = *Always*) across two dimensions: mental anxiety (10 items) and somatic anxiety (6 items),  $\alpha = 0.949$ . The 2-factor model fit the data well:  $\chi^2/df = 2.743$ , TLI = 0.935, CFI = 0.954, RMSEA = 0.082, SRMR = 0.038.

### Rumination scale

The Rumination Questionnaire is also a revised version of Yang (2009) for measuring rumination in the past week, which consists of 6 items (e.g., "The COVID-19 is still in mind in the past week, even if I don't want to") that were scored from 1 (*never*) to 5 (*always*) across two dimensions: rumination thinking intensity (3 items) and repeatability (3 items),  $\alpha = 0.794$ . The 2-factor model fit the data well:  $\chi^2/df = 2.333$ , TLI = 0.929, CFI = 0.962, RMSEA = 0.094, SRMR = 0.037.

**Table 1** Descriptive statistics

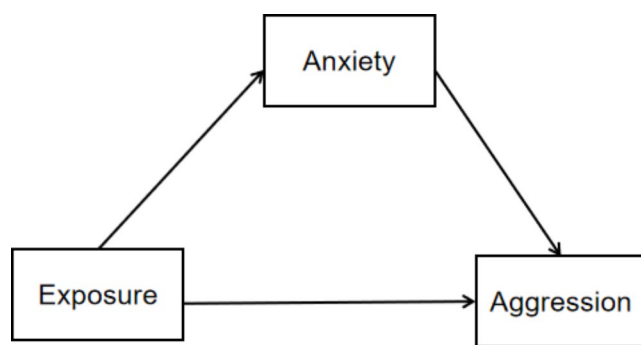
	<i>M</i>	<i>SD</i>	1	2	3	4
1. Rumination	2.29	0.02	-			
2. Anxiety	1.43	0.01	0.39**	-		
3. Exposure to COVID-19	2.00	0.25	0.26**	0.18**		
4. Aggression	1.67	0.14	0.23**	0.47**	0.13**	-

Note: *N* = 1518. \*\**p* < 0.01

**Table 2** Examining with the mediation impact of exposure on aggression

Predictors	Model 1 (Aggression)		Model 2 (Anxiety)		Model 3 (Aggression)	
	$\beta$	<i>t</i>	$\beta$	<i>t</i>	$\beta$	<i>t</i>
Gender	0.02	0.29	0.10	1.86	0.05	-0.64
Exposure	0.13	4.95***	0.18	6.97***	0.44	1.93
Anxiety					0.47	20.21***
<i>R</i> <sup>2</sup>	0.02		0.03		0.22	
<i>F</i>	12.45***		27.07***		146.64***	

Note. *N* = 1518. Gender was dummy coded as 1 = male, 2 = female; \**p* < 0.05, \*\**p* < 0.01, \*\*\**p* < 0.001

**Fig. 2** The structure of Model 4 in this study**Table 3** Examining the effect of moderated mediation

Predictors	Model 1 (Anxiety)		Model 2 (Aggression)	
	$\beta$	<i>t</i>	$\beta$	<i>t</i>
Gender	0.10	1.86	-0.02	-0.50
Exposure to COVID-19	0.18	6.97***	0.02	1.04
Rumination			0.04	1.75
Exposure to COVID-19 × Rumination			-0.01	-0.39
Anxiety			0.52	19.59***
Anxiety × Rumination			-0.14	-6.73***
<i>R</i> <sup>2</sup>	0.03		0.25	
<i>F</i>	27.07***		84.89***	

Note. *N* = 1518. The fake codes for gender were 1 = male and 2 = female.; \**p* < 0.05, \*\**p* < 0.01, \*\*\**p* < 0.001

## Data analysis

According to normality tests, the research variables did not significantly deviate from normalcy (i.e., Skewness [3.0] and Kurtosis [10.0]; Kline, 2005). The first step was to compute descriptive statistics. The PROCESS Models 4 and 15 macro for SPSS was used to evaluate the mediation and moderated mediation models using 5000 random sample bootstrapping confidence intervals (CIs) (Hayes, 2013). Before analysis, each variable was standardised.

## Results

### Preliminary analysis

Table 1 lists the research variables' means, standard deviations, and Pearson correlations. According to the findings, the four variables (exposure to COVID-19, anxiety, anger, and rumination) have a positive correlation with one another.

### Examining the mediating effect of anxiety

In hypothesis 3, we postulate that the association between COVID-19 exposure and violence is mediated by anxiety. Process macro Model 4 puts the claim to the test (Hayes, 2013). Table 2 demonstrates that anxiety and exposure to COVID-19 were positively associated ( $\beta = 0.18$ ,  $t = 6.97$ ,  $p < 0.001$ ), and aggression and anxiety were found to be positively related ( $\beta = 0.47$ ,  $t = 20.21$ ,  $p < 0.001$ ). As a result, hypothesis 1 was validated. Anxiety completely mediates this relationship-exposure and aggression (indirect effect = 0.082, SE = 0.013, 95% CI = [0.057, 0.107]). Figure 2; Table 2 displayed the findings.

### Moderated mediation effect analysis

The SPSS macro process Model 15 was utilized to assess the moderated mediation model (Hayes, 2013). Table 3 displays the results. Rumination and exposure to COVID-19 did not interact to predict aggression, as demonstrated in

Model 1 in Table 3 ( $\beta = -0.009$ ,  $t = -0.39$ ,  $p > 0.05$ ). The product of anxiety and meditation (interaction item) exhibited strong predictive power on aggression ( $\beta = -0.14$ ,  $t = -6.73$ ,  $p < 0.001$ ). We separately plotted anticipated aggression against anxiety for low and high rumination using the information from the previous section (Fig. 3).

Aggression revealed a substantial predictive value, according to a simple slope test. on anxiety of college students with low rumination,  $b_{simple} = 0.66$ ,  $p < 0.001$ . However, aggression showed a substantial predictive value for anxiety in college students with high levels of rumination, but much weaker,  $b_{simple} = 0.38$ ,  $p < 0.001$ . Additionally, Model 2 in Table 3 demonstrated that the interaction between rumination and anxiety had a substantial predictive impact on aggression ( $\beta = -0.14$ ,  $t = -6.73$ ,  $p < 0.001$ ). We separately plotted anticipated aggression against anxiety for low and high levels of rumination for the sake of description (Fig. 3). Rumination did not, however, significantly moderate the link between aggression and exposure to COVID-19.

In the bias-corrected percentile bootstrap analysis, it was discovered that rumination was a moderator of the indirect effect of exposure to COVID-19 on aggression via anxiety. The indirect association between exposure to COVID-19 and aggression in particular for college students with low rumination, was noteworthy,  $b = 0.116$ ,  $SE = 0.195$ , 95% CI = [0.079, 0.156]. For college students with high rumination, the indirect relationship between exposure and aggression was much weaker,  $b = 0.067$ ,  $SE = 0.012$ , 95% CI = [0.045, 0.091]. In conclusion, these findings showed that rumination reduced the anxiety-based indirect correlations between exposure to COVID-19 and aggression. As a result, Hypothesis 4 was only partially supported.

## Discussion

Our results confirmed both the direction and the significance of our assumptions concerning the impacts. The study offered a rare chance to analyze the findings in light

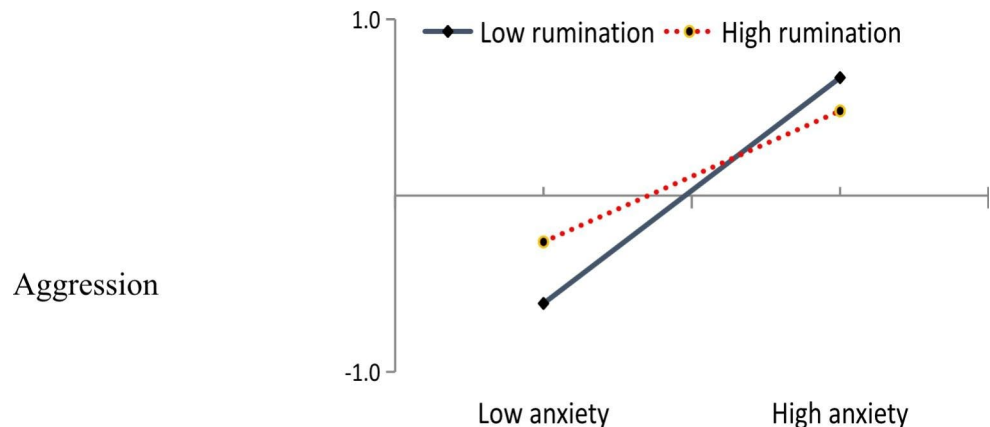
of the continuing epidemic. Consistent with prior findings (Marshall et al., 2018), our results also showed that those exposed to COVID-19 tended to report more anxiety and aggression, furthermore to the anxiety's complete mediation role on the connection between exposure to COVID-19 and aggression. However, on the basis of the differential susceptibility hypothesis (Valkenburg, P. M., & Peter, J., 2013), the risk of aggression is expected to vary based on the individual's unique risk and protective factors. In view of the above, the need to understand the effects of multiple risk factors (e.g., exposure to COVID-19, anxiety, et al.) and protective factors together as opposed to identifying the unique effect of one risk factor in isolation is worth highlighting (Khurana et al., 2019). Furthermore, in terms of the mechanisms that resulted in aggression, the moderating effect of rumination (possibly as a protective factor, which requires further discussion) was reflected in the outcome as well.

## Mediating effect of anxiety

Ecological risk factors are characteristics of the human environment that increase the likelihood of negative developmental outcomes (Brazil, 2022). Psychologists as well as other behavioral scientists have long been interested in the impact of multiple ecological risk factors on the psychological development of adolescents (Chigangaidze, 2021). It is well known that mediating variables (like anxiety "in the current study") are the interpretation mechanism between independent variables and dependent variables (Igartua, J. J., & Hayes, A. F., 2021). This study used multiple ecological risk model (MERM) to explain the mediating process at work, which may help answer the question of how or why multiple risk factors (e.g., exposure to COVID-19 and anxiety) are associated with aggression (Rajkumar et al., 2022). This in turn contributes to more efficient prevention and intervention against aggression during COVID-19.

The initial goal of this study is to illustrate the function of anxiety in mediating the connection between exposure to COVID-19 and aggression. In other words, anxiety is not

**Fig. 3** Interaction between anxiety and rumination on aggression





only the result of exposure to COVID-19 but also the catalyst of aggressive tendency, which is in line with MERM. Notably, the overall impact is substantial although the direct effect of the mediating effect is not, demonstrating that anxiety entirely mediates the association between exposure to COVID-19 and aggression.

Each individual connection in the mediation model is notable, with the exception of the mediation results. When it comes to the initial step of the mediation procedure (i.e., exposure to COVID-19→anxiety), the current study showed that exposure to COVID-19 was significantly associated with higher levels of anxiety, which is consistent with a knock-on effect that the closer the person to the crisis event is, the more pronounced the negative emotional experience of the crisis event (Subhas et al., 2021). Greater health risks and more stress are associated with higher levels of exposure to COVID-19, which reduces one's sense of security and increases uncertainty and anxiety (Zhou et al., 2018). With regard to the mediation model's second step (i.e., anxiety → aggression), according to the findings of this study, anxiety is linked to increased aggression. This result is consistent with the GAM (Anderson & Bushman, 2002), which suggests that the more anxiety, the more aggressive needed to be to alleviate anxiety. Besides, anxiety can lead to an unpleasant physiological arousal that draws more attention to negative information, creating a kind of hostile perception, which encourages potential aggression in ambiguous circumstances (Storm et al., 2019). This is especially true in light of the fact that anxiety and exposure to COVID-19 continue to be powerful, positive predictors of aggression, which is what we found.

### The moderating role of rumination

Although the relationship between multiple ecological risks and individual psychological development has been widely confirmed, there exist substantial differences in individual responses to the same ecological risk (Valido et al., 2022). Moderators can affect the size or direction of the relationship between an independent variable and an outcome variable (Livingston, M. D., & Haardörfer, R., 2019). An important and intriguing question relevant to moderating mechanisms has been raised (Igartua, J. J., & Hayes, A. F., 2021): does an individual's negative psychological quality exacerbate the adverse effects of ecological risk factors (e.g., whether individuals with high rumination in this study have higher levels of aggression and anxiety or not)? It is of great theoretical significance to answer this question accurately, which helps to test the "Organism-Environment Interaction Model" and is directly related to the formulation of social policy and the development of corresponding practical work (Corris, 2020). In other words, when the risk of the environment

is too high, focusing more on improving the environment for growth (e.g., reducing an individual's risk of infection) than only on the psychological qualities of individuals (like rumination, etc.) may be necessary for intervention (Doulcier et al., 2021).

Considering the link between aggression and anxiety, our findings revealed that rumination may act as a moderator. In instance, college students with low rumination have a large association between anxiety and aggression, whereas those with high rumination have a smaller relationship. In other words, rumination increased the chance of anxiety and aggression's negative impacts, but low rumination reinforced these effects more so than high rumination. According to the exclusion hypothesis of the "protective - protective model" (Wang et al., 2018), the exclusion hypothesis of the "risk-risk model," which states that one risk factor lessens the effect of the other on outcome variables, is supported by the finding that rumination reduced the association between anxiety and aggression. People who are anxious are more sensitive to unfavorable information and more likely to act aggressively. (Anderson & Bushman, 2003). For college students with low levels of rumination, they tend to take a cognitive problem-solving approach to facing COVID-19 and its aftermath properly, thereby reducing aggression (Dickson et al., 2017). However, due to the uncontrollability, uncertainty, and long latency of COVID-19, the protective effect of low rumination decreases as anxiety levels increase, leading to more aggression. For individuals with high levels of rumination, their aggressive schema will be activated by constant rumination, resulting in more aggressive behaviors unavoidably. Nevertheless, even those with high levels of anxiety may show a slight upward trend in aggressive behaviors.

In addition, the present study haven't shown that rumination played a moderating role in exposure to COVID-19 on aggression, which may be related to the high transmission speed and mortality of COVID-19 as well as its obvious "Human-to-human transmission" characteristics and a long-term incubation period. This higher uncertainty and uncontrollability pose a greater health threat to survival (Wen et al., 2020). Based on this, individuals with low rumination can adopt active coping strategies to properly face COVID-19 and its adverse outcomes (Conway et al., 2000). Individuals exposed to COVID-19 may face the possibility of mortality to varied degrees due to a lack of prompt and efficient preventative and treatment procedures, which reduces the role of active coping strategies to some extent, thereby weakening the buffering effect of low rumination on the negative effects of exposure to COVID-19. Furthermore, the direct impact of exposure to COVID-19 on aggression was inconsequential, suggesting that exposure to COVID-19 can only be associated with aggression through the mediation

of anxiety rather than the moderation of rumination (Lian et al., 2017).

## Limitations and future directions

In addition, a variety of limitations must be considered when interpreting the results. First, there are limitations to inferring causation from our cross-sectional data. Experimental and long-term research strategies should be used in the future to evaluate our mediation concept. Second, all variables are evaluated using self-report, which may result in response bias and social desirability effects. Therefore, the results should be replicated with other, more comprehensive or even representative samples. Third, the sample used for the current study was made up entirely of Chinese college students, which may have limited its applicability to a broader population and suggested that future studies using different kinds of samples be carried out.

Despite these limitations, the current work makes some theoretical and beneficial advances. Theoretically, this work builds on earlier research and supports the moderating function of rumination as well as the mediating function of anxiety. From a practical point of view, our research can provide some positive intervention suggestions for reducing college students' aggression in this era of COVID-19.

The findings of this study support the Frustrate Aggression Theory and the Scapegoat Theory once again by demonstrating that exposure to COVID-19 has a significant role in affecting people's negative emotions, which in turn enhances their aggressive actions. The negative effects of exposure to COVID-19 on particular emotions (such as anxiety) and behaviors, however, can be greatly mitigated by rumination as a moderating factor (i.e., aggression). These findings suggest that, particularly in a health crisis like COVID-19, rumination, as a cognitive style, has a considerable impact on the psychological route of both "state-behavior" and "state-emotion."

Above all, we need to reduce the infection risk from COVID-19 by formulating sound and scientific defense, thereby alleviating anxiety and controlling aggression. The findings of this study corroborate the scapegoat theory by demonstrating that exposure to COVID-19 plays a significant role in affecting people's negative emotions and that anxiety may work as one of the "bridges" connecting aggression and exposure to COVID-19 (Cason et al., 2016). This conclusion can be explained by the idea that when people are unable to cope with the source of their unfavorable feelings, such as anxiety, they search for a "scapegoat" (i.e., aggression) to whom they can vent their frustrations. Obviously, the current epidemic is not over, and it is not rigorous enough to determine the effectiveness of the response to the

epidemic by simply relieving anxiety. Accordingly, for individuals with high level of rumination, reducing their aggression can be achieved by reducing the level of rumination via the appropriate approaches (e.g., playing games, sweating while exercising, doing housework, etc.). For those with low level of rumination, their aggression can be reduced by managing anxiety via adequate sleep, proper exercise, relaxation training, etc. Because of the pandemic's dynamic character, aggression following a short-term or acute reaction to exposure to COVID-19 may potentially generate interesting results.

## Conclusion

In conclusion, while further replication and promotion are required, this study is a crucial step in determining how exposure to COVID-19 may be associated with aggression among Chinese college students. The findings demonstrated that anxiety may be one mechanism via which exposure to COVID-19 is linked to increased aggression. Relational implications from interaction effects suggest that it may be combined with exposure to COVID-19 to further cause the beginning of anxiety while promoting aggression. The relationship between anxiety and aggression among those with high rumination seems to be weaker than those with low rumination. The development of focused solutions for addressing certain problem areas, such as the COVID-19 epidemic and upcoming issues, can be aided by future study in the field.

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