

# **Prevalence of mental health issues and associated risk factors among Chinese international students in US colleges during the COVID-19 pandemic: a cross-sectional study**

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# Prevalence of mental health issues and associated risk factors among Chinese international students in US colleges during the COVID-19 pandemic: a cross-sectional study

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## Abstract

**Background:** Previous studies have shown that COVID-19 increased the prevalence of depression and anxiety among various populations. However, few have explored the mental health issues of Chinese international students in the US and the risk factors involved.

**Objective:** his study examines the prevalence of anxiety and depression among Chinese international students enrolled in US universities during the COVID-19 pandemic and identifies the risk factors pertaining to changes in lifestyle, social support, sleep quality, and the virtual instruction mode to this student population.

**Methods:** This study was conducted via an online cross-sectional questionnaire distributed through snowball sampling. The questions of the survey included demographic information, self-constructed questions on academic performance, financial concerns, use of social media, exercise, and psychological support, the Social Support Rating Scale (SSRS), the Insomnia Severity Index (ISI), the Patient Health Questionnaire-9 for depression (PHQ-9), and the General Anxiety Disorder-7 (GAD-7) for anxiety. Univariate analyses and multivariate logistic regression analysis were performed to identify the associated risk factors.

**Results:** From the 1881 participants, this study found a general prevalence of depression (PHQ-9 score ≥ 5) at 48.6% and that of anxiety (GAD-7 ≥ 5) at 43.0% among Chinese international students in the US during the late COVID pandemic period. Multivariate logistic regression analysis showed that recent traumatic event(s), having friend(s) as tuition source(s), agreeing with and strongly agreeing with the pandemic's impacts on financial status, a little workload, medium workload, a lot of workload, and higher ISI scores to be associated with an increased risk of depression, while being a PhD student, more sources of emotional support, and higher SSRI scores were associated a lower risk of depression. Additionally, having friend(s) as tuition source(s), a little workload, often staying up for online courses, strongly agreeing with remote learning's negative impacts on personal relationships, and higher ISI scores were associated with an increased risk of anxiety, while higher SSRI scores and older ages were associated with a lower risk of anxiety.

**Conclusions:** This study showed a high prevalence of depression and anxiety among Chinese international students in the US. Multiple risk factors pertaining to financial concerns, workload, social support, and sleep quality were identified. It is important for future studies to further investigate this student population and for schools to make adjustments to better accommodate their

psychological needs.

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## Original Manuscript

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**Keywords:** COVID-19; Depression; Anxiety; Epidemiology; International college student; Risk factors; Online survey

### Introduction

Coronavirus disease (COVID-19) was first reported in Wuhan, China, from a series of unexplained pneumonia cases<sup>1</sup>. The 2019-nCoV virus was later identified as the cause of the disease, which could be transmitted between humans through air [2]. Regardless of the rapid response from

healthcare and scientific communities, COVID-19 quickly spread and evolved into a global pandemic, with virus variants emerging in multiple countries. The pandemic has caused substantial economic impacts across the world (McKibbin et al.). At the moment of writing this paper, a total of 185,291,530 cases have been confirmed globally, with 4,010,834 deaths<sup>2</sup>. Meanwhile, non-pharmaceutical governmental interventions and personal preventative practices have been conducted, including social distancing, quarantining, washing hands, and wearing masks, and have been gradually integrated into the social norms of many societies. Together with the advent and systematic administration of the COVID vaccines, a number of countries, including China, have been able to contain the spread of the virus at a well-controlled level and gradually recover from previous lockdowns into a post-COVID period.

Still, the COVID-19 pandemic has raised concerns over its impacts on the mental health of various populations. Previous studies have shown that infectious outbreaks, such as SARS and the influenza pandemic, would trigger an array of mental health issues, owing to an increase of stressors including health-related worries, physical constraints, and financial concerns, etc.<sup>3-6</sup>. Mental health issues hold major impacts on all facets of one's physical and psychological wellbeing and could compromise one's cognitive functions, and thus formulate barriers for personal and academic attainment among college students. One study<sup>7</sup> found that, while psychopathology was not directly associated with grades in college students, it negatively correlated with the students' motivations and learning strategies and, in turn, their academic performances. Emotional challenges are also associated with students' future educational and career outcomes. Lee et al.<sup>8</sup> found that the onset of mental health issues, such as anxiety disorders and mood disorders, was associated with premature termination of college education. Another longitudinal study found that the onset of common mental disorders was also associated with later difficulties in employment<sup>9</sup>. Among these mental disorders, anxiety and depression are the most prevalent<sup>10</sup>.

Mental health issues among college students have increasingly integrated with public concerns in the past decade. A study from 2009 to 2015 showed that, except for bipolar disorder, bulimia, and schizophrenia, a significantly elevated prevalence of mental disorders was observed in college students<sup>11</sup>. Another study on Australian university students discusses various dimensions of pressures that were associated with higher risks of depression, which includes being a first-year student, body-image issues, and lack of confidence. The study also identifies that being a female student, relocation to attend universities, financial concerns, pressure to succeed, lack of confidence, and academic challenges were significantly associated with a higher risk of anxiety<sup>12</sup>. While a multitude of studies have investigated the pandemic-induced epidemiology of depression and anxiety among frontline healthcare personnel, patients, children, adolescents, etc.<sup>13-15</sup>, only a few concerned college students. One of them was an interview survey study by Son et al.<sup>16</sup>, which found that the COVID-19 outbreak increased anxiety among college students due to health-related concerns, difficulties in concentrating, sleep disruptions, decreased social interactions, and concerns over academic performance. Another study also found the disintegration of daily routines and study disruption to be risk factors for depression and anxiety during the pandemic<sup>17</sup>. Other risk factors, such as the amount of exercise and participation in distant learning, have also been identified in Chinese adolescents during the COVID surge<sup>13</sup>, as well as the shared concerns in academic delays and financial stress among university students<sup>18</sup>.

As a special group of US college students, Chinese international students studying in the US cope with more stressors than their peers. Prior to the COVID-19 outbreak, Chinese international students have already been confronting challenges including cultural differences, language acquisition, and adjustments to physical and social environments, etc.<sup>19,20</sup>. Studies have shown that while higher prevalence of mental health issues is observed in international students, this population seeks less help from psychological services<sup>20</sup>. During the pandemic, Chinese international students are challenged not only by the fear of their and their loved ones' health being at risk but also the potential isolation and discrimination stemming from the social stereotypes about Chinese

people<sup>21</sup>. Additionally, with the closure of college campuses, many international students started remote learning by overcoming time differences, in anticipation of potential sleep disruption and social isolation.

Despite the ongoing political and economic pressure, the number of international Chinese students studying in the US has skyrocketed in the past few years, with over 370,000 in the calendar year 2020<sup>22</sup>. To our knowledge, few studies have investigated the impact of the COVID-19 pandemic specifically on Chinese international students in US colleges. Therefore, this study aims to fill this knowledge gap by studying the prevalence of anxiety and depression in this population during the post-COVID period and identifying potential risk factors, including social support, sleep quality, remote learning, exercise, financial status, etc.

## Methods

### Participants

The survey Participants were recruited on WeChat, and data was collected using the Questionnaire Star online survey platform from 12th June 2021 to 14th July 2021. WeChat is a well-established social media in China with over a billion active users. The Questionnaire Star is a WeChat-based online survey platform widely applied in survey studies<sup>23,24</sup>. Snowball sampling method was used.

To be eligible for completing the survey, the participants needed to be: 1) aged 18 and above; 2) Chinese international students currently enrolled in a US university; and 3) volunteer to participate after informed consent. Participants with the following conditions were excluded: 1) self-report history of severe mental illness (e.g., schizophrenia, bipolar disorder, substance abuse etc.) or physical illness (e.g., cancer); 2) unable to complete the survey. This study protocol was approved by the Peking University Sixth Hospital Ethics Committee. Informed consent information was embedded at the beginning of the survey, and the participants were asked to read the informed consent information and click "agree" to start the survey. If participants clicked "disagree", the survey would automatically end.

### Study Design

This cross-sectional study investigated the prevalence of depression and anxiety in the population of Chinese students in US universities and investigated possible risk factors. The survey has a total of 60 items and takes about 5-10 minutes to finish. A minimal possible total response time was set at 180 seconds, assuming the minimal response time for each item at 3 seconds<sup>25</sup>. Three filtering questions were embedded in the questionnaire, including two bogus items (e.g., "please select 'agree' for this question") and one simple math problem (e.g., "what is 31+25"). Returned surveys that were incomplete, had lower-than-minimum total response time, or contained any incorrect response to the filtering questions were excluded.

The survey questions cover the following domains:

- 1) Demographic information: information on gender, age, current grade, current location, area of study, family relationship, existence of recent traumatic events and economic status.
- 2) Self-constructed questions on academic performance (workload, frequency of remote learning, tiredness associated with remote learning, attitude towards remote learning), pandemic's effect on family financial status, social media usage (Chinese social media and US social media), frequency of exercise, access to psychological support (attitude to mental illness, knowledge on mental illness, sources of support).



3) Social Support Rating Scale (SSRS): SSRS is a valid and widely used measure of social support in the Chinese population<sup>26</sup>. SSRS holds a total of 10 items under 3 dimensions: objective support, subjective support, and utilization of support<sup>27</sup>. This study used a modified version edited by Dan Ouyang that accommodates college students; Ouyang's version adapted the wording in some items and added a new item on teacher's support, resulting in a total of 11 items under 3 dimensions<sup>28</sup>.

4) Insomnia Severity Index (ISI): ISI includes 7 items, added up to a maximum of 21 points. The degree of insomnia is assessed by the final score, which is divided into 4 score ranges corresponding with levels of insomnia severity: non-clinically-significant insomnia (0-7), subthreshold insomnia (8-14), moderate severity clinical insomnia (15-21), and severe clinical insomnia (22-28)<sup>29</sup>.

5) Patient Health Questionnaire: the PHQ-9 is a valid depression scale widely applied in both research and clinical setting to test the severity of depression symptoms<sup>30</sup>. PHQ-9 consists of 9 items with a maximum score of 27. Total scores of PHQ-9 correspond with 5 categories: normal (0-4), mild major depressive disorder (5-14), moderate major depressive disorder (15-19), severe major depressive disorder (20-27).

6) Generalized Anxiety Disorder screener: GAD-7 is used to screen anxiety symptoms in the responders. Its validity was tested within both Chinese and US populations<sup>31-33</sup>.

## Data Analysis

After data collection, all responded questionnaires were downloaded from the Questionnaire Star platform for data analysis. Questionnaires with total response time < 180s, and those with incorrect answers to any filter questions were excluded according to the procedure. For the rest of the data, statistical analysis was performed using SPSS Statistics Version 25. Prevalence of depression and anxiety were calculated based on PHQ-9 and GAD-7 scores separately. A cutoff score of 5 points was used, meaning that any responder with a PHQ-9 score  $\geq 5$  would be considered as having depression and any responder with a GAD-7 score  $\geq 5$  would be considered as having anxiety. First, univariate analysis was performed using either t-tests and chi-square tests for continuous and categorical variables, respectively. Variables that demonstrated statistical significance ( $P < 0.05$ ) in the univariate analysis were further entered into multivariate logistic regression analysis with prevalence of depression and anxiety as dependent variables.

## Results

Responses from 1881 participants were included in the data analysis (female  $n = 905$ , 48.1%), with the general prevalence of depression (PHQ-9 score  $\geq 5$ ) being 48.6% and that of anxiety (GAD-7  $\geq 5$ ) being 43.0%. The mean total scores for PHQ-9 and GAD-7 for the entire sample were 6.17 (SD=6.28) and 5.10 (SD=5.48), respectively. Among participants assessed with depression, 537 reported mild, 235 reported moderate, and 143 reported moderate-to-severe depression; among participants assessed with anxiety, 419 reported mild, 48 reported moderate, and 142 reported severe anxiety.

Table(1) summarizes the demographic information and distribution of responses within the sample.

Univariate analysis was conducted to each parameter, using Chi Square or t test depending on the feature of the parameter. Significant associations were found between the risk for depression and education ( $P = 0.001$ ), recent traumatic event(s) ( $P < .001$ ), source of tuition ( $P < .001$ ), family relationships ( $P < .001$ ), pandemic's effects on financial status ( $P < .001$ ), frequency of Chinese social media usage ( $P = 0.027$ ), frequency of US social media usage ( $P = 0.014$ ), frequency of exercise in the past two weeks ( $P < .001$ ), workload for the past two weeks ( $P = 0.027$ ), frequency of staying up for online classes in the past two weeks ( $P < .001$ ), remote learning's effects on personal relationships ( $P < .001$ ), remote learning's effects on academic performance and career ( $P < .001$ ), willingness to seek professional help ( $P < .001$ ), amount of knowledge of common mental disorders ( $P < .001$ ), area of study ( $P = 0.006$ ), number of sources of help for emotional issues ( $P < .001$ ), Social Support Rating Scale score ( $P < .001$ ), Insomnia Severity Index score ( $P < .001$ ), and age ( $P = 0.039$ ). Similarly, significant associations were found between risk for anxiety and recent traumatic event(s) ( $P < .001$ ), source of tuition ( $P < .001$ ), family relationships ( $P < .001$ ), pandemic's effects on financial status ( $P < .001$ ), frequency of US social media usage ( $P = 0.001$ ), frequency of exercise in the past two weeks ( $P < .001$ ), workload for the past two weeks ( $P = 0.001$ ), frequency of staying up for online classes in the past two weeks ( $P < .001$ ), remote learning's effects on personal relationships ( $P < .001$ ), remote learning's effects on academic performance and career ( $P < .001$ ), willingness to seek professional help ( $P < .001$ ), amount of knowledge of common mental disorders ( $P < .001$ ), area of study ( $P = 0.01$ ), number of sources of help for emotional issues ( $P < .001$ ), Social Support Rating Scale score ( $P < .001$ ), Insomnia Every Index score ( $P = 0.001$ ), and age ( $P = 0.015$ ).

		Total (N = 1,881)		No Depression ((PHQ-9 <= 4) (N = 966))		Depression (PHQ-9 > 4) (N = 915)				No Anxiety (GAD-7 <= 4) (N = 1,072)		Anxiety (GAD-7) > 4 (N = 809)			
		N	%	N	%	N	%	X2	P	N	%	N	%	X2	P
<b>Gender</b>	Male	976	51.9	492	50.9	484	52.9	0.726	0.394	544	50.7	432	53.4	1.3	0.254
	Female	905	48.1	474	49.1	431	47.1			528	49.3	377	46.6		
<b>Education</b>	Bachelor	1302	69.2	656	67.9	646	70.6	14.168	<b>0.001</b>	722	67.4	580	69.2	4.365	0.113
	Master	508	27	258	26.7	250	27.3			305	28.5	203	27		
	PhD	71	3.8	52	5.4	19	2.1			45	4.2	26	3.8		
<b>Recent Traumatic event</b>	No	1559	82.9	862	89.2	697	76.2	56.482	<b>&lt;.001</b>	939	87.6	620	76.6	39.002	<b>&lt;.001</b>
	Yes	322	17.1	104	10.8	218	23.8			133	12.4	189	23.4		<b>1</b>
<b>Source of Tuition</b>	Parents and Family Members	1602	85	851	88.1	751	82.1	42.995	<b>&lt;.001</b>	939	97.6	663	82	45.417	<b>&lt;.001</b>
	Friends	46	2.4	7	0.7	39	4.3			9	0.8	37	4.6		
	Bank	71	3.8	20	2.1	51	5.6			24	2.2	47	5.8		
	Income	156	8.3	86	8.9	70	7.7			97	9	59	7.3		
	Other	6	0.3	2	0.2	4	0.4			3	0.3	3	0.4		
<b>Good family relationships</b>	Strongly Disagree	45	2.4	21	2.2	24	2.6	132.01	<b>&lt;.001</b>	23	2.1	22	2.7	112.66	<b>&lt;.001</b>
	Disagree	40	2.1	3	0.3	37	4			6	0.6	34	4.2		<b>1</b>
	Neither	114	6.1	21	2.2	93	10.2			34	3.2	80	9.9		
	Agree	665	35.4	298	30.8	367	40.1			334	31.2	331	40.9		
	Strongly Agree	1017	54.1	623	64.5	394	43.1			675	63	342	42.3		
<b>Pandemic's effects on financial</b>	Strongly Disagree	128	6.8	95	9.8	33	3.6	57.441	<b>&lt;.001</b>	95	8.9	33	4.1	56.789	<b>&lt;.001</b>
	Disagree	276	14.7	167	17.3	109	11.9			187	17.4	89	11		<b>1</b>

status	Neither	679	36.1	358	37.1	321	35.1			406	37.9	273	33.7		
	Agree	611	32.5	269	27.8	342	37.4			298	27.8	313	38.7		
	Strongly Agree	187	9.9	77	8	110	12			86	8	101	12.5		
Frequency of Chinese social media usage	Never	9	0.5	5	0.5	4	0.4	10.961	0.027	7	0.7	2	0.2	6.638	0.156
	Seldom	91	4.8	41	4.2	50	5.5			49	4.6	42	5.2		
	Sometimes	345	18.3	153	15.8	192	21			179	16.7	166	20.5		
	Often	941	50	507	52.5	434	27.4			550	51.3	291	48.3		
	Always	495	26.3	260	26.9	235	27.5			287	26.8	208	25.7		
Frequency of foreign social media usage	Never	57	3	28	2.9	29	3.2	12.467	0.014	32	3	25	3.1	18.97	0.001
	Seldom	235	12.5	101	10.5	134	14.6			116	10.8	119	14.7		
	Sometimes	564	30	277	28.7	287	31.4			295	27.5	269	33.3		
	Often	798	42.4	439	45.4	359	39.2			486	45.3	312	38.6		
	Always	227	12.1	121	12.5	106	11.6			143	13.3	84	10.4		
Frequency of exercise in the past two weeks	Never	23	1.2	5	0.5	18	2	67.948	<.001	6	0.6	17	2.1	70.055	<.001
	Seldom	206	11	75	7.8	131	14.3			91	8.5	115	14.2		
	Sometimes	520	27.6	221	22.9	299	32.7			245	22.9	275	34		
	Often	926	49.2	540	55.9	386	42.2			592	55.2	334	41.3		
	Always	206	11	125	12.9	81	8.9			138	12.9	68	8.4		
Workload for the past two weeks	None	171	9.1	78	8.1	93	10.2	10.994	0.027	82	7.6	89	11	18.777	0.001
	A little	239	12.7	111	11.5	128	14			124	11.6	115	14.2		
	Medium	951	50.6	522	54	429	46.9			586	54.7	365	45.1		
	A lot	472	25.1	229	23.7	243	26.6			253	23.6	219	27.1		
	Too much	48	2.6	26	2.7	22	2.4			27	2.5	21	2.6		
Frequency of staying up due to remote learning (past 2 weeks)	Never	216	11.5	104	10.8	112	12.2	44.156	<.001	116	10.8	100	12.4	54.73	<.001
	Seldom	495	26.3	296	30.6	199	21.7			320	29.9	175	21.6		
	Sometimes	740	39.3	399	41.3	341	37.3			453	42.3	287	35.5		
	Often	361	19.2	142	14.7	219	23.9			154	14.4	207	25.6		
	Always	69	3.7	25	2.6	44	4.8			29	2.7	40	4.9		
Remote learning's negative effects on personal relationships	Strongly Disagree	329	17.5	237	24.5	92	10.1	220.362	<.001	250	23.3	79	9.8	225.201	<.001
	Disagree	726	38.6	457	47.3	269	29.4			503	46.9	223	27.6		
	Neither	444	23.6	171	17.7	273	29.8			199	18.6	245	30.3		
	Agree	313	16.6	86	8.9	227	24.8			105	9.8	208	25.7		
	Strongly Agree	69	3.7	15	1.6	54	5.9			15	1.4	54	6.7		
Remote learning's negative effects on academic performance and future career	Strongly Disagree	268	14.2	192	19.9	76	8.3	163.526	<.001	203	18.9	65	8	170.742	<.001
	Disagree	722	38.4	441	45.7	281	30.7			490	45.7	232	28.7		
	Neither	448	23.8	198	20.5	250	27.3			220	20.5	228	28.2		
	Agree	351	18.7	117	12.1	234	25.6			136	12.7	215	26.6		
	Strongly Agree	92	4.9	18	1.9	74	8.1			23	2.1	69	8.5		
I will seek help from professionals when I think I have	Strongly Disagree	67	3.6	30	3.1	37	4	77.628	<.001	32	3	35	4.3	58.804	<.001
	Disagree	168	8.9	54	5.6	114	12.5			70	6.5	98	12.1		
	Neither	410	21.8	167	17.3	243	26.6			195	18.2	215	26.6		

emotional issues	Agree	883	46.9	483	50	400	43.7			530	49.4	353	43.6		
	Strongly Agree	353	18.8	232	24	121	13.2			245	22.9	108	13.3		
I have a fair amount of knowledge of common mental disorders	Strongly Disagree	54	2.9	29	3	25	2.7	42.949	<.001	30	2.8	24	3	21.809	<.001
	Disagree	170	9	55	5.7	115	12.6			78	7.3	92	11.4		
	Neither	568	30.2	264	27.3	304	33.2			297	27.7	271	33.5		
	Agree	828	44	467	48.3	361	39.5			506	47.2	322	39.8		
	Strongly Agree	261	13.9	151	15.6	110	12			161	15	100	12.4		
Area of study	STEM	710	37.7	331	34.3	379	41.4	10.305	0.006	373	34.8	337	41.7	9.249	0.01
	Non STEM	839	44.6	453	46.9	386	42.2			500	46.6	339	41.9		
	Arts	332	17.7	182	18.8	150	16.4			199	18.6	133	16.4		
Current location	China	1839	97.8	948	98.1	891	97.4	1.242	0.265	1054	98.3	785	97	3.501	0.061
	United States	42	2.2	18	1.9	24	2.6			18	1.7	24	3		
		Mean	SD	Mean	SD	Mean	SD	t	P	Mean	SD	Mean	SD	t	P
Number of sources for help when emotional issues occur		3.27	1.335	3.58	1.33	2.94	1.259	10.639	<.001	3.5	1.336	2.96	1.272	8.811	<.001
Social support rating scale score		39.87	8.24	42.58	7.6	37.01	7.91	15.556	<.001	42.116	7.77	36.89	7.89	14.349	<.001
Insomnia severity index score		4.52	3.555	2.7	2.56	6.43	3.45	-26.678	<.001	2.87	2.609	6.69	3.472	-27.241	0.001
Age		21.41	2.473	21.67	2.52	21.06	2.358	5.321	0.039	21.67	2.556	21.13	2.351	4.803	0.015

**Table 1.** Demographic information of the sample cohort and univariate analyses of risk factors.

Parameters examined with statistical significance were entered into multivariate logistic analyses as predictor variables for the risks of depression and anxiety, respectively. Multivariate logistic regression analysis on depression demonstrated associations between an increased risk for depression and recent traumatic event(s) (OR = 1.833, 95% CI: 1.300-2.584), having friend(s) as tuition source(s) (OR = 3.682, 95% CI: 1.195-11.345), agreeing with (OR = 1.917, 95% CI: 1.060-3.469) and strongly agreeing with (OR = 2.220, 95% CI: 1.127-4.374) the pandemic's impacts on financial status, a little workload (OR = 2.522, 95% CI: 1.424-4.467), medium workload (OR = 1.945, 95% CI: 1.154-3.279), a lot of workload (OR = 2.010, 95% CI: 1.149-3.515), and higher scores on the Insomnia severity index (ISI) (OR = 1.436, 95% CI: 1.371-1.505). A lower risk of depression was associated with factors including being a PhD student (OR = 0.296, 95% CI: 0.142-0.616), more sources of emotional support (OR = 0.853, 95% CI: 0.768-0.949), higher scores on the social support rating scale (SSRI) (OR = 0.965, 95% CI: 0.945-0.984), and older ages (OR = 0.945, 95% CI: 0.898-0.995).

In addition, an increased risk of anxiety was associated with having friends as tuition sources (OR = 4.134, 95% CI: 1.612-10.601), a little workload (OR = 1.814, 95% CI: 1.047-3.141), often staying up for online courses (OR = 1.704, 95% CI: 1.018-2.852), strongly agreeing with remote learning's negative impacts on personal relationships (OR = 3.189, 95% CI: 1.243-8.183), and higher scores on the Insomnia severity index (ISI) (OR = 1.424, 95% CI: 1.362-1.490). A lower risk of anxiety was associated with higher scores on the social support rating scale (SSRI) (OR = 0.964, 95% CI: 0.945-0.984) and older ages (OR = 0.931, 95% CI: 0.886-0.978).

#### Variables

#### Depression

#### Anxiety

		Sig.	OR	95% C.I.for EXP(B)		Sig.	OR	95% C.I.for EXP(B)	
				Lower	Upper			Lower	Upper
<b>Recent Traumatic event</b>		<b>0.001**</b>	1.833	1.300	2.584	0.190	1.246	0.897	1.730
<b>Source of Tuition</b>	Parents and Family Members	Ref				Ref			
	Friends	<b>0.023*</b>	3.682	1.195	11.345	<b>0.003**</b>	4.134	1.612	10.601
	Bank	0.352	1.379	0.701	2.713	0.205	1.505	0.800	2.830
	Income	0.293	1.262	0.818	1.949	0.566	1.136	0.735	1.758
	Other	0.913	1.130	0.128	9.973	0.325	0.351	0.044	2.821
<b>Good family relationships</b>	Strongly Disagree	Ref				Ref			
	Disagree	0.055	4.639	0.968	22.232	0.435	1.679	0.457	6.165
	Neither	0.946	1.034	0.392	2.731	0.224	0.568	0.228	1.414
	Agree	0.433	0.725	0.325	1.618	0.300	0.659	0.299	1.451
	Strongly Agree	0.195	0.591	0.267	1.309	0.109	0.527	0.240	1.154
<b>Pandemic's effects on financial status</b>	Strongly Disagree	Ref				Ref			
	Disagree	0.218	1.482	0.793	2.769	0.810	0.927	0.498	1.724
	Neither	0.056	1.759	0.987	3.135	0.674	1.129	0.641	1.990
	Agree	<b>0.031*</b>	1.917	1.060	3.469	0.174	1.495	0.837	2.671
	Strongly Agree	<b>0.021*</b>	2.220	1.127	4.374	0.112	1.712	0.882	3.325
<b>Frequency of foreign social media usage</b>	Never	Ref				Ref			
	Seldom	0.758	0.884	0.405	1.932	0.845	0.928	0.439	1.963
	Sometimes	0.850	0.931	0.446	1.946	0.462	1.304	0.643	2.647
	Often	0.951	1.023	0.492	2.129	0.838	1.076	0.531	2.182
	Always	0.368	1.437	0.653	3.163	0.807	1.100	0.511	2.368
<b>Frequency of exercise (past two weeks)</b>	Never	Ref				Ref			
	Seldom	0.339	0.521	0.137	1.983	0.176	0.421	0.120	1.475
	Sometimes	0.301	0.500	0.134	1.860	0.346	0.553	0.161	1.896
	Often	0.212	0.433	0.116	1.611	0.201	0.447	0.130	1.534
	Always	0.364	0.534	0.138	2.068	0.298	0.507	0.141	1.823
<b>Workload (past two weeks)</b>	None	Ref				Ref			
	A little	<b>0.002**</b>	2.522	1.424	4.467	<b>0.034*</b>	1.814	1.047	3.141
	Medium	<b>0.012*</b>	1.945	1.154	3.279	0.337	1.277	0.775	2.103
	A lot	<b>0.014*</b>	2.010	1.149	3.515	0.249	1.371	0.802	2.344
	Too much	0.581	0.757	0.281	2.038	0.537	0.734	0.275	1.957
<b>Frequency of staying up due to remote learning (past 2 weeks)</b>	Never	Ref				Ref			
	Seldom	0.450	0.830	0.512	1.345	0.634	1.122	0.699	1.801
	Sometimes	0.695	0.907	0.557	1.476	0.864	1.043	0.647	1.681
	Often	0.576	1.162	0.686	1.968	<b>0.043*</b>	1.704	1.018	2.852
	Always	0.729	0.859	0.364	2.027	0.848	0.922	0.400	2.125
<b>Remote learning's negative effects on personal relationships</b>	Strongly Disagree	Ref				Ref			
	Disagree	0.441	0.858	0.580	1.268	0.220	0.778	0.520	1.162
	Neither	0.774	1.068	0.680	1.678	0.985	0.996	0.634	1.563

	Agree	<b>0.048*</b>	1.670	1.005	2.775	0.152	1.439	0.875	2.366
	Strongly Agree	0.140	2.068	0.788	5.430	<b>0.016*</b>	3.189	1.243	8.183
<b>Remote learning's negative effects on academic performance and future career</b>	Strongly Disagree	Ref				Ref			
	Disagree	0.934	0.982	0.646	1.494	0.607	0.893	0.581	1.374
	Neither	0.642	1.119	0.697	1.798	0.558	1.152	0.718	1.850
	Agree	0.318	1.293	0.780	2.144	0.392	1.246	0.753	2.060
	Strongly Agree	0.474	1.372	0.577	3.261	0.834	1.089	0.490	2.419
<b>I will seek help from professionals when I think I have emotional issues</b>	Strongly Disagree	Ref				Ref			
	Disagree	0.652	1.209	0.529	2.763	0.838	1.086	0.492	2.398
	Neither	0.638	0.828	0.377	1.817	0.418	0.731	0.343	1.560
	Agree	0.930	0.966	0.446	2.091	0.686	0.857	0.407	1.806
	Strongly Agree	0.327	0.665	0.294	1.504	0.300	0.656	0.296	1.456
<b>I have a fair amount of knowledge of common mental disorders</b>	Strongly Disagree	Ref				Ref			
	Disagree	0.196	1.787	0.741	4.312	0.556	0.779	0.338	1.791
	Neither	0.822	1.099	0.482	2.509	0.629	0.825	0.377	1.805
	Agree	0.563	0.784	0.344	1.786	0.258	0.637	0.292	1.392
	Strongly Agree	0.874	1.074	0.444	2.600	0.557	0.776	0.333	1.810
<b>Area of study</b>	STEM	Ref				Ref			
	Non STEM	0.584	0.928	0.712	1.211	0.776	0.963	0.740	1.251
	Arts	0.116	0.759	0.539	1.070	0.354	0.852	0.607	1.196
<b>Number of sources for help when emotional issues occur</b>		<b>0.003**</b>	0.853	0.768	0.949	0.121	0.920	0.829	1.022
<b>Social support rating scale (SSRS) score</b>		<b>0.001**</b>	0.965	0.945	0.984	<b>0.000***</b>	0.964	0.945	0.984
<b>Insomnia severity index (ISI) score</b>		<b>0.000***</b>	1.436	1.371	1.505	<b>0.000***</b>	1.424	1.362	1.490
<b>Age</b>		<b>0.033*</b>	0.945	0.898	0.995	<b>0.005**</b>	0.931	0.886	0.978
<b>Education</b>	<b>Bachelor</b>	Ref							
	<b>Master</b>	0.094	1.274	0.960	1.690				
	<b>PhD</b>	<b>0.001**</b>	0.296	0.142	0.616				
<b>Frequency of Chinese social media usage</b>	<b>Never</b>	Ref							
	<b>Seldom</b>	0.482	0.531	0.091	3.103				
	<b>Sometimes</b>	0.931	1.078	0.198	5.876				
	<b>Often</b>	0.765	0.773	0.144	4.160				
	<b>Always</b>	0.820	0.822	0.151	4.457				

**Table 2.** Independent correlates of depression and anxiety by multivariate logistic regression analysis.

## Discussion

To our knowledge, this is the first study to investigate the prevalence of mental issues as well as the associated risk factors specifically targeting Chinese international students enrolled in US colleges during the COVID pandemic. The results revealed prevalence of depression and anxiety symptoms

(PHQ-9 $\geq$ 5, GAD-7 $\geq$ 5) at 48.6% and 43.0%, respectively. This prevalence rate of depression and anxiety is lower than a previous study on the general population of US college students during COVID using the same measures (PHQ-9 and GAD-7), which reported 80.57% prevalence rate for depression and 71.75% for anxiety<sup>34</sup>, but higher than those found by Liu et al. (2020)<sup>35</sup> (prevalence of depression at 19.06% and prevalence of anxiety at 8.78%) and Cao et al. (2020)<sup>36</sup> (prevalence of anxiety at 24.9 %) on Chinese college students during the COVID pandemic. The results imply that, compared to the general population of Chinese college students, the level of mental issues among Chinese international students studying in the US is significantly higher, approaching that among local US college students. However, this result needs to be viewed with caution as different rating scales were used in different studies.

In our study, PhD students were found to have a significantly lower prevalence of depression than undergraduate students. This is consistent with previous studies showing inverse correlation between education level and depressive symptoms<sup>34,37,38</sup>. Age difference also showed a significant influence on depression and anxiety prevalence rate, consistent with previous studies<sup>38</sup>. Many studies revealed gender differences in prevalence rate of depression and anxiety during COVID-19<sup>34,35</sup>. Our results demonstrated no significant differences between genders in either depression or anxiety prevalence among the Chinese international student population.

The pandemic has ushered in disruptive changes to multiple facets of life for college students, ranging from the transitions to virtual learning spaces, adjustments to isolating lifestyle, and deterioration of social relationships. Besides the high prevalence of mental issues among Chinese international students, the study has identified the associated risk factors, which should be considered in interventions and treatments targeting this student population. Firstly, recent traumatic event(s) has been found to be associated with a higher risk of depression among Chinese international students, similar to Peng's findings of the correlation between depressive symptoms and post-traumatic stress symptoms in the Chinese population<sup>38</sup>. With the first COVID outbreak observed in China, Chinese international students have to face costs directly or indirectly caused by the pandemic, such as the loss of a family member, witnessing a life-threatening experience, disruptions to family or school gatherings due to quarantine, and bankruptcy. Previous studies have shown that the exposure to traumatic events is related to a wide spectrum of adverse psychological and psychiatric outcomes<sup>39,40</sup>. Historically, global crises, such as the Great Depression of the 1930s and SARs, pose risks of traumatic event exposures. Various populations, including college students, are subjected to greater mental-health crises, as trauma magnifies the existent stressors and spawns new ones.

Furthermore, the economic impacts brought by the pandemic have exerted strong influence on the mental health of various populations<sup>41</sup>. Our results showed that concerns over financial status are highly correlated with higher risks of depression and anxiety in Chinese international students. This finding may in turn be related to the association between friends as financial sources and higher risks for depression and anxiety, as the pandemic's adverse impacts on financial status may elevate the likelihood of the students getting financial support from people other than their parents. Another finding worth pointing out is that, as college students started to make adjustments to distant learning, stress from academic life was elevated, and workload became a significant risk factor for depression. This factor may also be considered together with one's frequency of staying up late for online courses due to time differences and, in turn, the sleep problems as indicated by the Insomnia Severity Index scores. Many participants also reported that the remote style of learning has impaired their personal relationships, which, according to our findings, is significantly associated with anxiety.

As suggested in this study, higher scores on the social support rating scale (SSRS) are associated with lower risks of depression and anxiety and more sources for emotional support are associated with lower risks of depression, indicating that good social support can act as a protective factor

against mental health issues. This is also consistent with previous studies that discovered positive association between the level of social support and mental health status<sup>42</sup>. A recent study on the Chinese population has also shown that better scores on SSRS is associated with decreased psychological distress<sup>27</sup>. Therefore, governments and universities are encouraged to make corresponding adjustments and provide services and assistance for the students in need.

Notwithstanding, several limitations in this study should also be pointed out for future investigations to increase data reliability and generalizability. Firstly, the data were collected via an online survey system from anonymous participants. As the survey was distributed through snowball sampling, the demographic information of the participants could not be verified and sampling biases may exist. Therefore, the validity and quality of the responses from a part of the participants and the representativeness of the entire sample remained unclear. Additionally, the study was cross-sectional and thus lacked a longitudinal comparison to investigate the temporal dynamics of the prevalence and risk factors for depression and anxiety within the same population. Lastly, the sample was not evenly distributed regarding the levels of education (Undergraduate, Master, PhD) and current locations, with undergraduate participants and participants located in China accounting for the majority of the sample. This could account for the fact that the prevalence found in this study was different from those of other studies, and the even distribution of education levels could have produced different results. Future work may narrow down the inclusion criteria to only undergraduate students, master students, or PhD students, or to collect relatively the same amount of data from each subgroup to more accurately measure the prevalence and identify risk factors among all college students.

## Reference□

1. He F, Deng Y, Li W. Coronavirus disease 2019: What we know? *J Med Virol*. 2020;92(7):719-725. <https://pubmed.ncbi.nlm.nih.gov/32170865> <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7228340/>. doi: 10.1002/jmv.25766.
2. WHO coronavirus (COVID-19) dashboard. World Health Organization Website. <https://covid19.who.int/>. Updated 2021. Accessed 5:29P.M. CEST, July 9, 2021.
3. Mental health and psychosocial considerations during the COVID-19 outbreak. World Health Organization Website. <https://www.who.int/publications/i/item/mental-health-and-psychosocial-considerations-during-the-covid-19-outbreak>. Updated 2020. Accessed July 9, 2021.
4. Usher K, Durkin J, Bhullar N. The COVID-19 pandemic and mental health impacts. *International Journal of Mental Health Nursing*. 2020;29(3):315-318. <https://pubmed.ncbi.nlm.nih.gov/32277578> <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7262128/>. doi: 10.1111/inm.12726.
5. Douglas PK, Douglas DB, Harrigan DC, Douglas KM. Preparing for pandemic influenza and its aftermath: Mental health issues considered. *International Journal of Emergency Mental Health*. 2009;11(3):137-144.



<https://www.ncbi.nlm.nih.gov/pubmed/20437844>.

6. Pfefferbaum B, North CS. Mental health and the covid-19 pandemic. *The New England Journal of Medicine*. 2020;383(6):510-512. <http://dx.doi.org/10.1056/NEJMp2008017>. doi: 10.1056/NEJMp2008017.

7. Brackney BE, Karabenick SA. Psychopathology and academic performance: The role of motivation and learning strategies. *Journal of Counseling Psychology*. 1995;42(4):456-465. doi: 10.1037//0022-0167.42.4.456.

8. Lee S, Tsang A, Breslau J, et al. Mental disorders and termination of education in high-income and low- and middle-income countries: Epidemiological study. *British Journal of Psychiatry*. 2009;194(5):411-417. <http://bjp.rcpsych.org/cgi/content/abstract/194/5/411>. doi: 10.1192/bjp.bp.108.054841.

9. Mojtabai R, Stuart E, Hwang I, et al. Long-term effects of mental disorders on employment in the national comorbidity survey ten-year follow-up. *Soc Psychiatry Psychiatr Epidemiol*. 2015;50(11):1657-1668. <https://www.ncbi.nlm.nih.gov/pubmed/26211661>. doi: 10.1007/s00127-015-1097-z.

10. Keyes CLM, Eisenberg D, Perry GS, Dube SR, Kroenke K, Dhingra SS. The relationship of level of positive mental health with current mental disorders in predicting suicidal behavior and academic impairment in college students. *Journal of American College Health*. 2012;60(2):126-133. <http://www.tandfonline.com/doi/abs/10.1080/07448481.2011.608393>. doi: 10.1080/07448481.2011.608393.

11. Oswalt SB, Lederer AM, Chestnut-Steich K, Day C, Halbritter A, Ortiz D. Trends in college students' mental health diagnoses and utilization of services, 2009-2015. *Journal of American College Health*. 2020;68(1):41-51. <http://www.tandfonline.com/doi/abs/10.1080/07448481.2018.1515748>. doi: 10.1080/07448481.2018.1515748.

12. Farrer LM, Gulliver A, Bennett K, Fassnacht DB, Griffiths KM. Demographic and psychosocial predictors of major depression and generalised anxiety disorder in Australian university students. *BMC Psychiatry*. 2016;16(1):241. <https://www.ncbi.nlm.nih.gov/pubmed/27422284>. doi: 10.1186/s12888-016-0961-z.

13. Chen X, Qi H, Liu R, et al. Depression, anxiety and associated factors among Chinese adolescents during the COVID-19 outbreak: A comparison of two cross-sectional studies. *Translational Psychiatry*. 2021;11(1):148. <https://www.ncbi.nlm.nih.gov/pubmed/33654058>. doi: 10.1038/s41398-021-01271-4.

14. Wright HM, Griffin BJ, Shoji K, et al. Pandemic-related mental health risk among front line personnel. *Journal of Psychiatric Research*. 2021;137:673-680. <https://dx.doi.org/10.1016/j.jpsychires.2020.10.045>. doi: 10.1016/j.jpsychires.2020.10.045.

15. Xie X, Xue Q, Zhou Y, et al. Mental health status among children in home confinement during the

coronavirus disease 2019 outbreak in hubei province, China. *JAMA Pediatrics*. 2020;174(9):898-900.

<http://dx.doi.org/10.1001/jamapediatrics.2020.1619>. doi: 10.1001/jamapediatrics.2020.1619.

16. Son C, Hegde S, Smith A, Wang X, Sasangohar F. Effects of COVID-19 on college students' mental health in the United States: Interview survey study. *Journal of Medical Internet Research*. 2020;22(9):e21279.

<https://www.ncbi.nlm.nih.gov/pubmed/32805704>. doi: 10.2196/21279.

17. Woon LS, Leong Bin Abdullah, Mohammad Farris Iman, Sidi H, Mansor NS, Nik Jaafar NR. Depression, anxiety, and the COVID-19 pandemic: Severity of symptoms and associated factors among university students after the end of the movement lockdown. *PloS One*. 2021;16(5):e0252481.

<https://search.proquest.com/docview/2534613103>. doi: 10.1371/journal.pone.0252481.

18. Islam MA, Barna SD, Raihan H, Khan MNA, Hossain MT. Depression and anxiety among university students during the COVID-19 pandemic in bangladesh: A web-based cross-sectional survey. *PloS One*.

2020;15(8):e0238162. <https://www.ncbi.nlm.nih.gov/pubmed/32845928>. doi: 10.1371/journal.pone.0238162.

19. Liu M. Addressing the mental health problems of Chinese international college students in the United States. *Advances in Social Work*. 2009;10(1):69-86. <https://search.proquest.com/docview/61378218>. doi: 10.18060/164.

20. Yeung TS, Hyun S, Zhang E, et al. Prevalence and correlates of mental health symptoms and disorders among US international college students. *Journal of American College Health*. 2021;ahead-of-print(ahead-of-print):1-7. <http://www.tandfonline.com/doi/abs/10.1080/07448481.2020.1865980>. doi:

10.1080/07448481.2020.1865980.

21. Zhai Y, Du X. Mental health care for international Chinese students affected by the COVID-19 outbreak. *The Lancet. Psychiatry*. 2020;7(4):e22. [https://dx.doi.org/10.1016/S2215-0366\(20\)30089-4](https://dx.doi.org/10.1016/S2215-0366(20)30089-4). doi: 10.1016/S2215-0366(20)30089-4.

22. U.S. Department of Homeland Security (DHS). Read the 2020 SEVIS by the numbers report. Study in the States Website. <https://studyinthestates.dhs.gov/2021/03/read-the-2020-sevis-by-the-numbers-report>. Updated 2021. Accessed July 11, 2021.

23. Guo Y, Cheng C, Zeng Y, et al. Mental health disorders and associated risk factors in quarantined adults during the COVID-19 outbreak in China: Cross-sectional study. *Journal of Medical Internet Research*. 2020;22(8):e20328. <https://www.ncbi.nlm.nih.gov/pubmed/32716899>. doi: 10.2196/20328.

24. Tian Z, Xie X, Li X, et al. Prevalence of depression and its impact on quality of life in frontline otorhinolaryngology nurses during the COVID-19 pandemic in China. *PeerJ*. 2021;9:e11037.

<https://www.ncbi.nlm.nih.gov/pubmed/33976957>. doi: 10.7717/peerj.11037.

25. Wise SL, Kong X. Response time effort: A new measure of examinee motivation in computer-based tests. *Applied Measurement in Education*. 2005;18(2):163-183.

[http://www.tandfonline.com/doi/abs/10.1207/s15324818ame1802\\_2](http://www.tandfonline.com/doi/abs/10.1207/s15324818ame1802_2). doi: 10.1207/s15324818ame1802\_2.

26. Liu J, Li F, Lian Y. Investigation of reliability and validity of the social support scale. *Journal of Xinjiang Medical University*. 2008;31(1):1-3.

27. Yu H, Li M, Li Z, et al. Coping style, social support and psychological distress in the general Chinese population in the early stages of the COVID-19 epidemic. *BMC Psychiatry*. 2020;20(1):426.

<https://doi.org/10.1186/s12888-020-02826-3>. doi: 10.1186/s12888-020-02826-3.

28. Ouyang D. 社会支持对大学生心理健康的影响[the impact of social supports on college students' mental health]. *青年研究* [Youth Studies]. 2003(3):29-33. doi: 10.3969/j.issn.1008-1437.2003.03.005.

29. Morin CM, Belleville G, Bélanger L, Ivers H. The insomnia severity index: Psychometric indicators to detect insomnia cases and evaluate treatment response. *Sleep (New York, N.Y.)*. 2011;34(5):601-608.

<https://www.ncbi.nlm.nih.gov/pubmed/21532953>. doi: 10.1093/sleep/34.5.601.

30. Kroenke K, Spitzer RL, Williams JBW. The PHQ-9: Validity of a brief depression severity measure. *Journal of General Internal Medicine*. 2001;16(9):606-613. <https://doi.org/10.1046/j.1525-1497.2001.016009606.x>. doi: 10.1046/j.1525-1497.2001.016009606.x.

31. Tong X, An D, McGonigal A, Park S, Zhou D. Validation of the generalized anxiety disorder-7 (GAD-7) among Chinese people with epilepsy. *Epilepsy Res*. 2016;120:31-36.

<https://www.sciencedirect.com/science/article/pii/S0920121115300796>. doi:

<https://doi.org/10.1016/j.eplepsyres.2015.11.019>.

32. Zhang C, Wang T, Zeng P, et al. Reliability, validity, and measurement invariance of the general anxiety disorder scale among Chinese medical university students. *Frontiers in Psychiatry*. 2021;12:750.

<https://www.frontiersin.org/article/10.3389/fpsy.2021.648755>.

33. Spitzer RL, Kroenke K, Williams JBW, Löwe B. A brief measure for assessing generalized anxiety disorder: The GAD-7. *Archives of Internal Medicine*. 2006;166(10):1092-1097.

<http://dx.doi.org/10.1001/archinte.166.10.1092>. doi: 10.1001/archinte.166.10.1092.

34. Wang X, Hegde S, Son C, Keller B, Smith A, Sasangohar F. Investigating mental health of US college students during the COVID-19 pandemic: Cross-sectional survey study. *Journal of Medical Internet Research*. 2020;22(9):e22817. <https://pubmed.ncbi.nlm.nih.gov/32897868>

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7505693/>. doi: 10.2196/22817.

35. Liu X, Liu J, Zhong X. Psychological state of college students during COVID-19 epidemic. SSRN Electronic Journal. 2020. [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=3552814](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3552814). doi: 10.2139/ssrn.3552814.

36. Cao W, Fang Z, Hou G, et al. The psychological impact of the COVID-19 epidemic on college students in China. *Psychiatry Research*. 2020;287:112934. <https://dx.doi.org/10.1016/j.psychres.2020.112934>. doi: 10.1016/j.psychres.2020.112934.

37. McFarland MJ, Wagner BG. Does a college education reduce depressive symptoms in American young adults? *Soc Sci Med*. 2015;146:75-84. <https://pubmed.ncbi.nlm.nih.gov/26513116>  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4676078/>. doi: 10.1016/j.socscimed.2015.09.029.

38. Peng M, Mo B, Liu Y, et al. Prevalence, risk factors and clinical correlates of depression in quarantined population during the COVID-19 outbreak. *J Affect Disord*. 2020;275:119-124. <https://www.sciencedirect.com/science/article/pii/S0165032720323934>. doi: <https://doi.org/10.1016/j.jad.2020.06.035>.

39. Overstreet C, Berenz EC, Kendler KS, Dick DM, Amstadter AB. Predictors and mental health outcomes of potentially traumatic event exposure. *Psychiatry Res*. 2017;247:296-304.  
<https://www.sciencedirect.com/science/article/pii/S0165178115306855>. doi:  
<https://doi.org/10.1016/j.psychres.2016.10.047>.

40. Gerber MM, Frankfurt SB, Contractor AA, Oudshoorn K, Dranger P, Brown LA. Influence of multiple traumatic event types on mental health outcomes: Does count matter? *Journal of Psychopathology and Behavioral Assessment*. 2018;40(4):645-654. <https://doi.org/10.1007/s10862-018-9682-6>. doi: 10.1007/s10862-018-9682-6.

41. World Health Organization. Impact of economic crises on mental health. *Impact of Economic Crises on Mental Health*. 2011. <https://www.cabdirect.org/cabdirect/abstract/20113192511>.

42. Hefner J, Eisenberg D. Social support and mental health among college students. *Am J Orthopsychiatry*. 2009;79(4):491-499. <https://doi.org/10.1037/a0016918>. doi: <https://doi.org/10.1037/a0016918>.

## Supplementary Files