Perceived stress and mobile phone addiction among college students during the 2019 coronavirus disease: The mediating roles of rumination and the moderating role of self-control

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ABSTRACT

This present study aimed to examine the mediating role of rumination and the moderating role of self-control in the link between perceived stress and mobile phone addiction during the COVID-19 epidemic. A total of 628 college students completed Depression-Anxiety-Stress Scale, Smartphone Addiction Scale, Ruminative Responses Scale and Self-Control Scale. Mediation analysis highlighted that rumination mediated the association between perceived stress and mobile phone addiction. Moderated mediation analysis indicated that the indirect association between perceived stress and mobile phone addiction were moderated by self-control. Between the COVID affected group and the unaffected group, some differences also be observed in the moderating effect of self-control. This study emphasize the importance of rumination and self-control in understanding the possible mechanisms underlying the relationship between perceived stress and mobile phone addiction, which can be used to develop interventions to reduce the problematic behavior among college students during the COVID-19 pandemic.

1. Introduction

The Corona Virus Disease 2019 (COVID-19) has led to a serious outbreak of severe acute respiratory syndrome and has quickly evolved into a global public health event. During the period of staying home for epidemic prevention, smart phones may become one of the main tools for individuals to search for information, communicate with others and seek entertainments. Mobile phone addiction refers to a particular behavioral addiction in which an individual's physical, psychological, and social functions are impaired due to the excessive use of a mobile phone (Billieux et al., 2015). Its core symptoms consist of obsessive thoughts about mobile phones (craving), spending more and more time on mobile phones (tolerance), and experiencing anxiety when mobile phones are unavailable (withdrawal) (Kim et al., 2015). Studies revealed that mobile phone addiction was associated with a series of physical, mental and social functional problems (De-Sola et al., 2017; Elhai et al., 2017; Han et al., 2017). Moreover, screen time spent on mobile phones of college students in China was more than 5 h per day (MyCOS Research Institute, 2018). Therefore, as a high-risk group of mobile phone addiction, the outbreak of COVID-19 may further deepen the tendency towards it among college students. The examination of the mechanisms underlying mobile phone addiction among college students has great realistic significance.

1.1. The relation between perceived stress and mobile phone addiction

Numerous researchers found that perceived stress had a significantly positive prediction effect on mobile phone addiction (Cheng & Hong, 2017; Chiu, 2014; Gao et al., 2018; Xu et al., 2019). According to the general strain theory, problematic behaviors mainly result from the negative experience brought by various stress or tensions (Agnew, 1992). Young (2007) suggested that internet addicts' impulsive behavior can be treated as a measure to reduce perceived stress. In other words, mobile phone addiction becomes an approach to release daily pain and tension (Cheng & Hong, 2017). Moreover, previous study has shown that the unprecedented outbreak of the virus would cause immense pressure on the public of different ages, regions and occupations (Lu et al., 2009). The high contagiousness of the COVID-19 pandemic has

increased the perceived stress of general public (Wang et al., 2020; Zhao et al., 2021), which may increase the incidence of addictive behavior. However, few studies have explored the mechanism of the relationship between perceived stress and mobile phone addiction in the context of public health emergency of international concern. Therefore, the present study aimed to examine the relationship between perceived stress and mobile phone addiction.

1.2. Rumination as a mediator

Rumination refers to constant and repetitive thinking about negative situations and consequences, and long-term immersion in various passive emotions (Nolen-hoeksema et al., 2008). Davis (2001) proposed the cognitive behavioral model to explain the development and maintenance of pathological Internet use (PIU), which indicates that the distal contributory causes of PIU is stressful life event (i.e., COVID-19 epidemic), a necessary condition for the formation of PIU, and the proximal contributory causes is maladaptive cognitions (i.e., rumination), a sufficient condition for the formation of PIU. Considering that smartphone use shares many functional and psychological properties with internet use and they both are included in the behavior addiction category (Mok et al., 2014), a great many of researchers applied this theory to the field of mobile phone addiction (Kong et al., 2020). Given that perceived stress may cause rumination which in turn leads to mobile phone addiction, it is plausible to hypothesize that perceived stress is indirectly associated with mobile phone addiction through rumination.

1.3. Self-control as a moderator

Perceived stress may have effects on mobile phone addiction through the mediating role of rumination, however, individuals are not equally impacted by perceived stress. As a stable personality trait, self-control is defined as an ability to regulate, manipulate, or control one's impulsive thoughts, feelings, and behaviors (Telzer et al., 2011). Previous studies have explored the moderating effect of self-control between environmental factors (i.e., mass media, parental support) and problematic behaviors (i.e., tobacco and alcohol use, antisocial behavior) (Jones et al., 2007; Wills et al., 2010), however, rare studies have examined its moderating role between perceived stress and mobile phone addiction under the background of public health emergency, which is one of the aims of the present study.

According to the dual systems model of self-control (Hofmann et al., 2009), for individuals with high self-control, their behavior is more easily affected by the reflective system that helps them to present better delayed gratification when encountering negative life events; For individuals with low self-control, the impulse system starts to work and carries out intuitive heuristic processing to satisfy the current needs, which increases the incidence of impulsive behavior (i.e., mobile phone addiction) and malcognition (i.e., rumination) (Hofmann et al., 2009; Lu et al., 2019). Thus, under the pressure of pandemic, college students with low level of self-control may be more immersed in ruminative thinking and more inclined to satisfy the impulse of using smartphones immediately to seek consolation because of their difficulty in resisting impulsivity, which lead to rumination and mobile phone addiction. That is to say, self-control may moderate the first half of the mediating path of rumination and the direct prediction of perceived stress on mobile phone addiction.

Moreover, the strength model of self-control (Baumeister et al., 2007) purports that individual resources of self-control are limited. When one's psychological resources have been exhausted, a state of depletion results in failure on following tasks requiring self-control (Baumeister et al., 1998). Previous research has discovered that rumination weakens one's capacity of self-control (Denson et al., 2011). Individuals with rumination exhibit more bulimic symptoms if they had lower levels of self-control (Breithaupt et al., 2016). Therefore, the

pattern may be same in individuals with mobile phone addiction, such that, rumination is particularly dangerous among individuals with poor self-control. That is, self-control moderates the second half of the mediating path of rumination. Taken together, self-control seems to moderate the direct and indirect associations between perceived stress and mobile phone addiction during the COVID-19.

1.4. Difference in affected/unaffected group

The spread of COVID-19 is a highly stressful event that has exposed adolescents to threats to their health and a long duration of quarantine (Ying et al., 2020). In this vein, compare with unaffected group, adolescents affected by COVID might perceive higher stress (Wang et al., 2020; Zhao et al., 2021), which may cause repetitive thinking about the present situations and individual itself, thus inducing higher ruminative thinking. Recent research has indicated that the spread of COVID-19 may be increasing adolescents' mobile phone addiction lever (Li et al., 2021; Liu & Wang, 2021). Also, self-control is a protective factor against the effect of perceived stress on mobile phone addiction, thereby reducing their risk of mobile phone addiction in COVID affected group (Monroe & Simons, 1991). Thus, between the COVID affected group and the unaffected group, some differences may also be observed in the moderating effect of self-control.

1.5. The present study

The present study aimed to examine the underlying mediation (rumination) and moderation (self-control) mechanisms between perceived stress and mobile phone addiction among college students under the context of COVID-19 epidemic. Specifically, this study constructed a moderated mediation model to answer four main hypotheses:

Hypothesis 1. Rumination mediates the association between perceived stress and mobile phone addiction.

Hypothesis 2. Self-control moderates the direct association. Perceived stress has a weaker association with mobile phone addiction among college students with a high level of self-control, in comparison to those with a low level of self-control.

Hypothesis 3. Self-control moderates the mediation processes. Perceived stress has weaker associations with rumination, which in turn have weaker associations with mobile phone addiction among college students with a high level of self-control, in comparison to those with a low level of self-control.

Hypothesis 4. There are a significant difference in the moderated mediation model between affected group and COVID unaffected group.

The moderated mediation model is outlined in Fig. 1.

2. Methods

2.1. Participants

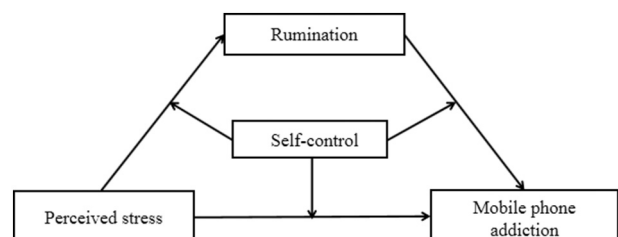Participants were recruited from one university in a large city in

Fig. 1. The moderated mediation model.

Central China. Convenience sampling was used to select classes in freshmen and sophomores. A total of 653 college students completed the survey. After getting rid of the invalid questionnaires (questionnaires with lots of blanks or repeated answers), data from 628 participants were retained – the valid response rate was 96.17% and the missing data percentage was 3.83%. All missing data were replaced by series means. In the sample, the mean age was 18.30 years (SD_{age} = 0.86, range = 16–21). 326 were females (51.91%) and 302 were males (48.09%). There were 203 (32.32%) participants reporting that they were not affected by the epidemic of COVID-19, 312 (49.68%) were mildly affected, and 113 (18.0%) were moderately and severely affected. There were 130 college students reporting that they used mobile phones for less than 3 h per day during the non-epidemic period, 266 for 3–5 h and 232 for more than 5 h; 37 people used mobile phones for less than 3 h per day during the epidemic period, 131 for 3–5 h, and 460 for more than 5 h.

2.2. Measures

2.2.1. Perceived stress
The dimension of stress from the Chinese version (Gong et al., 2010) of the Depression-Anxiety-Stress Scale (Lovibond & Lovibond, 1995) was used to assess the symptoms of stress individuals experience. The dimension of stress consists of 7 items rated on a four-point scale (1 = disagree to 4 = totally agree), with higher scores indicating a higher level of perceived stress. In this study, Cronbach's α for this scale was 0.87.

2.2.2. Mobile phone addiction
The Chinese version (Xiang et al., 2019) of the Short Version of the Smartphone Addiction Scale (SAS-SV) was used (Kwon et al., 2013). The scale consists of 10 items rated on a six-point scale (1 = totally disagree, 6 = totally agree), with higher scores indicating a higher level of mobile phone addiction. Previous research demonstrated that scoring 32 of 60 was selected as cut-off to classify mobile phone addicts (Lopez-Fernandez, 2017). Cronbach's α in this study was 0.89.

2.2.3. Rumination
Rumination was measured by the Chinese version (Han & Yang, 2009) of the Ruminative Responses Scale (Nolen-Hoeksema & Morrow, 1991). This scale assesses three dimensions of rumination, including symptom rumination, brooding and reflective pondering, and consists of 22 items. Each item is answered on a four-point scale (1 = never, 4 = always). Higher scores reflect a higher tendency to the ruminative mode of thinking. In this study, Cronbach's α for this scale was 0.96.

2.2.4. Self-control
The Chinese version (Yi, 2013) of the Self-Control Scale (Tangney et al., 2004) was used. This scale assesses two dimensions of self-control with 13 items, including impulse control and self-discipline. Participants rated these items on a five-point scale (1 = totally agree to 5 = totally disagree). The higher the score, the higher level of self-control. Cronbach's α in this study was 0.86.

2.3. Procedure

The investigation was conducted online from February 16 to 23, 2020. Participants provided informed consent and voluntarily participated following the assurance of confidentiality and anonymity. The data collectors were well-trained researchers to ensure standardization of the data collection process. The QR code and the link of the questionnaires were given to the students. They can scan the QR code or clicking the link to enter a website called "wenjuanxing" to complete the questionnaires. All participants were rewarded with an online shopping voucher which is worth five yuan after participation. The study was approved by the Research Ethics Committee of the first author's

institution.

2.4. Data analysis

First, a factor analysis was used for testing common method bias. Secondly, descriptive statistics, Chi square test, *t*-tests, and Pearson correlation analyses were conducted using SPSS 18.0. The third step was to test the mediation model and moderated mediation model using the SPSS macro PROCESS version 2.15 (model 4 and model 59) suggested by Hayes (2013). Because previous research indicates that gender and age may affect mobile phone addiction (Lian et al., 2018), these were included as covariates in the present study.

3. Results

3.1. Preliminary statistics

Common variance analysis was applied to the four questionnaires through Harman's one-factor method. Principal component analysis on all variables extracted 8 eigenvalues greater than 1. The first factor explained 30.44% of the variance, which was less than the critical value of 40%, demonstrating that the common method bias was not a problem in the current study (Podsakoff et al., 2003).

The results of the descriptive statistics and correlation analysis are presented in Table 1. Correlation analyses revealed that perceived stress was significantly and positively correlated with mobile phone addiction and rumination, and was significantly and negatively correlated with self-control. Mobile phone addiction was significantly and negatively correlated with self-control, and positively correlated with rumination. Self-control was significantly and negatively correlated with rumination.

3.2. Testing for the mediation model

Model 4 from the SPSS macro PROCESS was used to test for the existence of mediation. After controlling for gender and age, perceived stress was positively associated with mobile phone addiction in the absence of the mediator (β = 0.30, $p < 0.001$). As can be seen from Table 2, when rumination was included, perceived stress was positively associated with rumination (β = 0.55, $p < 0.001$), which in turn positively associated with mobile phone addiction (β = 0.34, $p < 0.001$). The association between perceived stress and mobile phone addiction was nonsignificant (β = 0.11, $p = 0.05$). Furthermore, the results of bootstrapping, which is presented in Table 3, showed that the 95% confidence interval for the indirect effect of rumination ranged from 0.12 to 0.28 (not including zero), and the direct effect of perceived stress on mobile phone addiction ranged from 0.00 to 0.21 (including zero). The mediation effect accounted for 63.33% of the total effects. These findings indicated that rumination fully mediated the relation between perceived stress and mobile phone addiction.

3.3. Testing for the moderated mediation model

Model 59 from the SPSS macro PROCESS was applied to test for the proposed moderated mediation model with rumination as mediator and self-control as moderator. As displayed in Table 4, the interaction of perceived stress and self-control did not show significant effects on mobile phone addiction (β = 0.06, $p > 0.05$), not supporting Hypothesis 2. However, the interaction of perceived stress and self-control showed significant effects on rumination (β = 0.10, $p < 0.001$), and the interaction of rumination and self-control showed significant effects on mobile phone addiction (β = −0.12, $p < 0.01$). These findings indicated that self-control moderated the association between perceived stress and rumination and between rumination and mobile phone addiction. The moderation mediation pathways with path weights included is outlined in Fig. 2.

Table 1

Descriptive statistics and correlations between variables.

Variables	M	SD	1	2	3	4	5	6
1. Perceived stress	10.98	3.47	1					
2. Mobile phone addiction	35.60	8.75	0.29**	1				
3. Self-control	40.07	4.66	−0.40**	−0.43**	1			
4. Rumination	38.97	10.64	0.57**	0.43**	−0.39**	1		
5. Age	18.30	0.86	0.03	−0.01	0.26	0.07	1	
6. Gender	0.52	0.50	0.06	0.12*	−0.06	0.17**	−0.07	1

Note. $N = 628$. *$p < 0.05$. **$p < 0.01$. Male = 0, female = 1.

Table 2

The mediation model of rumination between perceived stress and mobile phone addiction.

Predictors	Rumination			Mobile phone addiction		
	β	SE	95% CI	β	SE	95% CI
Constant	−1.45	0.88	[−3.17, 0.28]	0.51	0.96	[−1.38, 2.41]
Gender	0.32**	0.10	[0.13, 0.51]	0.13	0.11	[−0.01, 0.35]
Age	0.07*	0.05	[−0.03, 0.16]	−0.03	0.05	[−0.14, 0.07]
Perceived stress	0.55***	0.05	[0.48, 0.63]	0.11	0.05	[0.00, 0.21]
Rumination				0.34***	0.06	[0.23, 0.45]
R^2	0.35			0.19		
F	69.05**			22.61**		

Note. $N = 628$. Bootstrap sample size = 5000. CI = confidence interval. β = standardized coefficient.

* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$. Male = 0, female = 1.

Table 3

Bootstrapping indirect effect and 95% confidence interval (CI) for the mediation model.

	Estimated effect	SE	95% CI	Ratio to total effect
Total effect	0.30	0.05	[0.21, 0.39]	
Direct effect	0.11	0.05	[0.00, 0.21]	36.67%
Indirect effect	0.19	0.04	[0.12, 0.28]	63.33%

Note. $N = 628$. Bootstrap sample size = 5000. CI = confidence interval.

To further figure out the essence of the interaction effect, analysis of simple slope was conducted. Fig. 3 and Fig. 4 show the association between perceived stress and rumination and between rumination and mobile phone addiction at two levels of self-control (low level, 1 SD below the mean; high level, 1 SD above the mean). As can be seen from Fig. 3, for individuals with low self-control (1 SD below the mean), perceived stress had a strong effect on rumination (simple slope = 0.55, $p < 0.001$). For individuals with high self-control (1 SD above the mean), the association was still significant but much weaker (simple slope = 0.37, $p < 0.001$). As illustrated in Fig. 4, different from the moderation role of self-control between perceived stress and rumination, among
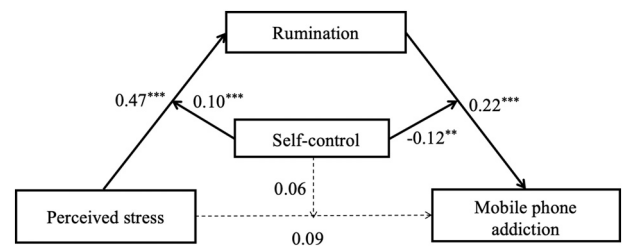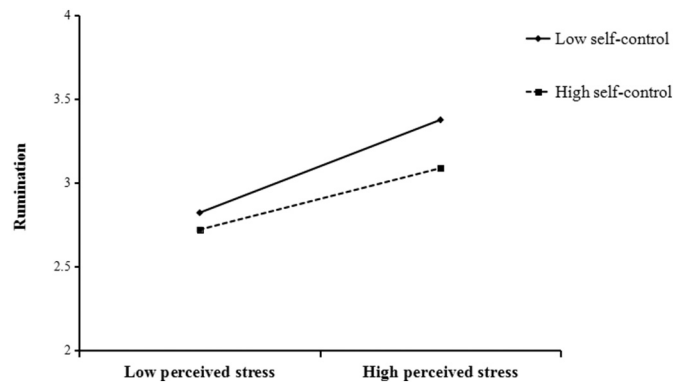

Fig. 2. The moderated mediation pathways.

Fig. 3. The relationship between perceived stress and rumination.

Table 4

The moderated mediation model of self-control between perceived stress and mobile phone addiction through rumination.

Predictors	Rumination			Mobile phone addiction		
	β	SE	95% CI	β	SE	95% CI
Constant	−1.45	0.84	[−3.09, 0.19]	0.13	0.89	[−1.62, 1.88]
Gender	0.30**	0.09	[0.12, 0.49]	0.13	0.10	[−0.07, 0.33]
Age	0.06	0.05*	[−0.03, 0.15]	−0.01	0.05	[−0.11, 0.08]
Perceived stress	0.47***	0.04	[0.39, 0.55]	0.09	0.05	[−0.02, 0.19]
Rumination				0.22***	0.05	[0.12, 0.33]
Self-control	0.20***	0.04	[0.12, 0.28]	0.33***	0.05	[0.24, 0.42]
Perceived stress×Self-control	0.10***	0.02	[0.05, 0.14]	0.06	0.03	[−0.01, 0.12]
Rumination×Self-control				−0.12**	0.04	[−0.20, −0.04]
R^2	0.42			0.32		
F	54.85**			25.78**		

Note. $N = 628$. Bootstrap sample size = 5000. CI = confidence interval. β = standardized coefficient.

* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$. Male = 0, female = 1.

Fig. 4. The relationship between rumination and mobile phone addiction.

Fig. 5. The moderated mediation pathways (the COVID unaffected group).

Fig. 6. The moderated mediation pathways (the COVID affected group).

individuals with low self-control (1 SD below the mean), the effect of rumination on mobile phone addiction was not significant (simple slope = 0.18, $p > 0.05$), while this effect (simple slope = 0.62, $p < 0.001$) was strongly significant for individuals with high self-control (1 SD above the mean).

3.4. Multigroup analysis

Because the subjects were divided into two groups (the COVID affected group and the COVID unaffected group), we conducted the multigroup analysis to figure out the differences between these two groups. As can be seen from Table 5, we found that the level of perceived stress, rumination, mobile phone addiction and self-control of the affected group were significantly higher than those of the unaffected group. Moreover, as shown in Fig. 5, we found that in the unaffected group, self-control did not work as moderator at any stage. However, Fig. 6 presents that in the affected group, self-control significantly moderated all pathways in the mediational model, supporting Hypothesis 4.

4. Discussion

Based on the general strain theory (Agnew, 1992), the cognitive-behavioral model of PIU (Davis, 2001), the present study constructed a moderated mediating model to test how and when perceived stress is linked with mobile phone addiction during the COVID-19 epidemic. As expected, the findings of the present study indicated that rumination mediated the association between perceived stress and mobile phone addiction. Self-control moderated the association between perceived stress and rumination and between rumination and mobile phone addiction. Importantly, in the affected group, self-control work as moderator at all pathways in the mediational model.

4.1. The mediating role of rumination

Our research revealed that rumination fully mediated the relation

Table 5
Independent-samples *t*-test for the COVID affected group and the COVID unaffected group ($M \pm SD$).

	Group 1	Group 2	*t*
Perceived stress	11.44 ± 3.43	10.03 ± 3.36	4.84***
Rumination	40.79 ± 10.53	35.16 ± 9,85	6.40***
Self-control	38.29 ± 4.35	37.16 ± 5.17	2.70**
Mobile phone addiction	36.92 ± 8.18	32.84 ± 9.26*	5.35***

Note. Group 1 = COVID affected group, Group 2 = COVID unaffected group.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

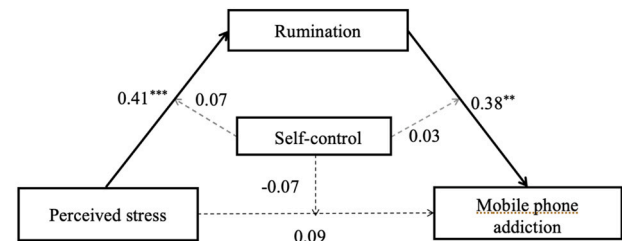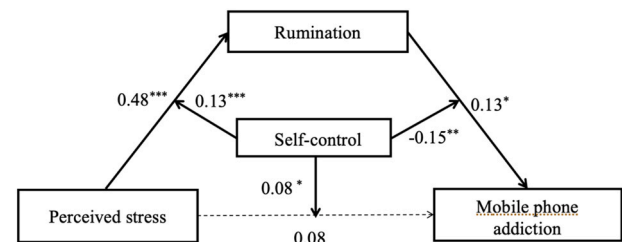between perceived stress and mobile phone addiction, which verifies hypothesis 1 and suggests that the effect of perceived stress on mobile phone addiction is mainly through rumination. In line with the cognitive-behavioral model of PIU (Davis, 2001), this study found that stressful life event can be considered as a distal cause and rumination as a proximal cause of mobile phone addiction, and the distal factor (i.e., perceived stress) affects mobile phone addiction through proximal factors (i.e., rumination). The results above are similar to previous research that showed that the distal factor (i.e., social anxiety) affects mobile phone addiction through proximal factors (i.e., rumination) (Kong et al., 2020). Our results further expand the theory on the basis of previous studies.

4.2. The moderating role of self-control

Moreover, self-control played a moderating role in the mediation process, supporting Hypothesis 3. For the first stage of the mediation process, with the increase of self-control, the conditional association between perceived stress and rumination became weaker. This was in agreement with previous study that uncovered individuals with low self-control tend to ruminate more frequently when under pressure, in that they are unable to focus attention on one thing and inhibit irrelevant ideas (Sofia & Cruz, 2015). The result also coincides with the dual systems model of self-control (Hofmann et al., 2009). For the second stage of the mediation process, one intriguing finding was that with higher levels of self-control, the conditional relation between rumination and mobile phone addiction became stronger rather than weaker. It seems that high self-control exacerbates the effect of rumination on mobile phone addiction. However, as shown in Fig. 2, it is still very clear that when self-control is at a low level, the score of mobile phone addiction is far higher than that when self-control is at a high level. That is to say, self-control not only does not aggravate the effect of rumination on mobile phone addiction, but also mitigate the effect. The reason for this result may be that regardless of the level of rumination, individuals with low self-control have a very high level of mobile phone addiction, so that although the level of mobile phone addiction is high, the predictive effect of rumination on it is difficult to exhibit. Also, relevant studies have documented that individuals with low self-control are unable to lower the increasing craving and are more likely to engage in mobile phone addiction (Gökçearslan et al., 2016; Liu et al., 2018).

In addition, this study found that the direct relation between perceived stress and mobile phone addiction was not moderated by self-

control, which violates hypothesis 2. One possible reason may be that the direct relation between perceived stress and mobile phone addiction was not significant, thus the moderator of self-control mainly moderates the mediation effect, rather than direct effect. Another reason may be that the level of self-control is significantly higher than that of the un-affected group ($t = 2.70$, $p<0.01$), but the total samples included the affected group and the unaffected group, which may cause moderation effect to be diluted by the unaffected group. This enlightens us to conduct multigroup analysis to further explore the moderating role of self-control in different affected groups.

4.3. Multigroup analysis

We also found that in the unaffected group, self-control did not work as moderator at any stage. In contrast, for individuals of the affected group, self-control moderated the association between perceived stress and rumination, between rumination and mobile phone addiction and between perceived stress and mobile phone addiction. It confirms the A Strengths-Based Perspective (Ungar, 2000) in that individuals would constantly stimulate their internal potential and excellent psychological quality (i.e., self-control, resilience), mobilize all protective resources and realize the dynamic process of good psychological adaptation when face setbacks and difficulties. This can also explain why self-control produces corresponding promotion under strong stress (Alvord & Grados, 2005; Herman-Stahl & Petersen, 1996). Also, new research reveals that as a protective factor, adolescents' personality advantage including self-control can cushion the impact of the stress of the COVID influenza pandemic, and help to maintain their mental health (Liu & Wang, 2021).

4.4. Limitations and implications

Several limitations to this study should be noted. First, the cross-sectional design of the study we used is unable to make use of causal inferences. Future research can adopt longitudinal or experimental designs to confirm the causality among these variables. Second several researchers believe that rumination is similar to self-reflection, which can help individuals take positive steps in dealing with their problems (Treynor et al., 2003). Therefore, whether the positive effect of rumination will affect mobile phone addiction may be a topic worthy of future studies. Third, the self-report method we used may produce social desirability and other biases which limit the validity of the data. Multiple assessments (i.e., teenagers, peers, parents, and teachers) can be adopted in future research to provide more solid evidence. Last but not least, because our participants were from one university selected from just one city, generalization of these findings to other populations should be made with caution. Future research may explore the proposed model among diverse populations. In spite of the limitations, the present study has both theoretical and practical implications. Firstly, to our knowledge, this research is among the first research to shed light on the relation between perceived stress and mobile phone addiction under the context of public health emergency. Also, this study provides important reference for the prevention and intervention of mobile phone addiction among college students in response to major public health events.

5. Conclusions

During the pandemic of COVID-19, perceived stress positively predicted college students' mobile phone addiction. Rumination mediated the relationship between perceived stress and mobile phone addiction. Moreover, self-control moderated the effect of perceived stress on rumination and the effect of rumination on mobile phone addiction. Also, between the COVID affected group and the unaffected group, some differences also be observed in the moderating effect of self-control.

CRediT authorship contribution statement

Bin Zhang: Conceptualization, Methodology, Funding acquisition, Supervision.

Yu Peng: Data curation, Writing- Original draft preparation, Writing-Reviewing and Editing

Huili Mao: Investigation.

Rongting Hu: Investigation.

Declaration of competing interest

None.

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