



## Research paper

# Prevalence and correlates of PTSD and depressive symptoms one month after the outbreak of the COVID-19 epidemic in a sample of home-quarantined Chinese university students

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## ABSTRACT

**Background:** When COVID-19 emerged in China in late 2019, most citizens were home-quarantined to prevent the spread of the virus. This study explored the prevalence of post-traumatic stress disorder (PTSD) and depression in a sample of home-quarantined college students to identify the psychological distress risk factors.

**Method:** The PTSD and depressive symptoms in the 2485 participants from 6 universities were investigated using online survey versions of the PTSD Checklist Civilian Version and the 9-question Patient Health Questionnaires (PHQ-9), and data on sleep durations, exposure, home-quarantine time and socio-demographic variables were also collected.

**Results:** The PTSD and depression prevalence were found to be 2.7% and 9.0%. Subjectively, feeling extreme fear was the most significant risk factor for psychological distress, followed by short sleep durations, being in their graduating year (4<sup>th</sup> year) and living in severely afflicted areas. Sleep durations was a mediator between exposures and mental health problems.

**Conclusions:** The results suggested that the psychological consequences of the COVID-19 could be serious. Psychological interventions that reduce fear and improve sleep durations need to be made available to the home-quarantined university students, and graduating students and those in the worst-hit areas should be given priority focus.

## Introduction

Around sixteen years after the outbreak of severe acute respiratory syndrome (SARS) in 2003 in Guangdong province, another highly pathogenic coronavirus, the coronavirus disease 2019 (COVID-19), emerged in mid-December, 2019, in Wuhan, Hubei province, China. The disease spread rapidly across all the Chinese provinces within a few days for several reasons. First, the local government did not realize that the disease had human-to-human transmission characteristics. Second, it was the beginning of China's Spring Festival travel rush and local

university students were all leaving for the holidays. On January 21<sup>st</sup>, Beijing finally announced that the virus had human-to-human transmission characteristics, which caused widespread public panic. Local governments across China then issued a first level public health alert and advised most citizens into home-quarantine to reduce the risk of transmission. By March 11, about 80,963 people in China had contracted the virus, of which 4,492 were seriously ill, and 3,162 had died.

Unlike individual level traumatic events, the COVID-19 outbreak has been a continuing crisis for every member of society. It is well known that stressful events such as natural disasters and man-made

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traumas can have a significant mental health impact and can result in conditions such as posttraumatic stress disorder (PTSD) and depression (Kopala-Sibley et al., 2016; Plexousakis et al., 2019; Schwartz et al., 2019). However, the impact of acute, pervasive, and continuing stressors on societal and individual psychologies, such as those associated with highly infectious and fatal disease outbreaks (Leppin and Aro, 2009) is poorly understood. Further, little is known about the prevalence and risk factors for mental health problems when faced with such stressors. Studies based on the similar 2003 SARS epidemic outbreak indicated that during the epidemic, different groups of people from the general public to health care workers had varying degrees of psychological problems such as fear and worry (Loh et al., 2005; Mihashi et al., 2009), PTSD and depression (Chen et al., 2006). It was also found that a number of SARS-related stressors predicted psychological symptoms in a sample of college students (Main et al., 2011). To date, there have been no studies on the psychological effects of the new coronavirus on the general population. However, it is expected that the need for psychological intervention will gradually increase and prompt rapid and urgent research on the associated psychological effects (Duan and Zhu, 2020). Therefore, as information available from previous studies is very limited, more research is needed to understand the psychological impact of the COVID-19 epidemic.

As China has around 33 million students studying on college campuses, the psychological impact of the new COVID-19 is a public health concern. In contrast to common life stressors (Duan and Zhu, 2020; Liu et al., 2020; Qian et al., 2020; Zhang et al., 2020), as the COVID-19 infection is acute and can spread rapidly, it presents as an uncontrollable stressor. Therefore, given the current worldwide concern over the COVID-19 epidemic, studies on the prevalence and risk factors for potential mental health problems could assist school counselors prevent, target or deal with the possible negative psychological consequences of epidemics on general college student populations.

During the SARS outbreak, as many people suffered from poor sleep and short sleep durations because of anxiety and depressive symptoms (Chen et al., 2006; Johal, 2009), it is reasonable to assume that a higher exposure leads to less sleep, which in turn increases the risk of mental illness. It is therefore necessary to understand the possible relationships between the COVID-19 pandemic, sleep duration and underlying mental illnesses in the college student population. Many people chose to self-isolate in their homes when the outbreak was announced. However, based on a study published from the SARS epidemic, the longer the isolation, the higher the possibility of psychological distress (Reynolds et al., 2008). Therefore, it is necessary to explore the relationship between the time spent in home-quarantine and mental illness to understanding the effect of major epidemic disease outbreaks on people's psychology. Such studies would improve knowledge on the psychological adjustment mechanisms needed to ensure the general well-being of the population. Based on previous studies, the following hypotheses are therefore proposed:

**Hypothesis 1.** Various degrees of exposure to the COVID-19 epidemic predict PTSD or depression.

**Hypothesis 2.** Longer home-quarantine times predict PTSD or depression.

**Hypothesis 3.** Shorter sleep durations predict PTSD or depression.

**Hypothesis 4.** Sleep duration mediates the association between number of exposures and psychopathology

## 2. Methods

### 2.1. Participants and procedure

The study protocol was approved by the Ethics Committee of the Sichuan Psychology Association. As part of the Surveys on the Behavior and Psychological Health Project affected by the COVID-19 (SBPHP\_

COVID-19), the surveys consisted of a series of web-based self-report surveys for adolescents, undergraduate students and working adults.

A baseline undergraduate student survey for this project was conducted using convenience sampling in six universities in Chengdu and Chongqing, two large cities in southwest China. An invitation letter was sent to the Psychology Associations in Chengdu and Chongqing, and four universities in Chengdu and two universities in Chongqing volunteered to participate in the survey. Approximately 20 classes from each university with between 20–60 students each were selected. Therefore, in total 3,610 students from 120 classes at the six universities were invited to participate in the survey.

The survey was completed on the Chinese Star Survey website between 20 February and 27 February, with the relevant smartphone link having been pushed to the WeChat student group by the class instructor. Before the start of the investigation, the details of the investigation were given by the class instructor to all participants, who then gave their electronic informed consent by signing the first page of the survey. Each student who completed the survey also had the chance to receive random WeChat Lucky Money of 1-10 CNY. Of the 3,610 students, 2501 finally completed the survey, a response rate of 69.3%. All surveys were anonymous, but as the survey is to be used again in the future, all participants were asked to give the last four digits of their phone number.

### 2.2. Measures

Data on demographic characteristics: sex, age and university year (1-4): were also collected from each participant. Depression, PTSD, sleep duration, home-quarantine duration, and exposures were measured as outlined in the following.

#### 2.2.1. PTSD

With a focus on the previous four weeks, the PTSD was assessed using the 17 item PTSD Check List-Civilian Version (PCL-C) (Weathers et al., 1999) on a five-point Likert scale ranging from 1 (not at all) to 5 (extremely), with the total score ranging from 17 to 85. Higher scores indicated higher PTSD levels, with scores of 38 or higher being considered probable PTSD (Dobie et al., 2002; Harrington and Newman, 2007). This scale has demonstrated good internal and test-retest reliability in a Chinese sample (Jin et al., 2014). In the current study, the Cronbach's  $\alpha$  was 0.915.

#### 2.2.2. Depression

Also with a focus on the previous four weeks, depression was measured using the Patient health Questionnaire-9 (PHQ-9) (Kroenke et al., 2001) on a 4-point Likert scale from 0 (never) to 3 (nearly every day), with the total score ranging from 0 to 27 and a recommended cutoff score of 10 (Manea et al., 2012). This scale has also been widely used with Chinese populations and has demonstrated excellent psychometric properties (Wang et al., 2014). The Cronbach's  $\alpha$  for the scale was 0.870 in this study.

#### 2.2.3. Sleep duration

Sleep duration was determined from the question: "How much sleep have you had on average every night over the past four weeks?" The participants were categorized into six groups based on their reported average sleep durations: <6 hours/night,  $\geq 6$  to <7 hours/night,  $\geq 7$  to <8 hours/night,  $\geq 8$  to <9 hours/night,  $\geq 9$  to <10 and  $\geq 10$  hours/night (Swinkels et al., 2013): with <6 hours/night being seen as a short sleep duration (Sun et al., 2018).

#### 2.2.4. Duration of home-quarantine

Home isolation duration was determined with the question: "How much time on average have you spent in quarantine from the outside since the COVID-19 outbreak?" Participants were categorized into 5 groups: None, < 1 week, 1-2 weeks, 2-4 weeks, and >4 weeks.

### 2.2.5. Exposure

A COVID-19 exposure scale was adapted from a modified version of the disaster exposure scale based on DSM-IV criteria for PTSD. The scale includes eight objective items coded as yes or no: people infected in their communities; living in the worst-hit areas; know a person who died of the infection; neighbors infected; friends infected; relatives infected; exposure to stressful media messages; and family members infected: and one item related to the subjective fear of contamination, also coded as yes or no. The total score for the objective and subjective experiences was calculated by adding up the yes responses.

### 2.3. Statistical Analysis

One-way ANOVA or *t* tests were used to examine the associations between the categorical variables. Multiple linear regression analyses were performed to identify the predictors for the PTSD PCL-C and Depression PHQ-9 Scale scores, with a *p* value of less than 0.01 being considered significant. The bias-corrected bootstrap method in the PROCESS macro within SPSS 22.0 (IBM, Chicago, IL, USA) was used to evaluate the proposed direct or indirect effects of exposure severity on PTSD or depression via sleep durations.

## 3. Results

### 3.1. Sample characteristics

In total, 2501 undergraduate students completed the survey. However, 16 were eliminated because of illogical answers, such as all choices being one or zero. Therefore, 2485 participant surveys were used in the analysis, which were made up of 1525 females and 960 males with a mean age of 19.81 years (SD, 1.55 years; range, 16–27 years). The majority of participants had no siblings (57.3%) and most lived at home (90.9%). The study sample demographic characteristics are shown in Table 1.

### 3.2. Exposure to COVID-19

The COVID-19 exposure was as follows: 10.5% reported that there were infected people in their communities; 9.8% reported that they were living in the worst-hit areas; and 13.8% reported feeling extreme fear. Few participants knew people that were infected: 1/2485 participants reported that family members were infected; 7/2485 reported that relatives were infected; 6/2485 reported that friends were infected; 8/2485 reported that their neighbors were infected; and 2/2485 reported that someone they knew had died from the COVID-19 infection. However, all participants reported that they had been exposed to stressful mass media/social media information (Table 1).

### 3.3. Prevalence of PTSD and depression, duration of home-quarantine, and sleep durations

The prevalence of probable PTSD and depression was determined to be 2.7% and 9.0%. Sleep durations per night since the outbreak of the COVID-19 were as follows: <6 hours (*n*=67, 2.7%), 6–7 hours (*n*=134, 5.4%) 7–8 hours (*n*=822, 33.1%), 8–9 hours (*n*=700, 28.2%), 9–10 hours (*n*=601, 24.2%) and >10 hours (*n*=161, 6.5%).

Most of the sample (*n*=2229, 89.7%) had chosen to stay at home during the epidemic, with the home-quarantine duration being: <1 week (*n*=147), 1–2 weeks (*n*=242), 2–4 weeks (*n*=1704) and >4 weeks (*n*=136).

### 3.4. Comparative analysis of the PCL-Total score and the PHQ-9 Total score stratified by demographic characteristics and the isolation and sleep durations

One-way ANOVA and *t* test calculations were used to assess the

**Table 1**  
Study Sample Demographic Characteristics (*n*=2485).

	N	%
<b>Variable</b>		
<b>Total</b>	2485	100
<b>Age, yr</b>		
16-19	1166	46.9
20-23	1183	47.6
24-27	136	5.5
<b>Gender</b>		
Male	960	39.2
Female	1525	60.8
<b>Only child</b>		
Yes	1061	42.7
No	1424	57.3
<b>University Year</b>		
1st year(freshman)	977	39.3
2nd year(sophomore)	778	31.3
3rd year(junior)	519	20.9
4th year(senior)	211	8.5
<b>Where you live</b>		
Home	2260	90.9
Dormitory	195	7.8
Other places	30	1.3
<b>Type of exposure</b>		
<b>Felt extreme fear</b>		
Yes	343	13.8
No	2142	86.2
<b>People infected in their communities</b>		
Yes	105	4.2
No	2380	95.8
<b>Family members infected</b>		
Yes	1	<0.1
No	2484	>99.9
<b>Relatives infected</b>		
Yes	7	0.3
No	2478	99.7
<b>Friends infected</b>		
Yes	6	0.2
No	2479	99.8
<b>Neighbors infected</b>		
Yes	8	0.3
No	2477	99.7
<b>Living in the worst-hit areas</b>		
Yes	244	9.8
No	2241	90.2
<b>Know someone who died of the infection</b>		
Yes	2	<0.1
No	2483	>99.9

differences in the depression and PTSD between the subgroups which were stratified by gender, age, only-child status, university year, place of residence, type of exposure, sleep duration, and home-quarantine duration. It was found that people with short sleep durations (<6 h/night) were more likely to experience PTSD and depressive symptoms, and that the mean PTSD and depression scale scores were higher in those that felt extreme fear, lived in the worst-hit areas and were in their final year of university (Table 2).

### 3.5. Ability of exposure variables and sleep duration to predict depression or PTSD

The regression model indicated that feeling extreme fear was the most significant predictor for both depression and PTSD, followed by short sleep duration, living in the worst-hit areas, and being a graduating/final year student. In contrast, home-quarantine duration, age, and only-child status did not predict either depression or PTSD (Table 3).

### 3.6. Bias-corrected bootstrap testing

Bias-corrected bootstrap testing showed that the number of

**Table 2**  
Comparative analysis of the PCL-Total score and PHQ-9.

Total score one month after the outbreak stratified by demographic, isolation time and sleep duration (n = 2485)						
Measure	PCL-Total score (Mean ± SD)	F/t	p	PHQ-9 Total score' (Mean ± SD)	F/t	p
<b>Age, yr</b>		2.01	0.13		0.86	0.42
16-19 (n=1166)	21.02 ± 6.21			3.42 ± 4.19		
20-23 (n=1183)	21.34 ± 6.09			3.56 ± 4.03		
24-27 (n=136)	22.04 ± 6.97			3.86 ± 4.24		
<b>Gender</b>		2.01	0.04		1.76	0.08
Male (n=960)	20.92 ± 6.29			3.33 ± 4.13		
Female (n=1525)	21.43 ± 6.14			3.63 ± 4.10		
<b>Only child</b>		5.73	0.02		0.83	0.40
Yes (n=1061)	21.53 ± 6.43			3.43 ± 4.12		
No (n=1424)	20.83 ± 5.86			3.57 ± 4.11		
<b>University Year</b>		9.89	<0.001		7.18	<0.001
1st year (n=977)	20.85 ± 5.94			3.31 ± 3.98		
2nd year (n=778)	21.15 ± 6.02			3.47 ± 4.15		
3rd year (n=519)	21.21 ± 5.76			3.45 ± 3.89		
4th year (n=211)	23.39 ± 8.35			4.74 ± 4.89		
<b>Where you live</b>		1.49	0.23		0.21	0.81
Home (n=2260)	21.17 ± 6.04			3.50 ± 4.11		
Dormitory (n=195)	21.97 ± 8.07			3.56 ± 4.22		
Other places (n=30)	21.13 ± 4.10			3.97 ± 4.20		
<b>Type of exposure</b>						
<b>Felt extreme fear</b>		14.07	<0.001		9.15	<0.001
Yes (n=343)	25.44 ± 8.94			5.37 ± 4.86		
No (n=2142)	20.56 ± 5.35			3.21 ± 3.90		
<b>People infected in their communities</b>		1.45	0.14		2.58	0.01
Yes (n=105)	22.11 ± 6.13			4.52 ± 4.27		
No (n=2380)	21.19 ± 6.20			3.47 ± 4.10		
<b>Living in the worst-hit areas</b>		5.11	<0.001		5.51	<0.001
Yes (n=244)	23.15 ± 7.81			4.88 ± 4.61		
No (n=2241)	21.02 ± 5.97			3.37 ± 4.03		
<b>Home- quarantine duration</b>		0.58	0.68		1.04	0.39
No (n=256)	20.72 ± 6.08			3.13 ± 3.97		
< 1 week (n=147)	21.58 ± 5.72			3.91 ± 4.36		
1-2 weeks (n=242)	21.21 ± 5.77			3.66 ± 4.06		
2 – 4 weeks (n=1704)	21.28 ± 6.27			3.53 ± 4.10		
> 4 weeks (n=136)	21.22 ± 6.85			3.33 ± 4.40		
<b>Sleep duration per night</b>		15.12	<0.001		14.10	<0.001
< 6 hours (n=67)	27.12 ± 10.48			7.05 ± 5.74		
6-7 hours (n=134)	22.73 ± 7.18			4.85 ± 5.09		
7-8 hours (n=822)	21.03 ± 5.77			3.28 ± 3.88		
8-9 hours (n=700)	21.11 ± 5.95			3.33 ± 3.82		
9-10 hours (n=601)	20.73 ± 5.54			3.34 ± 3.94		
> 10 hours (n=161)	20.98 ± 7.12			3.55 ± 4.61		

exposures had a direct effect on PTSD ( $z = 2.271$ , 95%CI: 1.871, 2.670), and depression ( $z = 1.227$ , 95%CI: 0.959, 1.495). Sleep duration was observed to be a mediator between number of exposures and PTSD ( $z = 0.104$ , 95%CI: 0.016, 0.204), or depression ( $z = .065$ , 95%CI: 0.010, 0.126) (Table 4).

**4. Discussion**

This study was the first to evaluate the posttraumatic stress, depressive reactions and psychological consequences in college students

approximately one month after the COVID-19 outbreak in China and identify the related risk factors. While probable one-month PTSD prevalence was found to be only 2.7% of a large Chinese college student sample, probable depression was found to be as high as 9%. Students who felt extremely scared during the outbreak, those living in the worst-hit areas, and graduating/final year students were found to have the highest risk of developing PTSD and/or depression. Shorter sleep durations were also found to be significantly associated with mental health consequences; however, longer home-quarantine was not found to be associated with PTSD or depression.

**Table 3**  
PTSD and depression Multiple regression analysis (n = 2485).

Model	PTSD		Standardized Coefficients Beta	Sig.	Depression		Standardized Coefficients Beta	Sig.
	Unstandardized Coefficients B	Std. Error			Unstandardized Coefficients B	Std. Error		
Gender	0.14	0.26	0.01	0.60	0.01	0.18	0.01	0.99
Only-child	0.64	0.24	0.05	0.02	0.11	0.16	0.01	0.49
University year	0.51	0.13	0.08	<0.001	-0.27	0.09	-0.06	0.002
People infected in their communities	0.66	0.59	0.02	0.27	0.86	0.40	0.04	0.03
Felt extreme fear	4.78	0.35	0.27	<0.001	2.07	0.24	0.17	<0.001
Living in the worst-hit areas	1.39	0.41	0.07	0.001	1.12	0.28	0.08	<0.001
Sleep duration per night	-0.48	0.09	-0.10	<0.001	-0.24	0.06	-0.08	<0.001

**Table 4**  
Mediation analyses results<sup>a</sup>.

Path	Effect	SE	p	95% CI
Exposure (X) → Sleep duration (M) → PTSD (Y)				
Total effect of X on Y	2.375	0.207	<0.001	1.968- 2.781
Direct effect of X on Y	2.271	0.204	<0.001	1.871- 2.670
Indirect effect of X on Y	0.104	0.048	<0.001	0.016- 0.204
X → M	-0.118	0.044	<0.001	-0.204- -0.032
M → Y	-0.881	0.093	<0.001	-1.063- -0.699
Exposure (X) → Sleep duration (M) → depression(Y)				
Total effect of X on Y	1.292	0.139	<0.001	1.021-1.564
Direct effect of X on Y	1.227	0.137	<0.001	0.959-1.495
Indirect effect of X on Y	0.065	0.030	<0.001	0.010-0.126
X → M	-0.118	0.044	<0.001	-0.204- -0.032
M → Y	-0.552	0.062	<0.001	-0.674- -0.430

<sup>a</sup> Bootstrap SEs and 95% CIs were calculated in the indirect effect

Abbreviations: PTSD, Posttraumatic stress disorder; SE, standard error; CI, confidence interval.

As about 89.7% percent of the students in this study were isolated at home, this study basically examined the PTSD and depression prevalence in college students isolated at home because of the COVID-19 outbreak. Almost everyone in the sample had been exposed to unceasingly stressful social media information about the new coronavirus. Faced with the lack of communication clarity common in initial disease outbreak periods, these reports tended to be full of rumors and uncertainty, which possibly amplified people's psychological distress (Johal, 2009; Ma, 2008). Many people therefore believed that this unknown new virus was highly contagious (Xu et al., 2020) and had many unknown transmission routes that could cause death or disability. They also believed that if they caught it, they would not receive good treatment and would infect their families. Because they could do little to change the external situation, in addition to fear and worry, many experienced feelings of helplessness (Zheng et al., 2005), which could partly explain the prominent rate of depression in the sample. Another explanation could be that as the social isolation reduced interpersonal communication, people's feelings of loneliness increased, which resulted in depressive symptoms (Ge et al., 2017; Weiss, 1973).

However, the PTSD (2.7%) and depression (9%) rates were much lower than a sample of 129 quarantined Canadian persons during the SARS epidemic (Hawryluck et al., 2004), who had PTSD and depression rates of 28.9% and 31.2%. In that study, longer quarantine durations were found to be associated with increased PTSD symptom prevalence, which was inconsistent with our results. These differences may have been because the Canadian participants had different levels of contact with the diagnosed patients, which may have increased their contamination fears. The depression prevalence in this study was comparable with the 8.8% estimate found in a general population of 959 Chinese college students using the same screening scale (Zhang et al., 2013). The depression rate, however, was slightly lower than the 11.8% found in an earlier study on Chinese college students based on the BDI scale (Yu et al., 2015). Therefore, the depression rate in the college students during the pandemic was not particularly high, possibly because it had only been a month since the start of the pandemic. Because there have been limited similar studies in the past, it is difficult to directly compare the rates in this study. However, as the college students were found to have higher rates of depression than PTSD, it is recommended that university mental health professionals pay greater attention to the incidence of depression in college student groups. As it is early days in the progression of COVID 19, the longitudinal mental health changes are as yet unknown. Therefore, further studies are needed to provide insight into the psychological impact of the coronavirus epidemic on the public.

The finding that 'feeling extremely scared' had the largest contribution to PTSD and depression after the COVID 2019 outbreak was consistent with previous trauma-related studies (Livanou et al., 2005; Roussos et al., 2005; Tang et al., 2018). However, the objective factor of

'living in the worst-hit area' had a relatively minor contribution. Fear is an adaptive response that initiates defensive behaviors to protect the self from danger, which means that PTSD can occur when fear is inappropriately regulated (Rau et al., 2005). A central PTSD problem has been found to be a reduced capacity to suppress fear even in safe conditions (Norrholm et al., 2011). However, in this study, fear was found to be an important predictor for both PTSD and depression. This was in contrast with previous studies that found that impaired fear inhibition was a biomarker for PTSD but not for depression (Jovanovic et al., 2010). One possible explanation for these results is that in some vulnerable personality types, anger and fear traits may act as moderators or mediators between fear and psychological distress (Lara and Akiskal, 2006). Given the contagious nature of the COVID 2019 and its long incubation period (14 days or more), many people may have feared that they would be unwittingly infected and would spread the disease to their family members. Therefore, psychological interventions that reduce the fear of the pandemic and instill emotional resilience in the people exposed to the pandemic could be helpful in preventing the development of PTSD or depressive symptoms. Further studies after an exposure to epidemics or traumas are needed to clarify the etiology of and relationship between fear and psychological distress.

It is important to note that short but not long sleep durations were found to have a strong association with PTSD and depressive symptoms in the current study. However, these results were in line with a previous meta-analysis that found that short sleep durations (< 6 hours) were associated with a higher risk of depression, and longer sleep durations (> 9 hours) were not associated with a significant risk of depression (Sun et al., 2018). The strong association between short sleep duration and PTSD in our results, however, was in agreement with previous studies on veterans (Swinkels et al., 2013) and earthquake survivors (Fan et al., 2017). As it was assumed that sleep duration mediated mental health problems, severe exposure may deteriorate sleep duration, which may then give rise to depression or PTSD, which is consistent with previous SARs studies (Johal, 2009). Other sleep parameters or other variables may also have acted as mediators; however, this requires further study. Nonetheless, these results add to previous studies that suggest that strategies to prevent short sleep durations could substantially reduce the risk of psychological problems from pandemic exposure.

The results of the present study indicated that graduating final year students had more depression and PTSD symptoms than students in the other years. The possible reason could be that as these students are due to complete their degrees this year, the uncertainty about the pandemic effect may have increased their worry about graduating, finding a job or enrolling in further study. This additional stress combined with the effects of the pandemic could be seen to be a dose-effect response that identifies a possible risk for developing mental health problems.

Therefore, to ease their concerns, subsequent psychological interventions should focus on strengthening psychological counseling and emotional comfort for graduating students. Further, the government could formulate special measures to assist these students obtain employment and provide compensatory opportunities for further study.

Despite the importance of the findings, this study had several limitations. First, as the study was focused on college students, the results may not be applicable to other adults or the general population. Second, some other variables, such as personality and coping styles, which could have influenced the results, were not measured in this study. Third, online self-assessments and non-rigorous random sampling could have reduced the representativeness and reliability of the results.

Feeling extreme fear was found to be the most significant risk factor for psychological distress, which indicated that the affected college student population needed to reduce their fear during the pandemic. The results of this study could assist in identifying those college students with an elevated risk of mental health problems so that they can be targeted for appropriate mental health interventions. Therefore, universities need to consider planning for acute and long-term psychological services for the students and special subgroups more vulnerable to fear, graduating seniors, and those living in hardest hit areas.

### Contributors

Wanjie Tang, Sen Chen and Jiuping Xu designed the study and wrote the protocols. Wanjie Tang, Tao Hu, Baodi Hu, Chao Xie, Gang Wang and Chunhan Jin participated in the data collection. Wanjie Tang undertook the statistical analysis, Wanjie Tang wrote the manuscript, which all authors helped revise, and all authors contributed to and approved the final manuscript.

### Authorship and copyright

All authors confirm that the submitted manuscript is an original contribution and has not been previously published, that it is not under consideration for publication elsewhere, and that, if accepted, will not be published elsewhere in similar form in any language, without the consent of Elsevier B.V. We also confirm that all authors contributed significantly to the study.

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### Role of the sponsor

The funding institutions had no role in the study design, data collection and analysis, decision to publish, or preparation of the manuscript.

### Ethical approval

All procedures complied with the ethical standards of the Research Ethics Committee of the Sichuan Psychology Association and the latest version of the Helsinki Declaration.

### Declaration of competing interest

The authors declare that they have no conflicts of interest.

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### Supplementary materials

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