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The Effect of Intolerance of Uncertainty on State Anxiety in the Regular Epidemic Prevention and Control Phase in the Context of Informatization: A Moderated Chain Mediation Model

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Abstract
The COVID-19 pandemic has led to a generally high level of state anxiety resulting from the high contagiousness of the disease and strict prevention and control policies. The present study mainly focused on the relationship between the individual intolerance of uncertainty and state anxiety in the regular epidemic prevention and control phase in China, and aimed to investigate the mediating role of information overload and rumination, as well as the moderating role of self-compassion. A total of 992 Chinese residents from 31 provinces participated in this study, and completed questionnaires regarding intolerance of uncertainty, information overload, self-compassion, rumination, and state anxiety. Descriptive statistics and correlation analyses, as well as tests for mediating effects and moderated chain mediating effects, were performed on the data using SPSS 26.0 and Process 3.5 macro program. The findings indicated that intolerance of uncertainty significantly predicted individual state anxiety. Information overload mediates the effects of intolerance of uncertainty and state anxiety. Rumination also mediates the effect of uncertainty intolerance on state anxiety. Information overload and rumination have a chain mediation effect on the link between intolerance of uncertainty and state anxiety. Self-compassion mediates the effect of information overload on rumination. The results illuminate theoretical and practical implications in the regular epidemic prevention and control phases and reveal the protective role of self-compassion.

Keywords Regular epidemic prevention and control · Intolerance of uncertainty · State anxiety · Self-compassion · Information overload · Rumination

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Introduction

Since the end of 2019, the novel coronavirus pneumonia (COVID-19) has spread rapidly worldwide. The World Health Organization classified the COVID-19 outbreak as an "international public health emergency." Because of the rapid spread and mutation of the new coronavirus, coupled with its severe clinical symptoms (Alimohamadi et al., 2020) and the subsequent complications and sequelae (Allegrante et al., 2020), there has been a tremendous negative impact on people's health (Chen et al., 2021), which has caused excessive fears and concerns during the epidemic—and these unreasonable fears and concerns have caused damage to individuals' physical and mental health and quality of life (Faisal et al., 2022; Jiang et al., 2022; Paluszek et al., 2021). Since April 2020, the COVID epidemic in China has entered a regular epidemic prevention and control phase (China, 2020): to cope with the chronicity of epidemic prevention and control, raise vigilance of thought, behavior, and institutions, and optimize the security process and emergency plan, the government has transformed emergency measures into sustainable, long-term prevention and control measures, so that epidemic prevention and control can be coordinated with regional economic and social development (Yu & Zheng, 2020). People's lives are affected by regular epidemic prevention and control measures, such as restricting social activities, relying on e-work and e-school, reducing economic activities, and losing jobs and salaries. Once the epidemic outbreak returns, colleges and universities will be closed, residents will be home-quarantined, suspected cases must undergo intensive medical isolation and observation, and the whole city will be on lockdown. Currently the COVID epidemic is in its fourth peak. Most of the new cases in this round are infected with the Omicron mutant strain, which presents a high degree of aggregation, is multi-site, wide, and attacks frequently, and the epidemic becomes more complicated than before (Wu et al., 2022). The uncertainty of the epidemic and the large amount of epidemic and health-related information have brought about an inescapable impact on people's mental health status. This is an important topic of concern in the present study.

Reviewing previous studies, we found that most of the studies on the association between individual tolerance for uncertainty and mental health were conducted from an individual perspective (Rettie & Daniels, 2021; Smith et al., 2020), lacking an information perspective and ignoring the larger context of the "information epidemic"; at the same time, few studies have explored the interaction between information overload and individual traits in the context of the information explosion. According to WHO Director-General Tedros Adhanom Ghebreyesus, the devastating consequences of the COVID-19 pandemic go far beyond the disease itself. Dr. Sylvie Briand, WHO's Director of Global Infectious Disease Preparedness, also noted that the COVID-19 outbreak was accompanied by an outbreak of an "infodemic." This shows that information overload in an epidemic is a cause for concern. Stress coping theory suggests that the effects of stress on individuals are related to coping and cognition (Folkman & Lazarus, 1985). What are the coping and cognitive patterns that result from the information explosion and uncertainty in the epidemic? How does this affect the individual? The present study attempts to answer this question. In addition, the current situation shows that the epidemic is unlikely to disappear in a

short period of time, and that regular epidemic prevention and control will continue for a long time in China. Therefore, in addition to exploring the factors influencing the physical and mental health of individuals during regular epidemic prevention and control, we also wanted to explore the protective factors that can be used as effective coping mechanisms and cognitive models to mitigate the negative effects of uncertainty and information overload during the epidemic in the framework of the stress-coping model. Therefore, this study attempts to explore the effects of intolerance of uncertainty on individuals' state anxiety, to examine the underlying mechanisms of information overload and rumination, to understand the effects of individual traits and informational behavior on their cognition and emotions from an informational perspective, and to provide theoretical guidance and empirical evidence to better help us understand and mitigate the negative effects of the epidemic.

The following are some of the key variables in this study.

Life is full of uncertain events, and some individuals are able to tolerate uncertainty, cope positively with it, and adapt well. Others may feel confused, react negatively, and experience excessive worry, anxiety, or even depression, a phenomenon known as intolerance of uncertainty (Freeston et al., 1994; Zhang & Dai, 2012; Dugas et al., 2004) considered intolerance of uncertainty to be a cognitive bias in the perception, interpretation, and response to uncertain situations or events, which affects individuals' cognitive, emotional, and behavioral responses. The outbreak of the COVID epidemic brings a great deal of uncertainty to all aspects of an individual's life, such as their own health, the epidemic itself, the impact of epidemic prevention and control on their routine, and their future development. Some scholars have pointed out that uncertainty is the defining characteristic of an epidemic (Yoon et al., 2021). Individual tolerance for uncertainty is closely related to worry, anxiety, and depression, which greatly affects psychological health (Freeston et al., 1994; Ladouceur et al., 2000).

Cattell and Scheier (1958) proposed two types of anxiety: trait anxiety, which refers to the overall, stable personality traits of a person, and state anxiety, which refers to the emotional state of an individual that changes when affected by a stressful event. Spielberger (1972) proposed an anxiety activation model by synthesizing previous studies, suggesting that, when an individual perceives a threatening situation, it activates his or her state anxiety. Studies have concluded that what is triggered more in public health emergencies is an immediate anxiety that is influenced by the context; therefore, the present study focused on the state anxiety of individuals in epidemics. Norr et al. (2013) conceptualized the inability to tolerate uncertainty as an important risk factor for anxiety disorders. It is believed that individuals with low uncertainty tolerance have a lower threshold for tolerating uncertain events than the general population, are prone to interpret uncertainty information as threatening, and feel stressed and anxious. Dugas et al. (2007) proposed a cognitive model of anxiety causation, suggesting that an individual's inability to tolerate uncertainty is an important cause of anxiety. Recent studies have found that individuals' tolerance of uncertainty in epidemics is closely related to negative emotional reactions; therefore, individuals who cannot tolerate uncertainty are likely to have higher levels of state anxiety.

The global outbreak of the COVID epidemic has brought about both a public health crisis and an information crisis (Xie et al., 2020). During the epidemic, a large amount of dense, contradictory, and indistinguishable information has had a huge impact on people's lives, including the negative cognitive and psychological effects of information overload on individuals (Liu et al., 2021). An information overload is a state in which an individual's information-processing capacity is insufficient to cope with the huge information processing demands (Eppler & Mengis, 2004). Uncertainty management theory considers uncertainty as discomfort that needs to be reduced (Brashers, 2001), and individuals who cannot tolerate high levels of uncertainty may reduce uncertainty by increasing information acquisition (Peng et al., 2021). One study has shown that to reduce uncertainty, individuals with high uncertainty intolerance tend to gather more certainty cues and information before making decisions than individuals with low uncertainty intolerance (Ladouceur et al., 1997), thus individual intolerance for uncertainty becomes a risk factor for information overload. In addition, the information-seeking and processing model of risk argues that when individuals are in a risk event, because of their uncertainty, individuals actively gather information about the risk event and construct defensive attitudes, beliefs, and behaviors to maintain their health. Therefore, in an epidemic full of uncertainty, individuals who cannot tolerate uncertainty may seek more information related to the epidemic as a way of coping, leading to a higher information overload. Furthermore, the limited capacity theoretical model of motivated-mediated message processing states that an individual is a processor with limited capacity (Lang, 2000), and an overload of information can cause the individual to become stressed (Xu & Yan, 2022; Swar et al., 2017) found that when users searched for health-related information, those who experienced information overload had more pronounced negative emotions such as anxiety and anger. Some researchers have further confirmed that perceived information overload leads to a significant increase in anxiety levels through the stimulus–organism–response theory. From this, we speculate that individuals with high intolerability of uncertainty seek more information, and their information overload is more severe, which eventually leads to more severe state anxiety.

Rumination is a pattern of responses in which individuals repeatedly think about the causes, consequences, and emotions of negative events (Nolenhoeksema, 1991; Watkins & Baracaia, 2001) investigated why people ruminate, and found that, despite its negative effects, many people believe that rumination as a method of coping under stress can improve understanding, promote insight, and enhance problem-solving ability. This suggests that uncertainty may motivate individuals to ruminate because they believe it may minimize ambiguity and uncertainty. It has also been shown that ruminators may feel uncertainty in ambiguous situations, and that these uncertainties may perpetuate ruminant thinking (Ward et al., 2003). This suggests that individuals intolerant of uncertainty are likely to experience more rumination. While rumination is a process of persistent thinking about one's distress, which leads individuals to persistently focus on their problems (Nolen-Hoeksema et al., 2008), when faced with external stimuli that are rife with uncertainty, individuals who employ ruminative coping may persistently think about the causal connection between events and their own negative emotions, making it difficult to alleviate negative emotions and leading to anxiety (Conway et al., 2000). Moreover, the emergence of rumination can over-

load limited cognitive resources, resulting in an inability to appropriately evaluate the current situation and a lack of appropriate emotion regulation. Thus, rumination is likely to mediate the effect of uncertainty intolerance on state anxiety.

Intolerance of uncertainty may cause individuals to seek more information to reduce uncertainty, and individuals will feel stressed when faced with a large amount of information that exceeds their processing capacity (Bawden & Robinson, 2009; Phillips-Wren & Adya, 2020), This may induce rumination by disrupting self-regulation or inhibiting self-control (Baumeister et al., 2006; Inzlicht et al., 2006). Rumination, as a persistent cognition, causes persistent psychophysiological activation and eventually leads to persistent emotional experiences such as anxiety (Brosschot et al., 2006). Nolen-Hoeksema's response style theory also views rumination as a coping style that mediates the relationship between negative stimuli and individual emotions (Nolen-Hoeksema et al., 2008). When individuals are caught in a stressful state of epidemic information overload, they repeatedly focus on their negative state of mind, resulting in a negative interpretation of the present situation with a subsequent increase in helplessness and anxiety. Joormann (2004) also argued that high information intake leads to too much irrelevant information entering the working memory, reducing the individual's extraction of positive information, and amplifying the negative aspects of difficult events and emotional experiences. Thus, individuals with information overload may be more inclined to engage in repeated negative thoughts about distress and situations. It is evident that information overload and rumination may play a chain-mediating role in the effects of uncertainty intolerance on state anxiety.

Self-compassion is conceptualized as an adaptive model in which individuals approach themselves in distress with a friendly, open, and non-isolating attitude (Neff, 2003b). Self-compassion involves three aspects: treating oneself with kindness when times are tough, being consciously aware of distressing emotions and thoughts, and relating personal experiences to the whole human experience (Neff, 2003a). Research has shown that self-compassion is effective in alleviating feelings of stress in high-pressure people (Finlay-Jones et al., 2015), to some extent, can promote individual psychological resilience. This is a healthy view of the self. When individuals face stressful situations, confronting and accepting negative feelings can reduce emotional distress and psychological symptoms (Dou et al., 2023; Homan & Sirois, 2017). Stress-coping theory suggests that the effects of stress are related to an individual's coping ability as well as his or her cognitive schema; moreover, self-compassion, as an adaptive schema, allows individuals to adopt a gentler and more inclusive and adaptive way of coping with problems. Many scholars have argued that information overload brings about an overloaded stress scenario (Bawden & Robinson, 2009), and when individuals are stressed and overwhelmed by the information overload in an epidemic, they are likely to be influenced by self-compassion, reduce overindulgence in ruminative thinking, poor coping pattern, and show less anxiety. Furthermore, according to the emotion regulation model of self-compassion, self-compassion can act as a protective factor to help individuals cope with adverse situations and reduce the occurrence of emotional problems through adaptive emotion regulation strategies, such as practicing self-kindness, positive thinking, and learning to decrease self-criticism.

In this study, we constructed a moderated chain mediation model (Fig. 1) to examine the relationships between intolerance of uncertainty, information overload, rumination, and state anxiety in the context of regular epidemic prevention and control and the information era in China. Correlation analyses were used to initially examine the associations among the variables for the next step of the study. Chain mediated effects analysis was used to examine whether information overload and rumination mediated the effect of intolerance of uncertainty on state anxiety. A moderated chain-mediation analysis test was used to examine whether self-compassion affected the mediating effect of information overload and rumination.

The following hypotheses are proposed:

♣ **Hypothesis 1** ♣ Intolerance of uncertainty positively predicts individual state anxiety levels.

♣ **Hypothesis 2** ♣ Information overload mediates the effect of intolerance of uncertainty on state anxiety.

♣ **Hypothesis 3** ♣ Rumination mediates the effect of intolerance of uncertainty on state anxiety.

♣ **Hypothesis 4** ♣ Information overload and rumination play a chain-mediating role in the effect of uncertainty intolerance on state anxiety.

♣ **Hypothesis 5** ♣ Self-compassion moderates the effect of information overload on rumination.

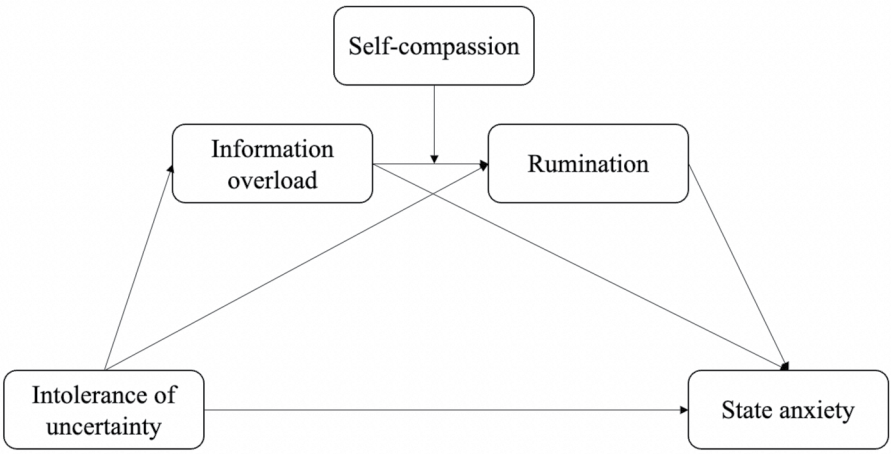

Fig. 1 Proposed Model

Method

Participants

The study was approved by the ethics committee of the university where it was conducted, and 1,086 questionnaires were distributed using a convenience sampling method, recruiting subjects from 31 provinces across China. Ninety-three invalid (inattentive responses, missed responses, and repeated responses) questionnaires were excluded, and one subject was removed as an extremum according to the recommendation of Tabachnick and Fidell (1984) because of a standardized score higher than 3.29 in one measure. The final number of valid questionnaires was 992, with an effective response rate of 91.34%. There were 492 males (49.60%) and 500 females (50.40%) aged 18–63 years (M = 25.67; SD = 6.22). At the time of data collection in this study, the country was in the phase of regular epidemic prevention and control, and the epidemic was generally stable, but there were occasional small outbreaks, and there was still a risk of large-scale outbreaks. Among the subjects in this study, 29 (2.93%) were diagnosed with a newly corona-positive infection. A total of 149 participants (15.02%) lived in neighborhoods or villages with infected persons; 78 subjects (7.86%) had relatives or friends who were infected or in close contact. A total of 177 participants (17.84%) had experienced isolation (there are two types of isolation in China: centralized isolation in special places, such as isolation hotels and mobile field hospitals, during which meals and nucleic acid tests are delivered daily by epidemic prevention staff. The second is home isolation, where one not allowed to leave home under community residents' committee management). A total of 913 subjects (92.03%) completed all stages of vaccination.

In addition, this study used a multiple-choice format to ask participants to report the medium they commonly used to obtain information about the outbreak. A total of 894 participants (90.10%) reported that Internet is their usual medium of information. A total of 629 subjects (63.40%) reported that television programs were common media; 595 subjects (60.00%) reported that they often obtained information about the epidemic from friends and colleagues, and 536 subjects (54.00%) said that their family members were an important way to obtain information.

Measures

Intolerance of Uncertainty Scale

The intolerance of uncertainty scale was used to measure the degree to which individuals tolerate uncertain events (Zhang et al., 2017). There are 12 items in the scale, such as "Unpredictable events make me upset" and "Uncertainty prevents me from having a fulfilling life," on a five-point Likert scale ranging from 1 ("not at all)" to 5 ("completely)." The higher the total score, the more intolerant of uncertainty the individual was. The scale is applicable to all age groups in China and has good reliability (Lv et al., 2019), the internal consistency in the current study was 0.87.

State Anxiety Inventory

The state anxiety inventory (SAI) developed by Spielberger (1983) and revised by Wang et al. (1999), was used to assess the level of state anxiety in individuals. There were 20 items on the scale, such as "I am extremely nervous and anxious" and "I feel panicked." A four-point Likert scale was used, ranging from 1 (for "not at all") to 4 (for "very obvious"). The higher the total score, the higher was the level of state anxiety. Items 1, 2, 5, 8, 10, 11, 15, 16, 19, and 20 are reverse scored. This scale is applicable to all age groups in China, and has good reliability; the validity (Li & Wu, 2016) in the present study was 0.94.

Information Overload Scale

The information overload scale developed by Yang et al. (2021) was used to measure the information overload of individuals during this stage of the epidemic. There are seven items on the scale, such as "Do you feel that you have received more information than you can handle about this event at one time?" and "Do you feel the need to keep refreshing or searching for information related to this issue?" A five-point Likert scale was used, ranging from 1 ("never") to 5 ("always"). The higher the total score, the higher the severity of information overload. The scale is applicable to all age groups in China and has good reliability (Xu & Yan, 2022), with an internal consistency of 0.84 in the current study.

Rumination Scale

The rumination scale developed by Han and Yang (2009) was used to assess the extent to which individuals think compulsively and repeatedly. The scale has 22 items, such as "I often think about why I am so upset" and "I often think about why I can't do things better." A five-point Likert scale was used, ranging from 1 ("never") to 4 for ("always"). The higher the total score, the more pronounced the ruminative thinking. The scale is applicable to all age groups in China and has good reliability (Zhao & Liu, 2021), and the internal consistency in this study was 0.95.

Self-Compassion Scale

The self-compassion scale developed by Hu (2013) was used to measure the extent to which individuals understood and accepted their suffering. There are 12 items on the scale, such as "When things get bad, I can understand that frustration is part of the life experience" and "When something painful happens, I try to look at it objectively." A five-point Likert scale was used, ranging from 1 ("not at all") to 5 for ("completely"). Higher scores indicate that individuals were more comfortable and soothed themselves from negative emotional experiences. Items 2, 3, 4, 8, and 11 are reverse-scored. The scale is applicable to all age groups in China and has good reliability (Gong et al., 2014), The internal consistency in this study was 0.71.

Data Analysis

SPSS 26.0 and PROCESS macro 3.5 programs were used to perform descriptive statistical analysis, correlation analysis, and a moderated chained-mediated effects test on the data.

Results

Common Method Bias

Because the results may be affected by common method bias when data are collected using self-reported methods, the Harman one-way test was used to test for common method bias (Podsakoff et al., 2003), and a total of 11 common factors with eigenvalues greater than 1 were obtained without rotation. The first common factor had an explanation rate of 28.46%, which was much lower than 40%, indicating that there was no serious common method bias in this study.

Descriptive Statistics and Correlation of Main Variables

Table 1 shows the results of descriptive statistics and correlation analyses for each variable. Uncertainty intolerance was significantly and positively correlated with information overload, rumination, and state anxiety. Information overload is significantly and positively correlated with state anxiety. Rumination was significantly positively correlated with state anxiety. Therefore, Hypothesis 1 was supported.

A further test of variance revealed that 29 subjects in this study had been diagnosed as COVID-19 positive within the last three months, and their level of state anxiety was significantly higher than the other subjects ($t=5.23$, $p<0.001$); 177 subjects had experienced home or intensive isolation within the last three months due to epidemic prevention requirements. Their state anxiety was significantly higher than that of the remaining 815 participants ($t=6.39$, $p<0.001$). A total of 149 subjects had a confirmed case in their neighborhood, and their state anxiety was significantly higher than that of the remaining 843 subjects ($t=6.34$, $p<0.001$). There were 78 subjects whose relatives or friends were diagnosed with COVID or close contacts in the last three months, and their state anxiety was significantly higher than that of the remaining 914 subjects ($t=4.46$, $p<0.001$).

Table 1 Descriptive statistics and correlations among main variables (N=992)

Variable	*M*	*SD*	*1*	*2*	*3*	*4*
1 Intolerance of uncertainty	38.03	8.47	—			
2 Information overload	17.12	5.27	0.51**	—		
3 Rumination	47.94	13.70	0.50**	0.72**	—	
4 State anxiety	38.46	12.31	0.29**	0.44**	0.52**	—
5 Self-Compassion	40.68	6.01	-0.36**	-0.42	-0.50**	-0.55***

**$p<0.01$, ***$p<0.001$, *M*: Mean value, *SD*: Standard deviation

In this study, 913 participants who completed the COVID-19 vaccination had significantly lower rumination than the remaining 79 (t = -3.33, p<0.001), and they also had significantly lower levels of state anxiety than the other participants (t = -4.39, p<0.001). In addition, the analysis showed significant differences in the level of self-compassion among individuals of different sexes (t = -2.32, p<0.05), and age had a significant effect on state anxiety (F34, 957=2.13, p<0.001). Considering the effect of these variables on the study variables, they were included in the model as control variables in subsequent analysis.

Mediation Model

Model 6 in the process macro program developed by Hayes was used to test the mediating role of information overload and rumination between intolerance of uncertainty and state anxiety (Hayes, 2017). The effects of sex, age, experience of infection, experience of isolation, whether someone around a residence is infected, whether someone in the family or friends is infected, and whether vaccination is completed were considered for the study variables. Therefore, sex, age, infection experience, isolation experience, presence of confirmed cases around residence, presence of confirmed cases in family and friends, and vaccination (a total of seven variables) were included in the model as control variables.

The results of the study showed (Table 2) that intolerance of uncertainty significantly and positively predicted state anxiety (β=0.30, p<0.001). After including information overload and rumination in the model, intolerance of uncertainty sig-

Table 2 Regression results for testing moderated mediation with information overload and rumination as mediators (N=992)

Regression equation		Overall fit indices			Significance of regression coefficients		
Result Variables	Predictive variables	R	R^2	F	β	*95%CI*	t
State anxiety	Intolerance of uncertainty	0.41	0.17	24.52***	0.30	[0.25,0.36]	10.32***
Information overload	Intolerance of uncertainty	0.52	0.27	44.78***	0.49	[0.44,0.55]	18.47***
Rumination	Intolerance of uncertainty	0.75	0.56	138.52***	0.17	[0.13,0.22]	7.26***
	Information overload				0.62	[0.58,0.67]	25.02***
State anxiety	Intolerance of uncertainty	0.59	0.35	52.49***	0.04	[-0.02,0.09]	1.22
	Information overload				0.10	[0.02,0.18]	2.61***
	Rumination				0.44	[0.36,0.52]	11.15***

***p<0.01, ***p<0.001. R^2: Coefficient of Determination, β:Regression coefficient, 95% CI refer to lower and upper 95% confidence intervals of the indirect effects estimated by the bias-corrected percentile Bootstrap method, respectively. Gender, age, infection experience, isolation experience, presence of confirmed cases around residence, presence of confirmed cases in family and friends, and vaccination were included in the model as control variables. All variables were standardized except for demographic variables.*

nificantly and positively predicted both information overload ($\beta=0.49$, $p<0.001$) and rumination ($\beta=0.17$, $p<0.001$). Moreover, information overload significantly and positively predicted rumination ($\beta=0.62$, $p<0.001$) and state anxiety ($\beta=0.10$, $p<0.001$). Rumination significantly and positively predicted state anxiety ($\beta=0.44$, $p<0.001$). At this point, intolerance of uncertainty was not a significant predictor of state anxiety ($\beta=0.04$, $p=0.2$).

The results of the mediation effect analysis (Table 3) showed that the value of the mediation effect of information overload was 0.05, that of the mediation effect of rumination was 0.08, and that of the chain mediation effect of information overload and rumination was 0.14. The bootstrap 95% confidence intervals for all three mediation paths did not contain zero, and all three mediation effects reached a significant level, accounting for total effects of 16.67%, 26.67%, and 46.67%, respectively. Therefore, Hypotheses 2, 3, and 4 were supported.

Moderated Chain Mediation Model

To explore the moderating effect of self-compassion, Model 91 of the process macro program developed by Hayes was used (Hayes, 2017). The results (Table 4) showed that after controlling for variables such as age and sex, information overload was a significant predictor of rumination ($\beta=0.54$, $p<0.001$), and the interaction between information overload and self-compassion was a significant predictor of rumination ($\beta=-0.07$, $p<0.01$). This finding suggests that self-compassion moderates the effect of information overload on rumination. Therefore, Hypothesis 5 is supported.

To better illustrate the moderating effect of self-compassion, we conducted a simple slope analysis. Figure 2 shows that for participants with low self-compassion ($M-SD$), information overload significantly and positively predicted rumination (*simple slope*$=0.61$, $p<0.001$), while for participants with high self-compassion ($M+SD$), information overload also significantly and positively predicted rumination, but its predictive effect was smaller (*simple slope*$=0.48$, $p<0.001$). This finding suggests that the effect of information overload on rumination decreases significantly as individual self-compassion increases.

Table 3 Mediating Effect Analysis of the Chain mediating Model

	B	*SE*	95%*CI*
Total effect	0.30	0.03	[0.25, 0.36]
Direct effect	0.03	0.03	[-0.02, 0.10]
Path1 Intolerance of uncertainty→ Information overload → State anxiety	0.05	0.02	[0.01, 0.09]
Path2 Intolerance of uncertainty→ Rumination→ State anxiety	0.08	0.01	[0.05, 0.10]
Path3 Intolerance of uncertainty→ Information overload → Rumination→ State anxiety	0.14	0.02	[0.10, 0.17]

B: Effect size. SE and 95% CI refer to the standard errors, lower and upper 95% confidence intervals of the indirect effects estimated by the bias-corrected percentile Bootstrap method, respectively.

Table 4 Regression results for testing a moderated chain mediation model (N = 992)

Regression equation		Overall fit indices			Significance of regression coefficients		
Result Variables	Predictive variables	*R*	R^2	*F*	*β*	*95%CI*	*t*
Information overload	Intolerance of uncertainty	0.52	0.27	44.78^{***}	0.49	[0.44,0.55]	18.47^{***}
Rumination	Intolerance of uncertainty	0.77	0.60	133.25^{***}	0.13	[0.08,0.18]	5.60^{***}
	Information overload				0.54	[0.49,0.59]	21.16^{***}
	self-compassion				-0.24	[-0.28,-0.19]	-9.87^{***}
	Information overload * self-compassion				-0.07	[-0.10,-0.02]	-3.00^{**}
State anxiety	Intolerance of uncertainty	0.59	0.35	52.49^{***}	0.04	[-0.02,0.10]	1.22
	Information overload				0.10	[0.03,0.18]	2.61^{**}
	Rumination				0.44	[0.36,0.52]	11.15^{***}

$^{**}p<0.01$, $^{***}p<0.001$. R^2: Coefficient of Determination, β:Regression coefficient, 95% CI refer to lower and upper 95% confidence intervals of the indirect effects estimated by the bias-corrected percentile Bootstrap method, respectively. Gender, age, infection experience, isolation experience, presence of confirmed cases around residence, presence of confirmed cases in family and friends, and vaccination were included in the model as control variables. All variables were standardized except for demographic variables.

Discussion

This study explores the negative effects of epidemics and protective factors on individuals in the context of regular epidemic prevention and control and the information era in China within the framework of the stress and coping model. Based on phenomenological observations and existing research, this study focused on the variables of intolerance of uncertainty, state anxiety, information overload, rumination, self-compassion, and the relationships among them. The results showed that intolerance of uncertainty significantly predicted state anxiety. Information overload and rumination play a chain-mediating role between intolerance of uncertainty and state anxiety. Self-compassion moderated the relationship between information overload and rumination.

China is in a period of regular epidemic prevention and control, and although the overall morbidity and mortality of COVID-19 in China are relatively low (Tan et al., 2021), the threat of the epidemic remains severe. At present, new cases in China are mainly caused by the Omicron mutant strain, and new cases and asymptomatic infected patients show aggregation, multiple sites, and extensive and frequent occurrence; and as epidemic prevention and control becomes more complex and acute than before and full of uncertainty (Wu et al., 2022). In addition, to stop the spread of the virus, the Chinese government requires maximum early detection, diagnosis, isolation, and treatment. People who have been in close contact with infected persons (and with those in close contact with them) are required to be centrally isolated, and the neighborhoods or buildings where infected persons or close contacts live are sealed and access is restricted. Thus, determining whether one is infected with the virus, has been in contact with an infected person, or an infected person is found in the community where one lives brings a great deal of uncertainty to one's life. In addition, during the current epidemic in Shanghai, for example, many communities are experiencing a shortage of supplies and medical resources, and many small businesses have gone out of business and closed down due to the epidemic (Chen, 2022). The uncertainty of the disease situation and concerns about the impact of the epidemic and prevention and control measures on normal life, work, and future development have affected the mental health of individuals in the epidemic.

Intolerance of Uncertainty and State Anxiety

This study found that intolerance of uncertainty significantly predicted the level of state anxiety; in other words, the more intolerant of uncertainty individuals were, the higher their level of state anxiety was. This is consistent with previous studies, and further supports the cognitive model of anxiety causation. An individual's inability to tolerate uncertainty is an important cause of their anxiety. The uncertainty of a situation under the impact of a major event can cause individuals to lose their sense of control, resulting in frustration, anxiety, and even physical and mental breakdown (Taylor, 1983). Owing to the continuous mutation of the virus and the increasing ability of new strains to spread, individuals do not know when or where COVID-19 will break out. In addition, once an outbreak occurs, they are subject to policy requirements, the closed management of neighborhoods, the suspension of leisure places,

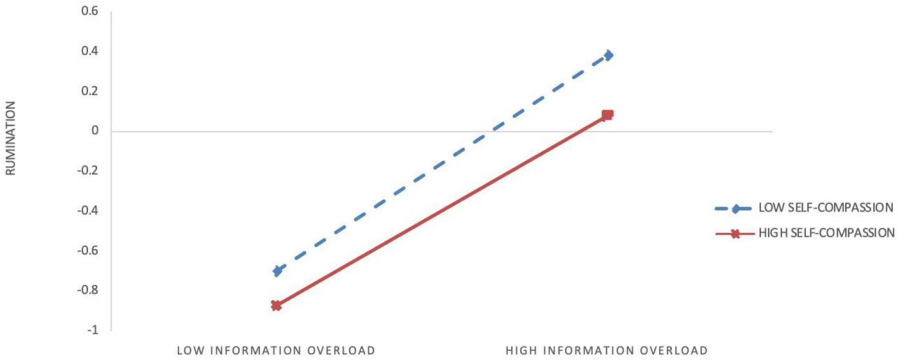

Fig. 2 The moderating role of self-compassion between information overload and rumination

and the prohibition of public transportation, and individuals are unsure whether their itineraries and plans will be disturbed. Hit by the epidemic, the country's overall unemployment rate rises, consumption plummets (Liu et al., 2022), poor economic situations occur, and concerns about work and the future bring people a strong sense of loss of control and powerlessness, triggering worry and anxiety. According to the interaction model of stress and coping, the impact of stimuli on individual psychologies depends on how individuals assess the situation (Lazarus & Folkman, 1984). In an epidemic filled with uncertain stimuli, individuals with a lower tolerance for uncertainty are more likely to make negative, threatening interpretations, which leads to higher levels of anxiety.

Mediating role of Information Overload

The results of this study suggest that information overload mediates the intolerance of uncertainty and state anxiety. This finding supports compensatory control theory (Kay et al., 2009). In a state of environmental uncertainty and lack of control, individuals need more information to cope with negative situations to maintain a sense of security and certainty, and to obtain some objective orderliness as compensation. Moreover, according to cultural dimension theory, Chinese individuals have a medium level of uncertainty avoidance tendency (Hofstede et al., 2005), and in the face of uncertainty, individuals tend to seek more knowledge and information to reduce the sense of threat and discomfort brought about by uncertainty. However, this over-consumption of information about the epidemic will lead to a state of information overload and a decrease in cognitive and processing ability of information (Bawden & Robinson, 2009; Chen et al., 2022), and the information in the epidemic is inherently both true and false. A recent study showed that the degree of information overload was a significant predictor of sharing unverified information (Laato et al., 2020), as individuals who received a large amount of mixed information during the epidemic were more likely to retransmit that information. It was found that individuals in an epidemic tend to exchange information with family, friends, colleagues, and community members in order to manage uncertainty and relieve stress (Chen et al., 2021), and the data suggests that information exchange with family, friends,

and colleagues is an important means for individuals to obtain information about the epidemic. As a result, unconfirmed information may, in turn, become a source of uncertainty for others, leading to more information-seeking behavior by others and bringing about more serious information overload. In this vicious circle, the impact of the information epidemic is continuously amplified, which continually aggravates the negative emotions of individuals (Bendau et al., 2021; Yeung et al., 2018).

Mediating role of Rumination

The present study also confirmed that rumination mediates the effect of intolerance of uncertainty on state anxiety. This is consistent with previous research. Goal progress theory suggests that individuals facing a discrepancy between their goal state and their current state will repeatedly think about how to reduce this discrepancy (Martin et al., 2003). In regular epidemic prevention and control, individuals must face the difference between the uncertain state—the sense of a loss of control—and the ideal state that is predictable and manageable, which in turn leads to reflection on this difference. Individuals who are highly intolerant of uncertainty may use ruminative thinking as a coping style to reduce the discrepancies caused by uncertainty. Rumination amplifies the emotional state of the moment and puts individuals in a negative mood, which increases anxiety (McIntosh, 1996). Ruminative thinking also plays an important role in coping with uncertain situations. The response style theory of ruminant thinking suggests that individuals with high ruminant thinking are often immersed in negative emotions compared to those with low ruminant thinking, and they are unable to cope better with uncertain problem situations, inducing even more negative emotions (Conway et al., 2000). Not only does this ruminant process directly generate negative emotions such as anxiety, but it also exacerbates the adverse effects of risk factors on mental health (Michl et al., 2013).

Chain-mediating Effect of Information Overload and Rumination

The present study also found that information overload and rumination act as chain mediators between intolerance of uncertainty and state anxiety. Information overload creates a stressful situation because of the inability to access, understand, or utilize the necessary information (Bawden & Robinson, 2009; Misra & Stokols, 2012; Wurman et al., 2001). When individuals are in a stressful situation and receive a great deal of negative information about the event without taking positive action, they develop ruminative thinking, which in turn triggers negative emotions (Papageorgiou & Wells, 2003).

It is worth noting that in the present study, when we included information overload and rumination in the model, the direct effect of intolerance of uncertainty on state anxiety was not significant. This finding may further reveal an intermediate mechanism for the effect of uncertainty intolerance on state anxiety in an epidemic setting. Studies have shown that intolerance of uncertainty can lead to "cognitive biases," which may not lead to direct changes in individual mood but rather affect individual processing of information (Buhr & Dugas, 2002). In addition to requiring more attention to process information, individuals with a high intolerance for uncertainty may

have problems with overinvolvement and withdrawal difficulties when processing information (Cisler & Koster, 2010).

The epidemic situation fluctuated during the epidemic prevention and control phases. Simultaneously, the characteristics of the current information pandemic era are such that false information will spread as widely as true information in cyberspace. The lower an individual's tolerance for uncertainty, the more likely he or she will try to cope with this uncertainty through convergent behavior by collecting information and thinking to make sense of it and reduce uncertainty, while excessive attention to epidemic-related information will lead to information overload, bringing a greater sense of loss of control and stress. Regurgitated thinking as a negative coping and cognitive mode triggered by stressful situations makes it difficult for individuals' to be separated from negative information, which in turn leads to negative emotions such as anxiety (Joormann, 2006).

Moderating Effects of self-compassion

Our results indicate that information overload is more significant in predicting rumination among individuals with low self-compassion than among those with high self-compassion. This finding further supports stress-coping theory, in which the effects of stressful situations on individuals are closely related to their coping methods and cognitive patterns. Positive thinking is an important dimension of self-compassion, which refers to an individual's ability to view his or her frustration or suffering in a positive, non-judgmental state, and not dwell on the experience of pain. Positive thoughts can regulate assessment patterns and prevent the creation and development of undesirable thinking patterns (Huang et al., 2019). Individuals with high levels of self-compassion use more cognitive reappraisal emotional strategies (Huang et al., 2019), possibly because positive thoughts play a central role in positive cognitive reappraisal, which can help individuals successfully cope with stressful events (Huang et al., 2019). Individuals with higher levels of self-compassion can view their experiences with a friendly, open, and tolerant attitude, even though they are wrapped up in a large amount of information about the epidemic and are better able to understand the suffering they are in at the time of the epidemic and cope with the problem positively (Qiu et al., 2022). In addition, Baumeister and Heatherton argued that individuals consume more self-control resources to cope with stressful or negative events (Heatherton & Tice, 1994). Self-control is a limited resource (Baumeister et al., 2007). Individuals with high self-compassion are aware that others are also experiencing epidemic dilemmas, remain aware of emotions and thoughts, and accept all the emotions and thoughts they generate (Neff, 2003a). They are less likely to be self-critical and to direct aggressive thoughts at themselves, thus avoiding damage to their own values due to the large amount of epidemic information. They are also more likely to consume fewer ego resources and maintain a more stable state of mind and body (Terry & Leary, 2011). Self-compassion significantly negatively predicts perceived stress (Homan & Sirois, 2017), and individuals under the stress of information overload are likely to mobilize more psychological resources, thus avoiding the constant consumption of internal resources on negative experiences and emotions. In addition, from the perspective of traditional Chinese culture, Chinese people who

pursue a state of moral cultivation are accustomed to "ponder their own mistakes" in the face of negative events and think about how they have failed (Li, 2020). Many studies have shown that individuals with high self-compassion experience low levels of negative experiences (Arch et al., 2014; Ceccarelli et al., 2019; Luo et al., 2018; Xu et al., 2023), and when they experience or recall negative events in an epidemic, self-compassion allows them not to criticize and blame themselves harshly, but to tolerate and understand their negative state, recognize that what happened to them is part of a common global epidemic experience, not to become overly involved, and maintain a calm state of mind. This ability to self-regulate can influence the level of interpretation that individuals habitually use to treat things, and can influence the perception of uncertain and negative situations, thus preventing individuals from falling into ruminating on regarding negative emotions.

Implications

The epidemic has stabilized in China, but it is far from disappearing, and there have been ups and downs. Information related to the epidemic still occupies an important part of everyone's life, and the impact of the epidemic on individuals' quality of life and physical and mental health cannot be ignored. This study is to explore the association between tolerance for uncertainty and mental health while considering the larger context of the "information epidemic", which has been overlooked in the previous literature. At the same time, we further explore the interaction between information overload and individual traits in the context of the information explosion. It also explores the protective factors that can be used as effective coping mechanisms and cognitive models to mitigate the negative effects of uncertainty and information overload during the epidemic in the framework of the stress-coping model. This study has several important implications.

First, this study investigates the effects of intolerance of uncertainty on state anxiety and its mediating mechanisms under regular epidemic prevention and control, as well as the important role of self-compassion in mitigating the negative effects of the information epidemic from both individual and social perspectives. This has important implications for understanding the psychological impact of the epidemic on individuals during the regular epidemic prevention and control phase in China and sheds light on how to reduce individuals' anxiety during the epidemic. Regular epidemic prevention and control is as much about preventing harm from new coronaviruses as it is about defending people from the trauma caused by adverse psychological emotions. Alleviating anxiety during the epidemic and improving individual mental health will also promote both the objective health evaluation of individuals' somatic conditions and the subjective experiential evaluation of their psychological conditions and self-perceptions (Liu & Chen, 2006), and will promote people's quality of life.

Second, in this era of always being connected to the Internet (Vorderer et al., 2018), people managing information intake has become the norm, even in a very important position. To reduce the negative effects of information overload in an epidemic, individuals can appropriately reduce the use of social media and focus more

on authoritative media to block the load on individual information processing systems at the source (Daradkeh et al., 2015).

Third, for close contact, isolation of sub-close contact groups is an effective prevention and control tool, although studies have shown that 'loneliness is significantly increased during isolation (Fan et al., 2021). A recent study showed that loneliness during an epidemic is a significant predictor of individual rumination (Arslan et al., 2022); it also pointed out that higher degrees of rumination have a negative effect on the psychological health of individuals, suggesting that individuals should seek more social support and increase their sense of connectedness during isolation to prevent the effects of adverse emotions.

Moreover, to secure a positive social mindset, currently it is mainly companies and governments that identify and cut off negative emotion-generating information as the main means, which requires considerable human and material resources. By focusing on individual micro-psychological mechanisms and using the self-compassion healthcare factor as an entry point for building a positive social mindset, we can achieve a small and multiplier effect.

Finally, the Chinese government has taken decisive and effective measures in the COVID epidemic. Cultural dimension theory states that China belongs to a collectivist culture with a very high level of rights (Hofstede et al., 2005). Most citizens respond positively to the government's epidemic prevention policy and strictly abide by it, once someone in the community is infected, nearby residents also cooperate with the quarantine policy for at least seven days, which will undoubtedly also bring uncertainty to the individual's life and work. Concerns about the fluctuating situation of the epidemic during the regular prevention and control phase; the impact of the epidemic and prevention and control on life, work, and study; and uncertainty about health-related information are all important components of the uncertainty in the epidemic. Therefore, the conclusions of this study also need to be understood in the context of China's regular epidemic prevention and control situation, the epidemic prevention and control strategies adopted in China, and the special cultural context of China.

Limitations and Future Directions

This study has some limitations. First, this study used a cross-sectional design, which failed to reveal a causal relationship between the variables. Follow-up studies might adopt a longitudinal tracking study design to explore the effect of relevant variables on individual state anxiety in greater depth. Simultaneously, we can combine different technical tools, such as big data and cognitive neuroscience, to reveal this issue systematically at multiple levels. Second, the data in this study were obtained from the subjects' self-reports, which inevitably has subjective reporting bias and thus affects the reliability of the results. In the future, data can be collected from other perspectives, such as field research and interviews. Third, this study mainly involved adults aged 18 years or older; however, the impact on adolescents and children during the regular prevention and control phase of the epidemic cannot be ignored. For example, the postponement of midterm and college entrance exams due to the pan-

demic poses new challenges to students' psychological adjustment skills. In addition, due to the high academic stress of Chinese school-aged adolescents (He et al., 2013), the uncertainty of the epidemic and the possibility of information overload may also result in more academic burnout and academic anxiety, which should be further explored in future studies. Fourth, our results focus on regular prevention and control as a special period, even though the epidemic may continue for a long time and the regular prevention and control phase will last just as long. However, it is not clear how the model in this study will change as the epidemic develops. For example, as the impact of the epidemic on urban governance recedes, the normalized prevention and control policy stabilizes, and the disturbance to residents' lives decreases. Regular nucleic acid testing may become a routine, with certainty in an uncertain environment. The future also needs to further explore the differences in the impact of the uncertainty of the epidemic on people at the different stages of the overall development of the COVID epidemic. Fifth, this study is based on China's "dynamic zeroing" policy in response to COVID-19, based on China's' collectivist, high-power distance cultural context. China has a lower mortality rate in epidemics in tighter cultures than in looser ones (Gelfand et al., 2021), and a collectivist culture in which individuals respond positively to government policies such as maintaining social distance and wearing masks to prevent epidemics (Williams et al., 2015). This may make Chinese society less anxious about the virus threatening their own lives but may increase the anxiety caused by the disturbance of individuals' daily life order due to strict social governance policies. Thus, there may be differences in the anxiety from health threats and anxiety from the order of life experienced by individuals in China and Western countries during the epidemic. Future research could continue to deepen the exploration of these differences and examine the research model in a cross-cultural scenario.

Conclusion

Intolerance to uncertainty significantly predicted individual state anxiety levels. Information overload mediates intolerance of uncertainty and state anxiety; rumination also mediates the effect of intolerance of uncertainty on state anxiety. Information overload and rumination mediated the chain between intolerance of uncertainty and state anxiety. Self-compassion mediates the effect of information overload on rumination.

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Author Contributions All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Jingdong Fu and Cheng Xu. The first draft of the manuscript was written by Jingdong Fu and Cheng Xu,

Data Availability The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. This study was conducted with the approval of the Ethics Committee of East China Normal University. All the respondents granted permission for inclusion by reading the introductions for the investigation and provided voluntary response.

Conflict of interest The authors declare that they have no conflict of interest.

References

Alimohamadi, Y., Sepandi, M., Taghdir, M., & Hosamirudsari, H. (2020). Determine the most common clinical symptoms in COVID-19 patients: A systematic review and meta-analysis. *Journal of preventive medicine and hygiene*, *61*(3), E304–E312. https://doi.org/10.15167/2421-4248/jpmh2020.61.3.1530.

Allegrante, J. P., Auld, M. E., & Natarajan, S. (2020). Preventing COVID-19 and its Sequela: "There is no magic bullet. It's just Behaviors. *American journal of preventive medicine*, *59*(2), 288–292. https://doi.org/10.1016/j.amepre.2020.05.004.

Arch, J. J., Brown, K. W., Dean, D. J., Landy, L. N., Brown, K. D., & Laudenslager, M. L. (2014). Self-compassion training modulates alpha-amylase, heart rate variability, and subjective responses to social evaluative threat in women. *Psychoneuroendocrinology*, *42*, 49–58. https://doi.org/10.1016/j.psyneuen.2013.12.018.

Arslan, G., Yıldırım, M., & Aytaç, M. (2022). Subjective vitality and loneliness explain how coronavirus anxiety increases rumination among college students. *Death studies*, *46*(5), 1042–1051. https://doi.org/10.1080/07481187.2020.1824204.

Baumeister, R. F., Vohs, K. D., & Tice, D. M. (2007). The Strength Model of Self-Control. *Current directions in psychological science: a journal of the American Psychological Society*, *16*(6), 351–355. https://doi.org/10.1111/j.1467-8721.2007.00534.x.

Baumeister, R. F., Gailliot, M., Dewall, C. N., & Oaten, M. (2006). Self-regulation and personality: How interventions increase regulatory success, and how depletion moderates the effects of traits on behavior: Personality and self regulation. *Journal of personality*, *74*(6), 1773–1801. https://doi.org/10.1111/j.1467-6494.2006.00428.x.

Bawden, D., & Robinson, L. (2009). The dark side of information: Overload, anxiety and other paradoxes and pathologies. *Journal of information science*, *35*(2), 180–191. https://doi.org/10.1177/0165551508095781.

Bendau, A., Petzold, M. B., Pyrkosch, L., Maricic, M., Betzler, L., Rogoll, F., Große, J., Ströhle, J., A., & Plag, J. (2021). Associations between COVID-19 related media consumption and symptoms of anxiety, depression and COVID-19 related fear in the general population in Germany. *European archives of psychiatry and clinical neuroscience*, *271*(2), 283–291. https://doi.org/10.1007/s00406-020-01171-6.

Brashers, D. E. (2001). Communication and uncertainty management. *Journal of communication*, *51*(3), 477–497. https://doi.org/10.1111/j.1460-2466.2001.tb02892.x.

Brosschot, J. F., Gerin, W., & Thayer, J. F. (2006). The perseverative cognition hypothesis: A review of worry, prolonged stress-related physiological activation, and health. *Journal of psychosomatic research*, *60*(2), 113–124. https://doi.org/10.1016/j.jpsychores.2005.06.074.

Buhr, K., & Dugas, M. J. (2002). The intolerance of uncertainty scale: Psychometric properties of the English version. *Behaviour research and therapy*, *40*(8), 931–945. https://doi.org/10.1016/S0005-7967(01)00092-4.

Cattell, R. B., & Scheier, I. H. (1958). The nature of anxiety: A review of thirteen multivariate analyses comprising 814 variables. *Psychological reports*, *4*(3), 351–388. https://doi.org/10.2466/pr0.1958.4.3.351. E.

Ceccarelli, L. A., Giuliano, R. J., Glazebrook, C. M., & Strachan, S. M. (2019). Self-compassion and psycho-physiological recovery from recalled sport failure. *Frontiers in psychology*, *10*(JULY), 1564–1564. https://doi.org/10.3389/fpsyg.2019.01564.

Chen, A. T., Ge, S., Cho, S., Teng, A. K., Chu, F., Demiris, G., & Zaslavsky, O. (2021). Reactions to COVID-19, information and technology use, and social connectedness among older adults with pre-frailty and frailty. *Geriatric nursing (New York)*, *42*(1), 188–195. https://doi.org/10.1016/j.gerinurse.2020.08.001.

Chen, Y. (2022). The impact of the new crown pneumonia epidemic on Shanghai's economy and thoughts on how to deal with it.SHANGHAI ENTERPRISE(06),76–82. (In Chinese)

Chen, Y., Xu, H., Liu, C., Zhang, J., & Guo, C. (2021). Association between future orientation and anxiety in university students during COVID-19 outbreak: the chain mediating role of optimization in primary-secondary control and resilience. *Frontiers in Psychiatry*, *12*. https://doi.org/10.3389/fpsyt.2021.699388

Chen, Y., Liu, C., Du, Y., Zhang, J., Yu, J., & Xu, H. (2022). Machine learning classification model using Weibo users' social appearance anxiety. *Personality and Individual Differences*, *188*, 111449. https://doi.org/10.1016/j.paid.2021.111449.

China, S. C. I. O. o. t. P. s. R. o. (2020). *Fighting Covid-19: China in Action*.People's Publishing House.

Cisler, J. M., & Koster, E. H. W. (2010). Mechanisms of attentional biases towards threat in anxiety disorders: An integrative review. *Clinical psychology review*, *30*(2), 203–216. https://doi.org/10.1016/j.cpr.2009.11.003.

Conway, M., Csank, P. A. R., Holm, S. L., & Blake, C. K. (2000). On assessing individual differences in rumination on sadness. *Journal of personality assessment*, *75*(3), 404–425. https://doi.org/10.1207/S15327752JPA7503_04.

Daradkeh, Y. I., Selimi, E. T., & Gouveia, L. B. (2015). Information overload: How to solve the problem? Current trends in technology and its impacts to individuals and organizational context. *International Journal of Open Information Technologies*, *3*(3), 27–30.

Dou, Q., Chang, R., & Xu, H. (2023). Body Dissatisfaction and Social Anxiety among Adolescents: A Moderated Mediation Model of Feeling of Inferiority, Family Cohesion and Friendship Quality. *Applied Research in Quality of Life*. https://doi.org/10.1007/s11482-023-10148-1

Dugas, M. J., Schwartz, A., & Francis, K. (2004). Brief report: Intolerance of uncertainty, worry, and Depression. *Cognitive therapy and research*, *28*(6), 835–842. https://doi.org/10.1007/s10608-004-0669-0.

Dugas, M. J., Savard, P., Gaudet, A., Turcotte, J., Laugesen, N., Robichaud, M., Francis, K., & Koerner, N. (2007). Can the Components of a Cognitive Model Predict the Severity of Generalized Anxiety Disorder? *Behavior therapy*, *38*(2),169–178. https://doi.org/10.1016/j.beth.2006.07.002

Eppler, M. J., & Mengis, J. (2004). The Concept of Information overload: A review of literature from Organization Science, Accounting, Marketing, MIS, and related disciplines. *The Information society*, *20*(5), 325–344. https://doi.org/10.1080/01972240490507974.

Faisal, R. A., Jobe, M. C., Ahmed, O., & Sharker, T. (2022). Mental Health Status, anxiety, and Depression levels of Bangladeshi University Students during the COVID-19 pandemic. *International journal of mental health and addiction*, *20*(3), 1500–1515. https://doi.org/10.1007/s11469-020-00458-y.

Fan, P., Shang, Y., Zhu, B., Wang, J., Guo, C., Jin, J., & Zhang, C. (2021). Investigation and analysis of loneliness,learning burnout and resilience of medical students under the normalization of novel coronavirus pneumonia. *China Journal of Health Psychology*, *29*(8), 1230–1235. https://doi.org/10.13342/j.cnki.cjhp.2021.08.025(In Chinese).

Finlay-Jones, A. L., Rees, C. S., & Kane, R. T. (2015). Self-Compassion, emotion regulation and stress among australian psychologists: Testing an emotion regulation model of self-compassion using structural equation modeling. *PloS one*, *10*(7), e0133481–e0133481. https://doi.org/10.1371/journal.pone.0133481.

Folkman, S., & Lazarus, R. S. (1985). If it Changes it must be a process: Study of emotion and coping during three Stages of a College examination. *Journal of personality and social psychology*, *48*(1), 150–170. https://doi.org/10.1037/0022-3514.48.1.150.

Freeston, M. H., Rhéaume, J., Letarte, H., Dugas, M. J., & Ladouceur, R. (1994). Why do people worry? *Personality and individual differences*, *17*(6), 791–802. https://doi.org/10.1016/0191-8869(94)90048-5.

Gelfand, M. J., Jackson, J. C., Pan, X., Nau, D., Pieper, D., Denison, E., Dagher, M., Van Lange, P. A. M., Chiu, C. Y., & Wang, M. (2021). The relationship between cultural tightness–looseness and COVID-19 cases and deaths: A global analysis. *The Lancet Planetary health*, *5*(3), e135–e144. https://doi.org/10.1016/S2542-5196(20)30301-6.

Gong, H., Jia, H., Guo, T., & Zou, L. (2014). The Revision of Self-compassion Scale and its Reliability and Validity in Adolescents *Psychological Research*(1),36–40, 79. (In Chinese)

Han, X., & Yang, H. (2009). Chinese Version of Nolen-Hoeksema Ruminative Responses Scale (RRS) Used in 912 College Students:Reliability and Validity.Chinese Journal of Clinical Psychology(5),550–551, 549. (In Chinese)

Hayes, A. F. (2017). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. Guilford publications.

He, J., Zhang, D., Sun, J., Yang, D., & Wang, X. (2013). Mental health status of middle school students in Henan. *Chinese Journal of School Health*, (3), 310–312. https://doi.org/10.16835/j.cnki.1000-9817.2013.03.019(In Chinese).

Heatherton, T., & Tice, D. M. (1994). *Losing control: How and why people fail at self-regulation*. San Diego: Academic.

Hofstede, G., Hofstede, G. J., & Minkov, M. (2005). *Cultures and organizations: Software of the mind* (2 vol.). Mcgraw-hill New York.

Homan, K. J., & Sirois, F. M. (2017). Self-compassion and physical health: Exploring the roles of perceived stress and health-promoting behaviors. *Health psychology open*, *4*(2), 2055102917729542–2055102917729542. https://doi.org/10.1177/2055102917729542.

Hu, X. (2013). *The Relationship Between Self-compassion, Coping Style and Subjective Well-being* 河南大学]. (In Chinese)

Huang, M., Jing, T., & Zhao, S. (2019). The influence of college students' psychological inflexibility on depression:The role of ruminative responses and mindfulness. *Psychological Research Psychologische Forschung*, *12*(5), 469–476. https://doi.org/10.3969/j.issn.2095-1159.2019.05.012(In Chinese).

Inzlicht, M., McKay, L., & Aronson, J. (2006). Stigma as Ego depletion: How being the target of Prejudice affects Self-Control. *Psychological science*, *17*(3), 262–269. https://doi.org/10.1111/j.1467-9280.2006.01695.x.

Jiang, D., Tan, X., Li, R., Xu, S., Peng, C., & Yi, X. (2022). Investigation and analysis of anxiety, sleep quality and quality of life among ordinary residents in Wuhan during the new crown pneumonia epidemic. *Psychologies Magazine*, *17*(01), 11–13. https://doi.org/10.19738/j.cnki.psy.2022.01.004(In Chinese).

Joormann, J. (2004). Attentional bias in dysphoria: The role of inhibitory processes. *Cognition and emotion*, *18*(1), 125–147. https://doi.org/10.1080/02699930244000480.

Joormann, J. (2006). Differential effects of rumination and dysphoria on the inhibition of irrelevant emotional material: Evidence from a negative priming task. *Cognitive therapy and research*, *30*(2), 149–160. https://doi.org/10.1007/s10608-006-9035-8.

Kay, A. C., Whitson, J. A., Gaucher, D., & Galinsky, A. D. (2009). Compensatory control: Achieving Order through the mind, our institutions, and the Heavens. *Current directions in psychological science: a journal of the American Psychological Society*, *18*(5), 264–268. https://doi.org/10.1111/j.1467-8721.2009.01649.x.

Laato, S., Islam, A. K. M. N., Islam, M. N., & Whelan, E. (2020). What drives unverified information sharing and cyberchondria during the COVID-19 pandemic? *European journal of information systems*, *29*(3), 288–305. https://doi.org/10.1080/0960085X.2020.1770632.

Ladouceur, R., Gosselin, P., & Dugas, M. J. (2000). Experimental manipulation of intolerance of uncertainty: A study of a theoretical model of worry. *Behaviour research and therapy*, *38*(9), 933–941. https://doi.org/10.1016/S0005-7967(99)00133-3.

Ladouceur, R., Talbot, F., & Dugas, M. J. (1997). Behavioral expressions of intolerance of uncertainty in worry: Experimental findings. *Behavior modification*, *21*(3), 355–371. https://doi.org/10.1177/01454455970213006.

Lang, A. (2000). The limited capacity model of mediated message processing. *Journal of communication*, *50*(1), 46–70. https://doi.org/10.1111/j.1460-2466.2000.tb02833.x.

Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal, and coping*. Springer publishing company.

Li, H. (2020). Introspection: On the paradigm of Huaxia Communication Research. *Journal of Shanxi University (Philosophy and Social Science Edition)*, *43*(2), 74–82. https://doi.org/10.13451/j.cnki.shanxi.univ (phil.soc.). 2020.02.010 (In Chinese)

Li, Y., & Wu, D. (2016). Procedural justice and employee's Job Engagement: The impacts of state anxiety and Supervisor Communication. *Science of Science and Management of S & T*, *37*(5), 138–149. (In Chinese).

Liu, H., Liu, W., Yoganathan, V., & Osburg, V. S. (2021). COVID-19 information overload and generation Z's social media discontinuance intention during the pandemic lockdown. *Technological forecasting & social change*, *166*, 120600–120600. https://doi.org/10.1016/j.techfore.2021.120600.

Liu, J., Ning, L., & Jiang, L. (2022). Mystery of the deviation between consumption and output during the period of COVID-19: Is it just an unemployment issue? *Journal of Finance and Economics*, *48*(5), 4–18. https://doi.org/10.16538/j.cnki.jfe.20220113.401(In Chinese).

Liu, T., & Chen, K. (2006). Questionnaire of quality of life in the evaluation of the quality of life. *Chinese Journal of Clinical Rehabilitation*, *26*, 113–116. https://doi.org/10.3321/j.issn:1673-8225.2006.26.054(In Chinese).

Luo, X., Qiao, L., & Che, X. (2018). Self-compassion modulates Heart Rate Variability and negative affect to experimentally Induced stress. *Mindfulness*, *9*(5), 1522–1528. https://doi.org/10.1007/s12671-018-0900-9.

Lv, X., Fu, C., & Wang, X. (2019). Effect and underlying mechanism of refutation texts on the trust and moral judgment of patients. *Acta Psychologica Sinica*, *51*(10), 1171–1186. https://doi.org/10.3724/sp.J.1041.2019.01171(In Chinese).

Martin, L. L., Shrira, I., & Startup, H. M. (2003). Rumination as a function of goal progress, stop rules, and cerebral lateralization. In C. Papageorgiou, & A. Wells (Eds.), *Depressive rumination* (pp. 153–175). John Wiley & Sons Ltd. https://doi.org/10.1002/9780470713853.ch8.

McIntosh, W. D. (1996). When does goal nonattainment lead to negative emotional reactions, and when doesn't it?: The role of linking and rumination. *Striving and feeling: Interactions among goals, affect, and self-regulation* (pp. 53–77). Lawrence Erlbaum Associates, Inc.

Michl, L. C., McLaughlin, K. A., Shepherd, K., & Nolen-Hoeksema, S. (2013). Rumination as a mechanism linking stressful life events to symptoms of depression and anxiety: Longitudinal evidence in early adolescents and adults. *Journal of abnormal psychology (1965)*, *122*(2), 339–352. https://doi.org/10.1037/a0031994.

Misra, S., & Stokols, D. (2012). Psychological and Health Outcomes of Perceived Information overload. *Environment and behavior*, *44*(6), 737–759. https://doi.org/10.1177/0013916511404408.

Neff, K. D. (2003a). The development and validation of a scale to measure self-compassion. *Self and identity*, *2*(3), 223–250. https://doi.org/10.1080/15298860309027.

Neff, K. D. (2003b). Self-compassion: An alternative conceptualization of a healthy attitude toward oneself. *Self and identity*, *2*(2), 85–101. https://doi.org/10.1080/15298860309032.

Nolen-Hoeksema, S., Wisco, B. E., & Lyubomirsky, S. (2008). Rethinking rumination. *Perspectives on psychological science*, *3*(5), 400–424. https://doi.org/10.1111/j.1745-6924.2008.00088.x.

Nolenhoeksema, S. (1991). Responses to Depression and their Effects on the duration of depressive episodes. *Journal of abnormal psychology (1965)*, *100*(4), 569–582. https://doi.org/10.1037/0021-843X.100.4.569.

Norr, A. M., Oglesby, M. E., Capron, D. W., Raines, A. M., Korte, K. J., & Schmidt, N. B. (2013). Evaluating the unique contribution of intolerance of uncertainty relative to other cognitive vulnerability factors in anxiety psychopathology. *Journal of affective disorders*, *151*(1), 136–142. https://doi.org/10.1016/j.jad.2013.05.063.

Paluszek, M. M., Asmundson, A. J. N., Landry, C. A., McKay, D., Taylor, S., & Asmundson, G. J. G. (2021). Effects of anxiety sensitivity, disgust, and intolerance of uncertainty on the COVID stress syndrome: A longitudinal assessment of transdiagnostic constructs and the behavioural immune system. *Cognitive behaviour therapy*, *50*(3), 191–203. https://doi.org/10.1080/16506073.2021.1877339.

Papageorgiou, C., & Wells, A. (2003). An empirical test of a clinical metacognitive model of rumination and depression. *Cognitive therapy and research*, *27*(3), 261–273. https://doi.org/10.1023/A:1023962332399.

Peng, W., Carcioppolo, N., Occa, A., Ali, K., Yang, Q., & Yang, F. (2021). Feel worried, overloaded, or Fatalistic? The determinants of Cancer uncertainty management preferences. *Health communication*, *36*(3), 347–360. https://doi.org/10.1080/10410236.2019.1692489.

Phillips-Wren, G., & Adya, M. (2020). Decision making under stress: The role of information overload, time pressure, complexity, and uncertainty. *Journal of decision systems*, *29*(1), 213–225. https://doi.org/10.1080/12460125.2020.1768680.

Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of applied psychology*, *88*(5), 879–903. https://doi.org/10.1037/0021-9010.88.5.879.

Qiu, H., Wang, P., Wang, Z., Si, L., & Yan, C. (2022). Efects of self-compasion intervention combined with mindfulnes-based cognitive therapy on mindfulnes thinking, anxiety status and slep quality in patients with generalized anxiety disorder. *China Journal of Health Psychology*, *30*(9), 1290–1295. https://doi.org/10.13342/j.cnki.cjhp.2022.09.003(In Chinese).

Rettie, H., & Daniels, J. (2021). Coping and tolerance of uncertainty: Predictors and mediators of mental health during the COVID-19 pandemic. *The American psychologist*, *76*(3), 427–437. https://doi.org/10.1037/amp0000710.

Smith, B. M., Twohy, A. J., & Smith, G. S. (2020). Psychological inflexibility and intolerance of uncertainty moderate the relationship between social isolation and mental health outcomes during COVID-19. *Journal of contextual behavioral science*, *18*, 162–174. https://doi.org/10.1016/j.jcbs.2020.09.005.

Spielberger, C. D. (1983). *Manual for the state-trait anxiety inventory* ((STAI vol.). Form Y.

Spielberger, C. D., & IN THEORY AND RESEARCH ON ANXIETY. (1972). CURRENT TRENDS. *Anxiety*, 3–19. https://doi.org/10.1016/B978-0-12-657401-2.50008-3

Swar, B., Hameed, T., & Reychav, I. (2017). Information overload, psychological ill-being, and behavioral intention to continue online healthcare information search. *Computers in human behavior*, *70*, 416–425. https://doi.org/10.1016/j.chb.2016.12.068.

Tabachnick, B. G., & Fidell, L. S. (1984). USING MULTIVARIATE STATISTICS - REPLY. *Applied psychological measurement*, *8*(4), 471–471. https://doi.org/10.1177/014662168400800412.

Tan, Y., Wang, L., & Huang, J. (2021). Differences and influencing factors for mortality rate of COVID-19: Based on age struc- ture and testing rate. *Population Research*, *45*(2), 30–46. (In Chinese).

Taylor, S. E. (1983). Adjustment to threatening events: A theory of cognitive adaptation. *The American psychologist*, *38*(11), 1161–1173. https://doi.org/10.1037/0003-066X.38.11.1161.

Terry, M. L., & Leary, M. R. (2011). Self-compassion, self-regulation, and health. *Self and identity*, *10*(3), 352–362. https://doi.org/10.1080/15298868.2011.558404.

Vorderer, P., Hefner, D., Reinecke, L., & Klimmt, C. (2018). *Permanently online, permanently connected: Living and communicating in a POPC World*. Routledge.

Wang, X., Wang, X., & Ma, H. (1999). Handbook of mental health assessment scale. *Chinese Journal of Mental Health*, *13*(1), 31–35. (In Chinese).

Ward, A., Lyubomirsky, S., Sousa, L., & Nolen-Hoeksema, S. (2003). Can't quite commit: Rumination and uncertainty. *Personality & social psychology bulletin*, *29*(1), 96–107. https://doi.org/10.1177/0146167202238375.

Watkins, E., & Baracaia, S. (2001). Why do people ruminate in dysphoric moods? *Personality and Individual Differences*, *30*(5), 723–734. https://doi.org/10.1016/S0191-8869(00)00053-2.

Williams, L., Rasmussen, S., Kleczkowski, A., Maharaj, S., & Cairns, N. (2015). Protection motivation theory and social distancing behaviour in response to a simulated infectious disease epidemic. *Psychology health & medicine*, *20*(7), 832–837. https://doi.org/10.1080/13548506.2015.1028946.

Wu, Y., Liu, J., Liu, M., & Liang, W. (2022). Epidemiologic features and scientific prevention and control advice of SARS-CoV-2 Omicron variant. *Chinese Journal of Disease Control & Prevention*, *26*(5), 497–501. https://doi.org/10.16462/j.cnki.zhjbkz.2022.05.001(In Chinese).

Wurman, R. S., Sume, D., Liefer, L., & Whitehouse, A. K. (2001). Information Anxiety 2. *Kybernetes*, *31*(5).

Xie, B., He, D., Mercer, T., Wang, Y., Wu, D., Fleischmann, K. R., Zhang, Y., Yoder, L. H., Stephens, K. K., Mackert, M., & Lee, M. K. (2020). Global health crises are also information crises: A call to action. *Journal of the Association for Information Science and Technology*, *71*(12), 1419–1423. https://doi.org/10.1002/asi.24357.

Xu, C., & Yan, W. (2022). The relationship between information overload and state of anxiety in the period of regular epidemic prevention and control in China: A moderated multiple mediation model. *Current psychology (New Brunswick N J)*, 1–18. https://doi.org/10.1007/s12144-022-03289-3.

Xu, H., Xu, C., & Guo, C. (2023). Cocaine use disorder is associated with widespread surface-based alterations of the basal ganglia. *Journal of psychiatric research*, *158*, 95–103.

Yang, Z., Chen, X., Kang, Y., & Xu, J. (2021). Development of information overload severity scale in the situation of coronavirusdisease 2019 epidemic. *West China Medical Journal*, *36*(4), 449–452. https://doi.org/10.7507/1002-0179.202003280(In Chinese).

Yeung, N. C. Y., Lau, J. T. F., Yu, N. X., Zhang, J., Xu, Z., Choi, K. C., Zhang, Q., Mak, W. W. S., & Lui, W. W. S. (2018). Media exposure related to the 2008 Sichuan Earthquake predicted probable PTSD among chinese adolescents in Kunming, China: A longitudinal study. *Psychological Trauma: Theory Research Practice and Policy*, *10*, 253–262. https://doi.org/10.1037/tra0000121.

Yoon, S., McClean, S. T., Chawla, N., Kim, J. K., Koopman, J., Rosen, C. C., Trougakos, J. P., & McCarthy, J. M. (2021). Working through an "infodemic": The impact of COVID-19 news consumption on employee uncertainty and work behaviors. *Journal of applied psychology*, *106*(4), 501–517. https://doi.org/10.1037/apl0000913.

Yu, Q., & Zheng, D. (2020). Study on the normalization of Epidemic Prevention and Control of the Corona Virus Disease 2019. *China Public Security (Academy Edition) No*, *58*(01), 65–68. (In Chinese).

Zhang, G., & Dai, B. (2012). A summary of research on intolerance of uncertainty. *Journal of Capital Normal University (Social Sciences Edition) No*, *205*(02), 124–130. (In Chinese).

Zhang, Y., Song, J., Gao, Y., Wu, S., Song, L., & Miao, D. (2017). Reliability and validity of the intolerance of uncertainty scale-short form in University students. *Chinese Journal of Clinical Psychology*, *25*(2), 285–288. https://doi.org/10.16128/j.cnki.1005-3611.2017.02.020(In Chinese).

Zhao, X., & Liu, J. (2021). Relation of depression severity to source monitoring, cognitive fusion and ruminative responses in patients with depression. *Chinese Mental Health Journal*, *35*(1), 13–18. https://doi.org/10.3969/j.issn.1000-6729.2021.01.003(In Chinese).

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