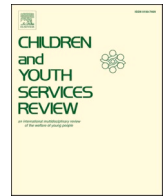




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## Depression and anxiety symptoms are associated with problematic smartphone use under the COVID-19 epidemic: The mediation models

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### ARTICLE INFO

#### Keywords:

COVID-19 epidemic  
Depression  
Anxiety  
Problematic smartphone use  
Resilience  
Perceived social support  
The sense of school belonging

### ABSTRACT

COVID-19 epidemic has brought wide psychological impacts on the young adults. To investigate the depression and anxiety symptoms and their associations with problematic smartphone use under the COVID-19 epidemic, a total of 847 Chinese undergraduate students joined in this study and were measured with their levels of depression and anxiety symptoms, resilience, perceived social support, the sense of school belonging and problematic smartphone use. Results showed that among the Chinese undergraduate students, the disorder rates of depression and anxiety symptoms were 29.16% and 46.64% respectively, and their symptoms ranged from mild to extreme severe. Depression and anxiety symptoms both positively predicted problematic smartphone use. Resilience, perceived social support and the sense of school belonging partially mediated both associations; resilience and the sense of school belonging exerted buffering effects, while perceived social support exacerbated the impacts. The current study advanced our understanding of the COVID-19 impacts and furthermore, suggested the protective factors for mitigating these impacts.

## 1. Introduction

Researchers have analyzed the roles of depression and anxiety symptoms for predicting problematic smartphone use and the theorized model has been proposed which explains that an individual with depression and anxiety symptoms overuses the smartphone as a coping strategy for releasing these negative emotions (Brand, Young, Laier, Wölfling, & Potenza, 2016; Brand, Wegmann, et al., 2019; Kardefelt-Winther, 2014). The fast spreading COVID-19 has greatly elevated the depression and anxiety levels among college students (Hager, Judah, & Milam, 2020; Li, Cao, Leung, & Mak, 2020); therefore, we focused on the associations between these negative affect and problematic smartphone use among the young adults under the status quo. Furthermore, the psychological health protective factors of resilience, perceived social support and the sense of school belonging were tested with their roles in these associations (see Figs. 1 and 2).

### 1.1. Problematic smartphone use

Problematic smartphone use describes the maladaptive smartphone use with the functional impairments on the users (Elhai, Levine, Dvorak, & Hall, 2016; Elhai, Yang, Fang, Bai, & Hall, 2020; Lo Coco et al., 2020). Although problematic smartphone use has not been officially included as a mental disorder in either DSM-5 or ICD-11, researchers have reported many findings in literature. The harmful effects of problematic smartphone use include neck and shoulder pain (Shan et al., 2013), hand dysfunction (İnal et al., 2015), disturbed sleep quality (Hughes & Burke, 2018; Liu, Zhou, Niu, & Fan, 2017) and the mental health issues of loneliness (Enez Darcin et al., 2016), decreased social support (Herrero, Urueña López, Torres, & Hidalgo, 2017) and lower altruistic level (Hao, Jin, Lyu, & Rabia Akram, 2020). Among college students, who are the advocates of cutting-edge technologies, problematic smartphone use is associated with lower grading points and less effective learning style (Lepp, Barkley, & Karpinski, 2014; Samaha & Hawi, 2016). Besides, researchers have discovered the predisposing factors of problematic

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<https://doi.org/10.1016/j.chilyouth.2020.105875>

Received 6 October 2020; Received in revised form 16 December 2020; Accepted 18 December 2020

Available online 25 December 2020

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smartphone use. Mindfulness (Li & Hao, 2019), empathy (Lachmann et al., 2018) and self-control (Jiang & Zhao, 2016) are negatively associated with problematic smartphone use while alexithymia demonstrates positive connection (Hao et al., 2019; Hao & Jin, 2020).

1.2. Depression and anxiety symptoms and problematic smartphone use

Previous studies have reported that both depression and anxiety symptoms are positively associated with problematic smartphone use (Elhai et al., 2020; Elhai, Yang, McKay, & Asmundson, 2020). A theory for understanding these relationships is the Interaction of Person-Affect-Cognition Execution model (I-PACE) (Brand, Young, et al., 2016; Brand, Wegmann, et al., 2019). I-PACE model proposes the determinants of excessive smartphone use including biology, personality, cognition, and psychopathology, etc. This model also suggests that an individual under the stressful condition tends to conduct the maladaptive use of the smartphone as a coping strategy for releasing the negative emotions. COVID-19, which was first discovered in late December 2019 in Wuhan (China), is spreading fast globally. As of 16 December 2020, the World Health Organization have reported 71,919,725 confirmed cases of COVID-19 worldwide, including 1,623,064 deaths (Coronavirus Disease (COVID-19) Dashboard, 2020). The dangerous and unfamiliar virus together with the associated home quarantine and social distancing have brought considerable psychological impacts on the college students by increasing their depression and anxiety symptoms (Hager et al., 2020; Li, Cao, et al., 2020). Following the I-PACE theory, we focused on the depression and anxiety symptoms under the COVID-19 epidemic as the predisposing psychopathology factors and aimed to examine their associations with problematic smartphone use.

1.3. Resilience, perceived social support and the sense of school belonging as mediators

Resilience is defined as a personal quality that enables one to recover from failures and thrive in face of life adversities (Connor & Davidson, 2003; Richardson, 2002). In face of challenging situations, a resilient individual cherishes hope, tolerates the distress and conducts self-

reflections and such qualities help to deal with the stressors efficiently and reduce negative emotions (Bacchi & Licinio, 2017; Simpson & Jones, 2013). This is supported by the findings concerning the COVID-19 that the buffering effect intrigued by resilience was evident for mitigating the depression and anxiety symptoms among the individuals (Barzilay et al., 2020; Labrague & Santos, 2020). Moreover, as a protective factor for securing an individual’s wellbeing, resilience is effective for countering addictive behaviors. Individuals with higher resilience are more capable of maintaining the psychological balance during the aftermath of adversities and this prevents them from falling into the addictive behaviors of gambling (Oei & Goh, 2015) and excessive alcohol consumptions (Krinner, Warren-Findlow, & Bowling, 2020). Furthermore, resilience is negatively associated with internet addiction which is interwoven with problematic smartphone use (Robertson, Yan, & Rapoza, 2018). Based on these evidences, we hypothesized that resilience should mediate and mitigate both the impacts of depression and anxiety symptoms on problematic smartphone use.

Perceived social support refers to the quality of emotional support provided by others and is a major source one counts on in difficult situations (Uchino, 2009; Zhang, Zhang, Zhang, Zhang, & Feng, 2018). Perceived social support could adjust individuals’ perspectives of stressful events because they believe they have the adequate resources to keep off the threats (Miloseva, Vukosavljevic-Gvozden, Richter, Milosev, & Niklewski, 2017). Therefore, such individuals are less likely to be bothered by depression and anxiety that usually come after the stressors such as an epidemic event (Li, Wu, et al., 2020). In addition, perceived social support is related to less addictive behaviors and this is supported by previous findings that social support increases the level of resilience to drug abuse (Nikmanesh & Honakzehi, 2016). The support received from friends and social circles could sufficiently compensate the loneliness, drive away negative emotions and help an individual to refrain from developing addictive behaviors (Costa, Patrão, & Machado, 2019). Perceived social support is negatively associated with problematic smartphone use thereof (P. Wang et al., 2018). Based on these, we hypothesized that perceived social support should mediate and mitigate both associations between depression and anxiety symptoms and problematic smartphone use.

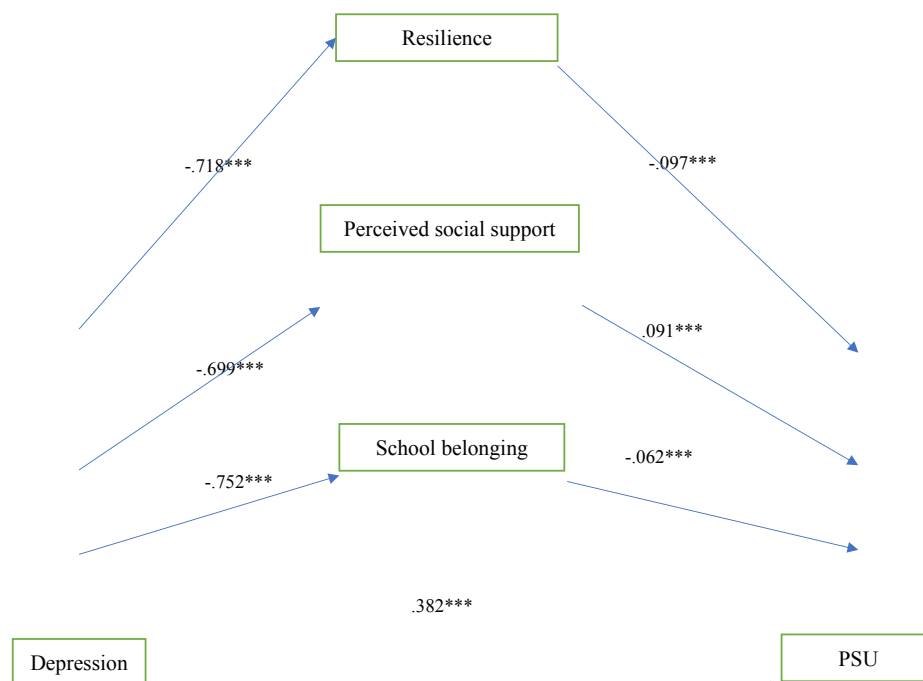


Fig. 1. The model with the mediation effects between depression symptom and problematic smartphone use under the COVID-19 epidemic (n = 847). \*\*\*p < 0.001. PSU = Problematic smartphone use.

The need to belong is the fundamental motivation of human beings and directs human's emotions and behaviors (Baumeister & Leary, 1995). The sense of school belonging describes "the extent to which students feel personally accepted, respected, included, and supported by others in the school environment" (Carol, 1993), and is related to a student's psychological wellbeing. A good sense of school belonging could help a student develop a meaningful life purpose (Lambert et al., 2013) and together with the support provided by the teachers and peers will increase an individual's resilience to manage depression and anxiety symptoms (Shochet, Smith, Furlong, & Homel, 2011; Zhang, Mou, Tong, & Wu, 2018). Moreover, a good sense of school belonging drives away the loneliness by helping a student develop healthy interpersonal relationships (Arslan, 2020). Consequently, the students spend less time on their smartphones seeking in the virtual world for unreal interpersonal interactions and the chance to develop problematic smartphone use is reduced (Wang et al., 2017). We hypothesized that the sense of school belonging should mediate and mitigate both the impacts of depression and anxiety symptoms on problematic smartphone use.

1.4. The current study

Following the I-PACE theory (Brand, Young, et al., 2016; Brand, Wegmann, et al., 2019), we constructed two mediation models. The current study focused on the associations between depression and anxiety symptoms and problematic mobile phone use under the COVID-19 epidemic. Furthermore, we examined the mediation effects of resilience, perceived social support and the sense of school belonging in these relationships. We hypothesized that (1) depression and anxiety symptoms were both positively associated with problematic smartphone use; (2) resilience, perceived social support and the sense of school belonging mediated these relationships and mitigated the impacts.

2. Methods

2.1. Participants and procedure

The method of stratified random cluster sampling was used to recruit the participants from three universities in Northeast China. The survey was conducted in early March 2020 when the COVID-19 was in epidemic in China and all college students were required to remain at home and continued their learning via online courses. Questionnaires were stored in a website (<https://www.wjx.cn/>) and the link was forwarded to the students at the end of the online classes via QQ and WeChat groups. It took 20 minutes to complete the survey. The participants clicked the submit button and answers were collected automatically. A total of 907 students joined in the survey and 847 were valid for analyses afterwards (60 responded with missing data). The average age of the participants was 20.09 years (SD = 1.168). More female students (n = 657, 77.6%) joined in the survey than male students (n = 190, 22.4%). The survey was approved by the Ethics Committee of Liaoning National Normal College and the written consent was obtained from each participant. By online lottery, small gifts were given to participants for joining this survey.

2.2. Measures

2.2.1. Smartphone addiction scale-short version (SAS-SV)

We used the SAS-SV to measure the levels of problematic smartphone use among the participants (Kwon, Kim, Cho, & Yang, 2013). The SAS-SV is a short version of the original SAS. The shortened questionnaire contains 10 items and runs on a 6-point Likert system ranging from 1 = strongly disagree to 6 = strongly agree. Higher scores indicate higher levels of problematic smartphone use. Sample items include e.g., "Missing planned work due to smartphone use" and "Having a hard time concentrating in class, while doing assignments, or while working due to smartphone use". SAS-SV has been widely used and its Chinese version has been proved with great reliability (Elhai et al., 2020; Luk et al., 2018). The Cronbach's alpha in the current sample was 0.844.

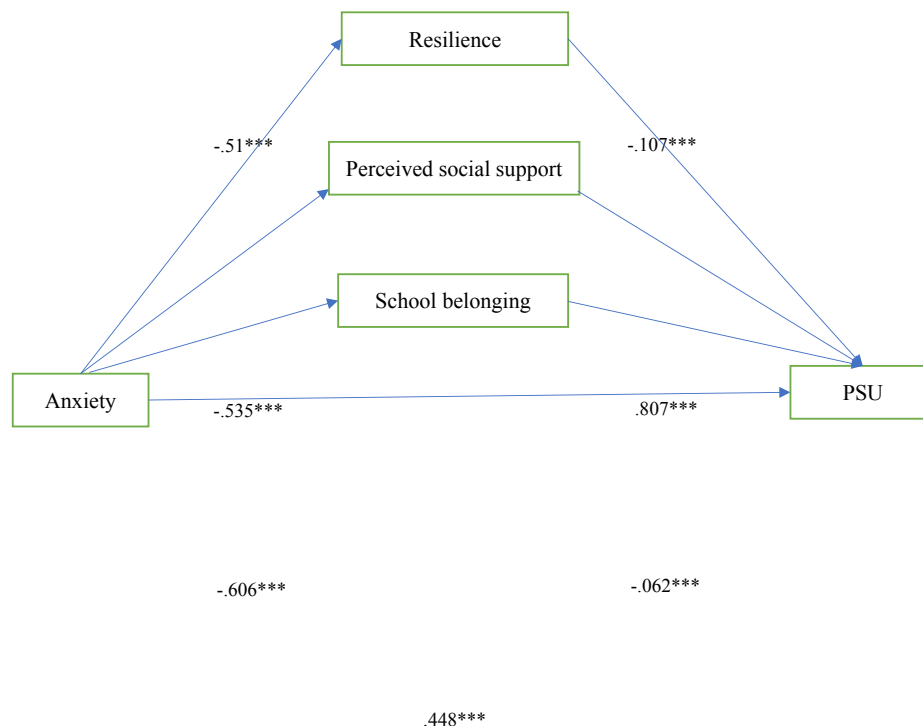


Fig. 2. The model with the mediation effects between anxiety symptom and problematic smartphone use under the COVID-19 epidemic (n = 847). \*\*\*p < 0.001. PSU = Problematic smartphone use.

### 2.2.2. Depression, anxiety, stress scale-21 (DASS-21)

The DASS-21 was used to measure the depression and anxiety symptoms among Chinese undergraduate students under the COVID-19 epidemic (Lovibond & Lovibond, 1995). Each symptom was measured by 7 items with options from 0 = did not apply to me to 3 = applied to me very much. Based on the scores obtained, each symptom was categorized as normal (depression 0–9, anxiety 0–7), mild (depression 10–13, anxiety 8–9), moderate (depression 14–20, anxiety 10–14), severe (depression 21–27, anxiety 15–19) and extreme severe (depression 28+, anxiety 20 + ). Sample items include e.g., “I couldn’t seem to experience any positive feeling at all” (depression); “I was aware of dryness of my mouth” (anxiety). The Chinese version of DASS-21 has been tested with good reliability among Chinese population (Elhai et al., 2020; Wang et al., 2016). The Cronbach’s alphas in the current sample were 0.879 for depression symptoms and 0.84 for anxiety symptoms.

### 2.2.3. The Connor-Davidson resilience scale (CD-RISC)

The CD-RISC running on 5-point Likert system consists of 25 items for measuring an individual’s level of resilience with options from 0 = not true at all to 4 = true nearly all the time. Sample items include e.g., “Past success gives confidence for new challenge” and “Tend to bounce back after illness or hardship”. The Chinese version of CD-RISC works well on Chinese population and has been tested with good validity (Chen et al., n.d.; Tian et al., 2016). The Cronbach’s alpha in the current sample was 0.932.

### 2.2.4. Perceived social support scale (PSSS)

The participants’ levels of perceived social support were measured with PSSS which contains 12 items and runs on a 7-point Likert system with 1 = very strongly disagree and 7 = very strongly agree. Sample items include e.g., “There is a special person who is around when I am in need” and “There is a special person with whom I can share joys and sorrows”. The questionnaire has been widely used among Chinese participants and was proved with good validity (Tian et al., 2016; Zhang, Zhang, et al., 2018). The Cronbach’s alpha in the current sample was 0.943.

### 2.2.5. Psychological sense of school membership scale (PSSM)

The sense of school belonging was measured by PSSM which runs on a 6-point Likert system. It consists of 18 items and ranges from 1 = very strongly disagree to 6 = very strongly agree. Sample items include e.g., “People at this school are friendly to me” and “I am included in lots of activities at this school”. The Chinese version of PSSM has been proved with good validity (Pan, Wang, Song, Ding, & Dai, 2011). The Cronbach’s alpha in the current sample was 0.9.

## 2.3. Data analyses

### 2.3.1. Statistical analyses

We used the SPSS 22 for the statistical analyses of the current study. The significant value was set at 0.05. First, the scores of DASS-21 were calculated to measure the depression and anxiety symptoms among the Chinese undergraduate students under the COVID-19 epidemic. Second, the data were checked with the distribution and we found they were in non-normal distribution. Wilcoxon Mann-Whitney test was used to check the possible differences in the levels of depression and anxiety symptoms, resilience, perceived social support, the sense of school belonging and problematic smartphone use among the male and female participants. Third, Spearman’s analysis was conducted to test the correlations among all the investigated variables. Fourth, model 4 of SPSS macro PROCESS 3.1 (Hayes, 2018) was used to examine the mediation effects of resilience, perceived social support and the sense of school belonging in the relationships between depression and anxiety symptoms and problematic smartphone use respectively by generating bias-corrected bootstrap confidence interval (using 5000 bootstrapping samples). According to Preacher, Rucker, and Hayes (2007) and Hayes

(2015), the analyses via the SPSS macro PROCESS had no requirement on the data distribution.

### 2.3.2. Control variables

Based on the results of previous findings (Demirci, Akgönül, & Akpınar, 2015; van Deursen, Bolle, Hegner, & Kommers, 2015; Wang, Wang, Gaskin, & Wang, 2015), age and gender were significantly correlated with problematic smartphone use and thus were treated as control variables in the mediation analyses afterwards.

## 3. Results

### 3.1. The depression and anxiety symptoms under the COVID-19 epidemic

Our study showed that the frequencies of each symptom were depression (normal  $n = 600$ , 70.84%, mild  $n = 103$ , 12.16%, moderate  $n = 108$ , 12.75%, severe  $n = 18$ , 2.13% and extreme severe,  $n = 18$ , 2.13%) and anxiety (normal  $n = 452$ , 53.36%, mild  $n = 77$ , 9.09%, moderate  $n = 196$ , 23.14%, severe  $n = 70$ , 8.26% and extreme severe,  $n = 52$ , 6.14%) (see Table 1).

### 3.2. Testing for the differences in the participants’ gender

The results of the Wilcoxon Mann-Whitney test indicated that male students showed significantly higher levels in depression and anxiety symptoms and resilience. No significant difference was observed in other variables (see Table 2).

### 3.3. Correlations among the investigated variables

The results of Spearman’s analysis showed that all the investigated variables were in significant associations with each other. Depression and anxiety symptoms were positively correlated with problematic smartphone use. Resilience, perceived social support and the sense of school belonging were negatively associated with depression and anxiety symptoms and problematic smartphone use (see Table 3).

### 3.4. Testing for the mediation effects of resilience, perceived social support and the sense of school belonging

The results of the mediation analyses showed that after controlling for age and gender, depression symptom predicted problematic smartphone use ( $\beta = 0.329$ ,  $p < 0.001$ ) both directly and indirectly via resilience ( $\beta = 0.07$ , 95% confidence interval 0.033 to 0.113), perceived social support ( $\beta = -0.064$ , 95% confidence interval  $-0.112$  to  $-0.021$ ) and the sense of school belonging ( $\beta = 0.047$ , 95% confidence interval 0.003 to 0.092) (see Tables 4 and 5). The analysis on the association between anxiety symptom and problematic smartphone use yielded similar results. After controlling for age and gender, anxiety symptom predicted problematic smartphone use ( $\beta = 0.402$ ,  $p < 0.001$ ) directly and indirectly via resilience ( $\beta = 0.055$ , 95% confidence interval 0.028 to 0.088), perceived social support ( $\beta = -0.046$ , 95% confidence interval  $-0.083$  to  $-0.016$ ) and the sense of school belonging ( $\beta = 0.038$ , 95%

**Table 1**  
The COVID-19 depression and anxiety symptoms.

Rating	Depression	Anxiety
Normal	600(70.84%)	452(53.36%)
Mild	103(12.16%)	77(9.09%)
Moderate	108(12.75%)	196(23.14%)
Severe	18(2.13%)	70(8.26%)
Extreme severe	18(2.13%)	52(6.14%)
Total	847	847

Note.  $N = 847$ , Normal (depression 0–9, anxiety 0–7), Mild (depression 10–13, anxiety 8–9), Moderate (depression 14–20, anxiety 10–14), Severe (depression, 21–27, anxiety 15–19) and Extreme severe (depression 28+, anxiety 20 + )



**Table 2**  
Results of Wilcoxon Mann-Whitney test.

Variables	Depression	Anxiety	Resilience	Perceived social support	School belonging	PSU
Male	478.1	478.71	468.26	406.81	409.8	432.84
Female	408.35	408.18	411.20	428.97	428.11	421.44
Z	-3.501***	-3.521***	-2.832**	-1.1	-0.909	-0.566

Note. N = 847, \*\*p < 0.01. \*\*\*p < .001. PSU = problematic smartphone use. Male = 1, female = 2.

**Table 3**  
Spearman correlation coefficients of all the investigated variables.

Variables	1	2	3	4	5	6
1. Depression						
2. Anxiety	0.817***					
3. Resilience	-0.386***	-0.295***				
4. Perceived social support	-0.368***	-0.313***	0.492***			
5. School belonging	-0.417***	-0.356***	0.449***	0.511***		
6. PSU	0.360***	0.393***	-0.229***	-0.118***	-0.216***	
Median	4	6	87	63	79	31
P <sub>25</sub> , P <sub>75</sub>	2,10	2,12	78,97	54,71	70,86	25,36

Note. N = 847, \*\*\*P ≤ 0.001. PSU = Problematic smartphone use. P<sub>25</sub> = 25th percentile, P<sub>75</sub> = 75th percentile. The data were in non-normal distribution and Spearman's analysis was conducted accordingly.

**Table 4**  
Mediation analysis between depression and PSU by Process model 4.

Outcome variables	Independent variables	β	SE	t	P
PSU	constant	29.968***	4.631	6.471	0.000
	Age	-0.150	0.224	-0.670	0.503
	Gender <sup>a</sup>	0.643	0.633	1.016	0.310
	Depression	0.382***	0.038	10.153	0.000
Resilience	constant	93.169***	7.934	11.743	0.000
	Age	0.515	0.383	1.344	0.179
	Gender <sup>a</sup>	-5.766***	1.084	-5.137	0.000
	Depression	-0.718***	0.064	-11.143	0.000
Perceived social support	constant	58.777***	7.027	8.336	0.000
	Age	0.505	0.339	1.488	0.137
	Gender <sup>a</sup>	-0.995	0.960	-1.036	0.300
	Depression	-0.699***	0.057	-12.255	0.000
School belonging	constant	81.162***	6.802	11.933	0.000
	Age	0.151	0.328	0.461	0.645
	Gender <sup>a</sup>	-1.010	0.930	-1.087	0.277
	Depression	-0.752***	0.055	-13.624	0.000
PSU	constant	38.709***	5.087	7.610	0.000
	Age	-0.136	0.220	-0.618	0.536
	Gender <sup>a</sup>	0.110	0.634	0.174	0.862
	Resilience	-0.097***	0.022	-4.358	0.000
	Perceived social support	0.091***	0.027	3.430	0.001
	School belonging	-0.062*	0.027	-2.325	0.020
	Depression	0.329***	0.042	7.797	0.000

Note. N = 847, \*p < 0.05, \*\*\*p < 0.001. PSU = Problematic smartphone use.  
<sup>a</sup> Male = 1, female = 2.

confidence interval 0.003 to 0.076) (see Tables 6 and 7). Namely, resilience, perceived social support and the sense of school belonging partially mediated the effects between depression and anxiety symptoms and problematic smartphone use respectively under the COVID-19 epidemic.

**4. Discussion**

The current study focused on the associations between depression and anxiety symptoms and problematic smartphone use respectively under the COVID-19 epidemic. In addition, we found that both

**Table 5**  
Bootstrapping indirect effect and 95% confidence interval (CI) for the mediation model between depression and PSU by Process model 4.

Indirect paths	Estimated effect	95% CI	
		Lower	Upper
Depression → resilience → PSU	0.07 <sup>a</sup>	0.033	0.113
Depression → Perceived social support → PSU	-0.064 <sup>a</sup>	-0.112	-0.021
Depression → school belonging → PSU	0.047 <sup>a</sup>	0.003	0.092
Total indirect effects	0.053 <sup>a</sup>	0.002	0.105

Note. N = 847. Bootstrap sample size = 5000. PSU = problematic smartphone use.

<sup>a</sup> Empirical 95% confidence interval does not overlap with zero.

relationships were partially mediated by resilience, perceived social support and the sense of school belonging.

We observed that male students had significantly higher scores in both depression and anxiety symptoms. Compared with female students, the COVID-19 associated home quarantine and social distancing pose more trouble to the young male adults who are sports enthusiasts and keen on socializing. In our study, the resilience level of male students was higher than females. This could be explained by that males have more optimistic attitudes than females towards life adversities (Lasota, Tomaszek, & Bosacki, 2020). In addition, the CD-RISC scale (Connor & Davidson, 2003), which assesses the individual, personal strengths and resources, could be more applicable to males (You & Park, 2017).

**4.1. The relationships between depression and anxiety symptoms and problematic smartphone use under the COVID-19 epidemic**

Our study revealed that both depression and anxiety symptoms positively predicted problematic smartphone use, which supported our hypothesis 1. As suggested by the I-PACE model (Brand, Young, et al., 2016; Brand, Wegmann, et al., 2019), individuals with depression and anxiety symptoms depend on the disorderly use of smartphones for releasing their negative emotions. The COVID-19 associated home quarantine, social distancing and online teaching have elevated the students' psychological distress (Li, Cao, et al., 2020) and smartphones are their first and probably the only option to reach out and release the unwanted feelings. In addition, the excessive reassurance seeking motive observed among the distressed individuals (Cougale et al., 2012; Evraire & Dozois, 2011) drives the uncontrollable smartphone use of

**Table 6**  
Mediation analysis between Anxiety and PSU by Process model 4.

Outcome variables	Independent variables	$\beta$	SE	t	P
PSU	constant	28.796***	4.563	6.311	0.000
	Age	-0.144	0.220	-0.656	0.512
	Gender <sup>a</sup>	0.631	0.621	1.016	0.310
	Anxiety	0.448***	0.039	11.562	0.000
Resilience	constant	90.002***	8.253	10.906	0.000
	Age	0.574	0.398	1.444	0.149
	Gender <sup>a</sup>	-5.013***	1.124	-4.462	0.000
	Anxiety	-0.510***	0.070	-7.279	0.000
Perceived social support	constant	56.109***	7.321	7.664	0.000
	Age	0.555	0.353	1.572	0.116
	Gender <sup>a</sup>	-0.347	0.997	-0.348	0.728
	Anxiety	-0.535***	0.062	-8.606	0.000
School belonging	constant	78.986***	7.110	11.110	0.000
	Age	0.199	0.343	0.581	0.562
	Gender <sup>a</sup>	-0.377	0.968	-0.390	0.697
	Anxiety	-0.606***	0.060	-10.027	0.000
PSU	constant	38.515***	4.907	7.848	0.000
	Age	-0.118	0.216	-0.547	0.584
	Gender <sup>a</sup>	0.100	0.618	0.162	0.871
	Resilience	-0.107***	0.022	-4.945	0.000
	Perceived social support	0.087***	0.026	0.341	0.001
	School belonging	-0.062*	0.026	-2.414	0.016
	Anxiety	0.402***	0.041	9.889	0.000

Note. N = 847, \*p < 0.05, \*\*\*p < 0.001.

<sup>a</sup> Male = 1, female = 2.

**Table 7**  
Bootstrapping indirect effect and 95% confidence interval (CI) for the mediation model between anxiety and PSU by Process model 4.

Indirect paths	Estimated effect	95% CI	
		Lower	Upper
Anxiety → resilience → PSU	0.055 <sup>a</sup>	0.028	0.088
Anxiety → Perceived social support → PSU	-0.046 <sup>a</sup>	-0.083	-0.016
Anxiety → school belonging → PSU	0.038 <sup>a</sup>	0.003	0.076
Total indirect effects	0.046 <sup>a</sup>	0.006	0.088

Note. N = 847. Bootstrap sample size = 5000. PSU = problematic smartphone use, CI = confidence interval.

<sup>a</sup> Empirical 95% confidence interval does not overlap with zero.

repeatedly checking for updated information about the virus and the status quo (Billieux, Maurage, Lopez-Fernandez, Kuss, & Griffiths, 2015), which also enhances the likelihood to develop problematic smartphone use.

#### 4.2. Mediation effects of resilience, perceived social support and the sense of school belonging

Our study revealed the mediation effects of resilience and the sense of school belonging for mitigating the impacts of both depression and anxiety symptoms on problematic smartphone use. These findings partially supported our hypothesis 2. COVID-19 has escalated into a global pandemic and the associated home quarantine and the social distancing add to the distress level of college students who are more vulnerable to psychological disturbance under stressful situations (Lee & Lee, 2019; Peng et al., 2010). There is a study that reported that under the COVID-19 epidemic, individuals with depression and anxiety symptoms are also observed with low resilience (Barzilay et al., 2020). According to the Matthew effect or “The rich get richer, the poor get poorer” model (Merton, 1968), individuals with adequate resources manage to attain more, while those with less fail to get enough. The

distressed students with low resilience, instead of gaining more psychological toughness to get through the difficulties, fail to become resilient enough to tackle the influence of depression and anxiety. With less resilience, such students tend to lose control over their smartphone use by indulging in the entertaining contents to escape the challenging situation (Kim et al., 2014). This would increase the likelihood of developing problematic behavior.

We observed that the sense of school belonging was another mediator between depression and anxiety symptoms and problematic smartphone use. Among the factors contributing to the psychological distress among college students, the low sense of school belonging could be a critical one (Pittman & Richmond, 2007). The depression and anxiety symptoms emerge with the low sense of school belonging (Arslan, 2020) and such situation could become worse because they are off the campus and confront inadequate face to face communications with teachers and peers due to home quarantine. Again, the Matthew theory (Merton, 1968) suggests that the students with psychological distress and low sense of school belonging could only sense part of the help and kindness offered by the teachers and school administrators away from their homes. Consequently, the psychological detachment from the campus deteriorates. To keep in touch with the academic progression and satisfy their intrinsic need to belong, the students turn to excessive smartphone use for information checking and this behavior would induce problematic use.

In the same model, we observed the mediation effect of perceived social support; however, contrary to our hypothesis 2, it exacerbated the impacts. Perceived social support is effective for mitigating the adverse impacts brought by stressful events and individuals with depression and anxiety symptoms are eager for external support to comfort their hearts (Miloseva et al., 2017). However, the temporarily altered life patterns suggested the other possibility. Smartphone communication is the most common way for maintaining interpersonal relationship among college students and they are used to sending and obtaining support through the cyber connections. This scenario is strengthened by the home quarantine and social distancing during the epidemic. The more social support a student sends and gets, the more time he/she has to spend on the smartphone. The excessive smartphone use under the COVID-19 satisfies an individual’s need to care for others; however, if becoming uncontrollable, the more frequent uses would convert into a problematic behavior.

### 5. Strengths and limitations

Our study focused on the depression and anxiety symptoms and problematic smartphone use among Chinese undergraduate students under the COVID-19 epidemic. In addition, we examined the mediation effects of resilience, perceived social support and the sense of school belonging in these relationships. The current study advanced our understanding of the studied issue and had practical implications as well.

Negative life events such as an epidemic increase an individual’s distress symptom especially among the young adults (Wong, Gao, & Tam, 2007). Our study measured the depression and anxiety levels of Chinese undergraduate students under the COVID-19 epidemic. The results showed that compared with depression, nearly half of the participants had anxiety symptoms ranging from mild to extreme severe. Although the average age of the participants was over 20 years, they are still not well prepared for the emergencies. Our study demonstrated the protective roles of resilience and the sense of school belonging for buffering the impacts of depression and anxiety symptoms on problematic smartphone use. We sincerely hope with our findings, the whole community, while calculating the material losses, pay more attention to the psychological status of the young adults. In addition, measures should be taken by college authorities to train the students’ resilience and enhance their connectedness to schools, so that they are more competent for future challenges.

Despite the findings of the current study, several limitations need to

be addressed. First, the study recruited the undergraduate students from the universities in Liaoning Province in North China which may not generalize to the larger population in the whole country. Second, the gender disparity in the current survey should be balanced and the majority of female participants might impact the results. Third, this cross-sectional study could not build the causality between the negative affect and problematic smartphone use.

## 6. Conclusion

The current study focused on the depression and anxiety symptoms under the COVID-19 epidemic and their associations with problematic smartphone use. Besides, we found the mediation effects of resilience, perceived social support and the sense of school belonging in these relationships. Our findings helped to broaden the understanding of the COVID-19 epidemic and suggested the ways to mitigate its adverse impacts.

## Funding statement

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

## Contributors

Author L.J. and Z.H. designed the study and wrote the protocol. Authors L.J., J.H. and H.A. conducted literature searches and provided summaries of previous research studies. Authors L.J. and Z.H. conducted the statistical analysis. Authors J.H., M.S. and H.M. collected the data. Author L.J. wrote the first draft of the manuscript and all authors contributed to and have approved the final manuscript.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Acknowledgements

Not applicable.

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