ORIGINAL RESEARCH

Anxiety and Depression Among College Students During the COVID-19 Lockdown: A Cross-Sectional Survey in Jiangsu, China

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Background: This study aimed to explore the levels of anxiety and depression in a sample of home-quarantined college students to identify the risk factors for psychological distress during the COVID-19 lockdown.

Methods: A total of 1156 college students studying in Jiangsu, China, participated from August 5 to August 14. A structured questionnaire was used to collect data anonymously, including demographic characteristics, the generalized anxiety disorder-7 (GAD-7) questionnaire, the patient health questionnaire-9 (PHQ-9), a physical activity scale, and items related to COVID-19. The chi-square test and Fisher's exact test were employed to establish the differences in levels of anxiety and depression across sociodemographic characteristics. Binary logistic regression was applied to measure the predictors of levels of anxiety and depression, and associations were considered significant at p <0.05.

Results: The estimates of anxiety and depression were 48.1% and 57.6%, respectively. The univariate analysis indicated a significant difference in anxiety levels across student grades, whether the student was an only child, the distance from the worst-hit areas, and physical activity/exercise intensity. Physical activity intensity and living in communities with infected people were statistically correlated with the level of depression. Binary logistic regression results indicated that the predictive factors for anxiety were living within a short distance from the worst-hit areas (10~20 km), engaging in higher education (graduate students), and low-intensity daily exercise. Factors statistically predicting depression symptoms were having siblings, a COVID-19 diagnosis in the community and low-intensity daily exercise.

Conclusion: During outbreaks, students in an extremely stressful state are more likely to develop anxiety and depression, particularly postgraduates. Psychological interventions to reduce fears and encourage exercise should be available to home-quarantined college students. Students who live in the worst-hit areas and are not the only child in the family should be prioritized.

Keywords: coronavirus disease 2019, college students, mental health, depression, anxiety, fears

Introduction

The World Health Organization (WHO) recognized COVID-19 as a global pandemic on March 11, 2020, and classified it as an international public health crisis.[1] This global pandemic has caused millions of infections and deaths worldwide. In China, the domestic epidemic is now being controlled regularly.[2] Unlike in other countries where the epidemic continues to spiral out of control, the spread of COVID-19 has been effectively controlled in China.[3] However, with the situation under control, some regions in China began to relax restrictions, leading to the resurgence of the virus.[3]

On July 20, 2021, nine positive COVID-19 samples were examined at Nanjing Lukou International Airport.[4] Many staff tested positive for the Delta variant, the genetic variation of the SARS-CoV-2 virus that evolved during the global spread of COVID-19. The virus spread to multiple provinces via airline passengers, representing the second massive

wave of the pandemic outbreak in China.[5] This variant came from an international flight and was different from the previous variants. Certain changes improved its transmissibility[6] and made it easier for the virus to evade host immunity;[7] consequently, this variant posed a threat to global public health.[8] Delta virus has a higher viral load and duration of shedding,[9] which increases its transmissibility. This variant also lowered vaccine effectiveness and caused vaccine failure (as demonstrated by data from the UK, Qatar, Israel, and other regions).[5] Breakthrough cases were potentially as transmissible as unvaccinated cases. The reduced utility of the vaccine and stronger transmissibility made the Delta variant likely to have negative effects on public psychology.[10]

To slow the infection spread, the government implemented separation measures, with home quarantine and school closures being the most universally used methods to prevent students from infection.[11] The essential pandemic interventions inevitably interrupt the social processes that maintain mental health.[12] Studies have shown that COVID-19 may have a long-lasting effect on emotional well-being during the post-acute phase, especially among vulnerable individuals, such as students.[13] Meanwhile, mandatory home isolation might increase the risk of students experiencing depressed moods, negative emotions, aggressiveness, and cognitive distress.[14] According to a previous investigation, nearly 24.9% of college students reported anxiety symptoms in the first phase of the outbreak in China.[15] A study conducted in Bangladesh showed that most undergraduates experienced depression or anxiety during social isolation.[16] Another study found that isolation posed a mental health threat to students in Dhaka city.[17]

Therefore, given the current national concerns over the COVID-19 epidemic, studies on the risk factors for potential mental health problems could help university administrators prevent, target, or handle the possible negative psychological effects of epidemics on general college student populations.[18]

Here, we conducted a questionnaire survey to evaluate the mental situation of college students maintaining relative isolation during the COVID-19 outbreak. The characteristics that influence the psychological health of students were identified to aid in the design of psychological intervention programs.

Materials and Methods
Participants and Data Collection
This was a cross-sectional survey study using convenience sampling to select students in Jiangsu, China. Considering the severity of COVID-19, the data were collected by an online questionnaire instead of face-to-face interviews. The questionnaire was compiled and completed through the Questionnaire Star Platform (Wenjuanxing, http://www.wjx.cn), relying on WeChat, QQ, and other social software to investigate the basic situation of college students and their psychological status during the epidemic.

The inclusion criteria for this study encompassed all students aged 18 or over studying at universities in Jiangsu and willing to participate. Incomplete and unserious responses, such as answer times less than two minutes or seven questions in a row, were eliminated. The minimum sample size was determined using Raosoft[19] with the confidence level, margin of error, and response distribution set as 95%, 5%, and 50%, respectively. The results showed that the recommended sample size was 384. Data collection was conducted from August 5 to August 14, 2021, approximately two weeks after a state-enforced strict quarantine was implemented after an official announcement regarding the COVID-19 outbreak was transmitted in Jiangsu (July 20, 2021).

Final Formal Questionnaire
The final formal questionnaire consisted of four parts (42 items in total): Part 1: Students' demographic characteristics (12 items in total, eg, gender, grade, and place of residence); Part 2: Generalized Anxiety Disorder 7-item Scale (7 items in total); Part 3: Patient Health Questionnaire 9-item Scale (9 items in total); Part 4: Students' physical activity status (7 items in total). The questionnaire was constructed as follows:

GAD-7
The Generalized Anxiety Disorder Scale assessed the level of anxiety symptoms (GAD-7; Chinese version).[20,21] This scale is a validated 7-item anxiety screening tool designed by Spitzer et al.[20] The GAD-7 measures symptoms of anxiety in the preceding two weeks, with higher scores indicating higher levels of anxiety (eg, "Being unable to stop or control worrying", "Becoming easily annoyed or irritable"). Participants reported the symptom severity as 0 (not at all), 1 (several days), 2 (more than half the days), or 3 (nearly every day). The presented clinical cutoff points are 5 (mild anxiety), 10 (moderate anxiety), and 15 (severe

anxiety).[22,23] The items' dependability and validity have been established and are suitable for Chinese individuals.[21] In the current study, a cutoff score ≥5 was considered to identify anxiety.[24,25] The Cronbach's α for the scale was 0.908 in this survey.

PHQ-9

The level of depression was assessed by the Patient Health Questionnaire (PHQ-9; Chinese version).[26,27] The PHQ-9 also measured symptoms of depression in the preceding two weeks. We used the PHQ-9 as a depression screening tool to measure symptoms of depression (eg, "Trouble falling asleep, or sleeping too much", "Feeling down, depressed, or hopeless").[28] The PHQ-9 instrument includes 9 items that are scored from 0 (never) to 3 (nearly every day) and generates a total score ranging from 0 to 27. An aggregate score ≤4 indicates no depression, 5–9 indicates minimal depression, 10–14 demonstrates moderate depression, 15–19 indicates moderate depression and ≥20 indicates severe depression.[26] The PHQ-9 has been widely and commonly used among Chinese people and has shown effective psychometric qualities.[27] A cutoff score ≥5 was used to screen minimal to extremely severe depression and to determine the existence of depression among the participants.[24,25] In the present study, the PHQ-9 scale was found to have very good reliability (Cronbach's α= 0.886).

Student Physical Activity

A seven-item question assessed participants' physical activity/exercise status, which assessed sedentary, walking, moderate, and vigorous activities. eg, "In the past two weeks, apart from the necessary daily walking hours, how long did you spend on physical exercise?", "During the past two weeks, how long did you perform the high-intensity physical activity per day on average?". Data were converted to metabolic equivalent minutes per week (MET-min/week) using the formula published by Craig.[29] Then we divided the data into low (<600 MET-min/week), moderate (600–2999 MET-min /week) and high physical activity levels (≥3000 MET-min/week).

Data Analysis and Statistics

We used the Statistical Package Programme for Social Science Version 24.0 (SPSS by IBM, USA) for the statistical analysis. Descriptive statistics were used to analyze sociodemographic characteristics, the rates of anxiety (GAD-7), and the rates of depression (PHQ-9). Anxiety and depressive symptoms were recorded as dichotomous variables according to whether the values were above or below the cutoffs for each measurement (0= Not anxiety/depressive at all, 1= Have anxiety/depressive symptoms). The chi-square or Fisher's exact tests were used as appropriate to analyze whether sociodemographic characteristics were associated with anxiety or depression levels. We used binomial logistic regression to determine if sociodemographic and COVID-19-related variables influenced anxiety and depression.

The binomial logistic regression models contained all variables with marginally significant differences (p values < 0.1)[30] in the univariate analysis. The odds ratios (ORs) and 95% confidence intervals (95% CIs) for binomial logistic regression analyses are presented. For all statistical tests, a p value of less than 0.05 was considered statistically significant. Nagelkerke R-square was used to calculate the explained variation. Omnibus tests of the model coefficients were used to detect the overall statistical significance of the prediction models. Imputation and other substitution procedures were not employed. Only respondents who provided complete data were incorporated into the analysis.

Results

In total, 1204 students were invited to participate in this study. Thirty-four did not reply to the invitation, and fourteen questionnaires were eliminated because of inconsistent answers. Finally, 1156 valid questionnaires were screened. The recovery rate was 96.0%.

Sample Characteristics

The sociodemographic characteristics of the participants are shown in Table 1. Most participants were female (n=887; 76.7%), and 23.3% (n=269) were male. A substantial proportion of the participants (n=972; 84.1%) were undergraduate students, and most lived at home (n=763; 66.0%). More than half of the participants (n=594; 51.4%) had siblings, and 50.4% (n=583) were from urban areas.

Table 1 Demographics and Relevant Characteristics of Participants (n=1156)

Variable	Values	N (%)
Sex	Female	887 (76.7%)
	Male	269 (23.3%)
Grade	Freshman	208 (18.0%)
	Sophomore	272 (23.5%)
	Junior	266 (23.0%)
	Senior	226 (19.6%)
	Postgraduate	184 (15.9%)
University located in affected area	Yes	399 (34.5%)
	No	757 (65.5%)
Place of residence	Home	763 (66.0%)
	Dormitory or other places	393 (34.0%)
Living in affected area	Yes	416 (36.0%)
	No	740 (64.0%)
Origin of student	Urban area	583 (50.4%)
	Rural area	573 (49.6%)
Only child status	Only child	562 (48.6%)
	Nononly child	594 (51.4%)
Class peer leader	Yes	279 (24.1%)
	No	877 (75.9%)
Quarantine at school	Yes	677 (58.6%)
	No	479 (41.4%)
Whether there are infected patients in your community	Yes	124 (10.7%)
	No	1032 (89.3%)
Distance from worst-hit areas	1~10 km	302(26.1%)
	10~20 km	113 (9.8%)
	20~50 km	129 (11.2%)
	More than 50 kilometers	612 (52.9%)
Per capita living space	Between 10–20 sq	427 (36.9%)
	Between 20–30 sq	297 (25.7%)
	More than 30 square meters	432 (37.4%)
Physical activity/exercise intensity	Low	433 (37.5%)
	Middle	516 (44.6%)
	High	207 (17.9%)

(*Continued*)

Table 1 (Continued).

Variable	Values	N (%)
Undergraduate's place of residence	Home	687 (70.7%)
	Dormitory or other places	285 (29.3%)
Postgraduate's place of residence	Home	76 (41.3%)
	Dormitory or other places	108(58.7%)
Total		1156 (100%)

Regarding university location, 34.5% (n=399) of the students attended universities located in the area of the outbreak, and 36.0% (n=416) were living in areas where COVID-19 outbreaks had occurred. Approximately 10.7% (n=124) reported infected people in their communities. Over half of the graduate students (n=108; 58.7%) did not return home during the COVID-19 outbreak, while most of the undergraduates (n=687; 70.7%) were already living at home.

Level of Anxiety

The GAD-7 score ranges between 0 and 21. Students in our sample presented a mean score of 4.69. The majority of students in this study did not present anxiety related to COVID-19 (n=600; 51.9%), 38.7% (n=448) had mild anxiety, 6.6% (n=76) had moderate anxiety, and 2.8% (n=32) exhibited severe anxiety, as presented in Table 2. In total, the rate of anxiety in students was 48.1%.

Level of Depression

The PHQ-9 has a score range of 0–27. Less than half of the students had no symptoms of depression (n=490; 42.4%) during the new wave COVID-19 outbreak. Approximately 40.5% (n=468) of students had mild depression, 11.7% (n=135) had moderate depression, 3.3% (n=38) had moderately severe depression, and 2.1% (n=25) had severe depression, as shown in Table 3. The total level of depression among students was 57.6%.

Table 2 Levels of Anxiety of Respondents

Level of Anxiety	Frequency (n)	Percent (%)
Did not present anxiety	600	51.9%
Mild anxiety	448	38.7%
Moderate anxiety	76	6.6%
Severe anxiety	32	2.8%
Total	1156	100.0%

Table 3 Levels of Depression of Respondents

Level of Depression	Frequency (n)	Percent (%)
Not symptoms of depression	490	42.4%
Mild depression	468	40.5%
Moderate depression	135	11.7%
Moderately severe depression	38	3.3%
Severe depression	25	2.1%
Total	1156	100.0%

Factors Affecting Student Group Anxiety and Depression Levels

The significant difference between sociodemographic characteristics and anxiety was illustrated in the univariate analysis. As indicated in Table 4, grade (p=0.005), only child status (p=0.031), distance from worst-hit areas (p=0.040), and physical activity/exercise intensity (p= 0.003) were significantly correlated.

In the univariate examination of the relationship between sociodemographic factors and depression levels, there was a significant difference based on whether there were infected people in the students' communities (p=0.003) and the students' physical activity/exercise intensity (p<0.001). As shown in Table 4, no statistically significant variations in other sociodemographic factors related to depression level were present.

Table 4 Univariate Statistics on the Association Between Sociodemographic Characteristics and Anxiety and Depression Levels (n=1156)

Variable		Total	Anxiety				Depression			
			Yes	No	Statistics	P value	Yes	No	Statistics	P value
		n (%)	n (%)	n (%)			n (%)	n (%)		
Sex	Female	887 (76.7%)	435 (78.2%)	452 (75.3%)	1.363a	0.136	510 (76.6%)	377 (76.9%)	0.021a	0.471
	Male	269 (23.3%)	121 (21.8%)	148 (24.7%)			156 (23.4%)	113 (23.1%)		
Grade	Freshman	208 (18.0%)	97 (17.4%)	111 (18.5%)	14.661a	0.005**	117 (17.6%)	91 (18.6%)	7.996a	0.092
	Sophomore	272 (23.5%)	119 (21.4%)	153 (25.5%)			157 (23.6%)	115 (23.5%)		
	Junior	266 (23.0%)	113 (20.3%)	153 (25.5%)			140 (21.0%)	126 (25.7%)		
	Senior	226 (19.6%)	122 (21.9%)	104 (17.3%)			147 (22.1%)	79 (16.1%)		
	Postgraduate	184 (15.9%)	105 (18.9%)	79 (13.2%)			105 (15.8%)	79 (16.1%)		
University located in affected area	Yes	399 (34.5%)	202 (36.3%)	197 (32.8%)	1.562a	0.117	234 (35.1%)	165 (33.7%)	0.267a	0.325
	No	757 (65.5%)	354 (63.7%)	403 (67.2%)			432 (64.9%)	325 (66.3%)		
Place of residence	Home	763 (66.0%)	356 (64.0%)	407 (67.8%)	1.862a	0.096	432 (64.9%)	331 (67.6%)	0.908a	0.187
	Dormitory or other places	393 (34.0%)	200 (36.0%)	193 (32.2%)			234 (35.1%)	159 (32.4%)		
Living in afffected area	Yes	416 (36.0%)	212 (38.1%)	204 (34.0%)	2.136a	0.081	246 (36.9%)	170 (34.7%)	0.617a	0.235
	No	740 (64.0%)	344 (61.9%)	396 (66.0%)			420 (63.1%)	320 (65.3%)		
Origin of student	Urban area	583 (50.4%)	266 (47.8%)	317 (52.8%)	2.876a	0.051	332 (49.8%)	251 (51.2%)	0.213a	0.344
	Rural area	573 (49.6%)	290 (52.2%)	283 (47.2%)			334 (50.2%)	239 (48.8%)		
Only child status	Yes	562 (48.6%)	254 (45.7%)	308 (51.3%)	3.688a	0.031*	310 (46.5%)	252 (51.4%)	2.693a	0.057
	No	594 (51.4%)	302 (54.3%)	292 (48.7%)			356 (53.5%)	238 (48.6%)		
Class peer leader	Yes	279 (24.1%)	135 (24.3%)	144 (24.0%)	0.012a	0.483	155 (23.3%)	124 (25.3%)	0.637a	0.233
	No	877 (75.9%)	421 (75.7%)	456 (76.0%)			511 (76.7%)	366 (74.7%)		
Quarantine at school	Yes	677 (58.6%)	324 (58.3%)	353 (58.8%)	0.037a	0.447	390 (58.6%)	287 (58.6%)	0.000a	0.523
	No	479 (41.4%)	232 (41.7%)	247 (41.2%)			276 (41.4%)	203 (41.4%)		
Whether there are infected patients in your community	Yes	124 (10.7%)	66 (11.9%)	58 (9.7%)	1.464a	0.133	86 (12.9%)	38 (7.8%)	7.843a	0.003**
	No	1032 (89.3%)	490 (88.1%)	542 (90.3%)			580 (87.1%)	452 (92.2%)		

(*Continued*)

Table 4 (Continued).

Variable		Total	Anxiety				Depression			
			Yes	No	Statistics	P value	Yes	No	Statistics	P value
		n (%)	n (%)	n (%)			n (%)	n (%)		
Distance from worst-hit areas	1~10 km	302 (26.1%)	157 (28.2%)	145 (24.2%)	8.324a	0.040*	183 (27.5%)	119 (24.3%)	5.072a	0.167
	10~20 km	113 (9.8%)	63 (11.3%)	50 (8.3%)			66 (9.9%)	47 (9.6%)		
	20~50 km	129 (11.2%)	65 (11.7%)	64 (10.7%)			82 (12.3%)	47 (9.6%)		
	More than 50 kilometers	612 (52.9%)	271 (48.7%)	341 (56.8%)			335 (50.3%)	277 (56.5%)		
Per capita living space	Between 10–20 sq	427 (36.9%)	219 (39.4%)	208 (34.7%)	3.266a	0.195	260 (39.0%)	167 (34.1%)	3.659a	0.161
	Between 20–30 sq	297 (25.7%)	142 (25.5%)	155 (25.8%)			160 (24.0%)	137 (28.0%)		
	More than 30 sq	432 (37.4%)	195 (35.1%)	237 (39.5%)			246 (36.9%)	186 (38.0%)		
Physical activity/ exercise intensity	Low	433 (37.5%)	235 (42.3%)	198 (33.0%)	11.870a	0.003**	281 (42.2%)	152 (31.0%)	15.798a	0.000***
	Middle	516 (44.6%)	236 (42.4%)	280 (46.7%)			280 (42.0%)	236 (48.2%)		
	High	207 (17.9%)	85 (15.3%)	122 (20.3%)			105 (15.8%)	102 (20.8%)		
Total		1156(100%)								

Note: *p < 0.05 Pearson's r; **p < 0.01 Pearson's r; ***p < 0.001 Pearson's r.

Binary Logistic Regression

A GAD-7 score of 5 or more indicated anxiety symptoms.[31] Binomial logistic regression was performed to determine the effects of the study variables on the likelihood that students had anxiety symptoms (GAD-7≥5). The logistic regression model was statistically significant, x2 (12)= 37.82, p<0.001. The model explained 43.0% (Nagelkerke-R2) of the variance regarding anxiety symptoms, correctly classifying 58.7% of cases. The sensitivity was 51.1%, the specificity was 65.8%, the positive predictive value was 58.1%, and the negative predictive value was 59.2%.

The results of the binary logistic regression analysis of factors associated with anxiety are shown in Table 5. Participants in their sophomore year were 0.596 times less likely than postgraduate students to have anxiety symptoms (OR= 0.596; 95% CI= 0.395–0.900, p= 0.014). Participants in their junior year were 0.566 times less likely than postgraduate students to have anxiety (OR= 0.566; 95% CI= 0.384–0.835, p=0.004). Students who lived 10~20 km from the worst-hit areas were 1.616 times more likely than the students who stayed 50 kilometers away from centers to experience anxiety (OR= 1.616; 95% CI= 1.062–2.458, p= 0.025). Students engaging in low-intensity daily physical exercise were 1.630 times more likely than those engaging in high-intensity daily exercise to experience anxiety symptoms (OR= 1.630; 95% CI= 1.157–2.297, p= 0.005) during the COVID-19 outbreak.

Binomial logistic regression was performed to ascertain the effects of the study variables on the likelihood that students had depressive symptoms (PHQ-9≥5).[31] The logistic regression model was statistically significant, x2 (8)= 34.94, p < 0.001. The model explained 40.0% (Nagelkerke-R2) of the variance in depressive symptoms and correctly classified 58.5% of cases. The sensitivity was 84.7%, the specificity was 22.9%, the positive predictive value was 59.9%, and the negative predictive value was 52.3%.

The results of the binary logistic regression analysis of the factors associated with depression are shown in Table 6. Students who are the only child in their family were 0.786 times less likely than those with siblings to have symptoms of depression (OR= 0.786; 95% CI= 0.619–0.999, p= 0.049). Students who had COVID-19-infected people in their communities were 1.860 times more prone to depression than those who did not (OR= 1.860; 95% CI= 1.224–2.825,

Table 5 Binary Logistic Regression Analysis of the Factors Related to Anxiety

Variable		Anxiety				95% CI	
		B	S.E	P value	OR		
Grade	Freshman	−0.403	0.225	0.073	0.669	0.430	1.039
	Sophomore	−0.517	0.210	0.014*	0.596	0.395	0.900
	Junior	−0.569	0.198	0.004**	0.566	0.384	0.835
	Senior	−0.118	0.205	0.566	0.889	0.594	1.329
	Postgraduate			0.019			
Place of residence	Home	0.082	0.163	0.616	1.085	0.789	1.492
Origin of student	Urban area	−0.164	0.130	0.207	0.849	0.658	1.095
Only child status	Yes	−0.248	0.130	0.056	0.780	0.605	1.006
Distance from worst-hit areas	1~10 km	0.251	0.170	0.139	1.286	0.922	1.793
	10~20 km	0.480	0.214	0.025*	1.616	1.062	2.458
	20~50 km	0.225	0.202	0.265	1.252	0.843	1.860
	More than 50 kilometers			0.112			
Physical activity/exercise intensity	Low	0.489	0.175	0.005**	1.630	1.157	2.297
	Middle	0.186	0.170	0.275	1.204	0.863	1.680
	High			0.009			

Notes: *p < 0.05 Pearson's r; **p < 0.01 Pearson's r; ***p < 0.001 Pearson's r; place of residence: 1 = home, 2 = dormitory or other places; origin of student: 1 = urban area, 2 = rural area; only child status: 1 = yes, 2 = no.
Abbrevitions: B, unstandardized beta coefficient; SE, standard error; OR, odds ratio; 95% CI, 95% confidence interval.

Table 6 Binary Logistic Regression Analysis of the Factors Related to Depression

Variable		Depression				95% CI	
		B	S.E	P value	OR		
Grade	Freshman	0.083	0.211	0.694	1.087	0.718	1.644
	Sophomore	0.123	0.199	0.537	1.131	0.765	1.672
	Junior	−0.129	0.196	0.512	0.879	0.598	1.292
	Senior	0.407	0.209	0.052	1.503	0.997	2.264
	Postgraduate			0.001			
Only child status	Yes	−0.240	0.122	0.049*	0.786	0.619	0.999
Whether there are infected patients in your community	Yes	0.620	0.213	0.004**	1.860	1.224	2.825
Physical activity/exercise intensity	Low	0.544	0.173	0.002**	1.723	1.227	2.420
	Middle	0.129	0.167	0.437	1.138	0.821	1.577
	High			0.001			

Notes: *p < 0.05 Pearson's r; **p < 0.01 Pearson's r; ***p < 0.001 Pearson's r; Only child status: 1 = Yes, 2 = No; Whether there are infected patients in your community: 1 = Yes, 2 = No.
Abbreviations: B, unstandardized beta coefficient; SE, standard error; OR, odds ratio; 95% CI, 95% confidence interval.

p= 0.004). Students engaging in low-intensity daily physical exercise were 1.723 times more likely to experience depression than those engaging in high-intensity daily physical exercise (OR= 1.723; 95% CI= 1.227–2.420, p= 0.002) during the COVID-19 outbreak.

Overall, the students' anxiety rate was 48.1%, and the depression rate was 57.6%. The univariate analysis and binary logistic regression results indicated that higher education levels (graduate students) and engaging in low-intensity daily exercise were associated with anxiety symptoms. Factors statistically predicting depression symptoms were having siblings, having a COVID-19 diagnosis in the community and engaging in low-intensity daily exercise (p < 0.001).

Discussion

This online-based, cross-sectional study identified and assessed relevant risk factors for anxiety and depression among students during the peak of the epidemic, from July 20 to August 13, 2021, in Jiangsu, China. The following major findings were obtained: (1) Students with siblings had a higher possibility of having depression symptoms than only children. (2) Due to academic and work pressure, graduate students faced higher risks of anxiety during the outbreak of COVID-19 than undergraduate students. (3) Students living near the worst-hit areas had the highest risk of developing anxiety and depression. (4) Maintaining high-intensity physical exercise was beneficial for alleviating negative emotions caused by COVID-19.

According to recent studies, students from COVID-19-affected regions worldwide have high rates of anxiety and depression.[32] In our study, 48.1% of students had anxiety during the COVID-19 outbreak,[33] and the levels of depressive symptoms (57.6%) were roughly twice as high as meta-analytic estimates among Chinese college students before the pandemic (23.8%).[34] Notably, the results showed widespread mental health problems among college students in Jiangsu during the two-month quarantine period following the initial outbreak of COVID-19. Similar results have been found in studies conducted in the UK[35] and Italy,[36] indicating the importance of providing mental health services for students during the COVID-19 lockdown.

The rate of anxiety symptoms was 48.1%. Associated factors included the student's grade, only child status, distance from worst-hit areas, and physical activity/exercise intensity. Students who lived in communities with infected people were vulnerable to depression. Physical activity/exercise intensity was also found to be associated with depression. However, no significant difference in relative quarantine or sex was found, which is inconsistent with previous research.[37] We conclude that male and female students faced equivalent stresses and negative emotions during the pandemic.

The binomial logistic regression analysis results indicated that being an only child was independently associated with depression. In addition, the "only child in the family" was less likely to suffer from depression. Students from families in which they are the only child have special characteristics due to the one-child policy in China.[38] Many previous studies[39] found that those children were lonelier, more self-centered, less able to adapt to the social environment, more stubborn, more dependent on the family,[40] and more likely to have psychological problems than those with siblings.[41] However, according to our findings, only children were psychologically healthier than those with siblings, consistent with the findings of previous studies conducted in China.[42] These positive indicate that being an only child may be beneficial to mental health.[43] These findings are consistent with the theory of resource dilution. According to resource dilution theory, only children have more resources than those with siblings, such as parental attention and encouragement, because the additional child dilutes family resources.[44] Meanwhile, the only child is the focus of the concerns, engagement, and responses of his or her parents, which may make him or her feel more confident and secure.[45] Thus, the psychological status of only children is more stable than that of those with siblings; thus, only children were less likely to develop depression symptoms during the COVID-19 outbreak. Based on our findings, we suggest that the government should pay more attention to the mental health status of quarantining students with siblings. In particular, parents of students with siblings should provide more support and encouragement for each child and increase mutual communication during COVID-19 outbreaks.

In addition, the present study found that graduate students had a higher risk of anxiety symptoms than sophomores and juniors. This result is in contrast to those reported in previous studies,[46,47] in which younger students were found to have a higher risk for psychological health disorders than older students.[48] In this study, 58.7% of postgraduate students remained in their dormitories or other locations without returning home. However, the vast majority of undergraduates stayed at home during the COVID-19 outbreak. We speculate that most undergraduate students returned home when

COVID-19 emerged in Jiangsu, especially sophomores and juniors, who have fewer study and employment pressures. Due to unfinished research projects and laboratory experiments, students in Master's or doctorate programs tended to remain in school longer. Thus, unfortunately, they were required to remain in relative isolation at their universities during the pandemic and were unable to do anything about this situation. Many of the students felt helpless and afraid, and many graduate students faced academic and work-related pressures.[49] This additional stress, combined with the impacts of the pandemic, could be regarded as a dose-effect response indicating a probable risk of mental health problems. Therefore, based on our findings, we suggest that preventive interventions should emphasize relieving anxiety symptoms and provide psychological counseling and emotional comfort for graduate students. Furthermore, the school could formulate special measures to help graduate students finish research projects promptly and provide a comfortable learning and living environment during school isolation.

In this study, "10~20 km from worst-hit areas" and "people infected in their communities" were the two factors that exerted the strongest impact on anxiety and depression risk, respectively. A similar finding was revealed by Tang et al,[18] who suggested that both factors could cause students to feel afraid. Fear is an adaptive response that initiates protective activities, implying that when fear is inappropriately regulated, anxiety or depression may occur.[50] Given the long incubation period of COVID-2019 (14 days–28 days or more) and its contagious nature,[18] many students, especially those with infected people in the communities, feared that they were unwittingly infected and risked spreading the virus to their family members. Meanwhile, research conducted in Switzerland revealed that youth are among the most vulnerable in society during the pandemic, and younger patients are more likely to fear getting sick or dying from COVID-19.[51] Thus, we propose that the government organize psychological interventions to reduce the fear of the COVID-19 pandemic and instill emotional resilience in all students in medium and high-risk areas, which may help reduce inner pressure and even prevent the development of depressive symptoms.

Furthermore, reduced physical activity is a risk factor for elevated mental stress,[52] especially during the COVID-19 lockdown.[53] The findings of this study are consistent with previous research showing that a decreased risk of psychiatric distress was associated with daily physical activity,[54] which could preserve mood stability and improve immunity.[55] Regular physical activity is an effective treatment for poor mental health[54] and can reduce negative emotions directly within a certain range. Previous studies have suggested that only moderate exercise improves mental health levels, while high intensity worsens mental health.[56] However, in our study, compared to students who engaged in low-intensity physical exercise, those engaging in daily high-intensity exercise were less vulnerable to symptoms of anxiety and depression. One possible reason is that students need additional physical activity to offset the psychological burden and negative emotions caused by the disease outbreak and social distancing during the special period of the COVID-19 outbreak.[56] Overall, physical exercise appears to be a universal, readily available medicine that helps reduce unpleasant psycho-physical circumstances.[57] Previous studies have suggested that the relationship between physical activity and mental health is nonlinear, and 45 min of daily vigorous physical activity appeared to minimize negative emotions during the COVID-19 outbreak.[56] Therefore, during this special period, several indoor exercises should be recommended, such as yoga and relaxation training, which can help relieve psychological pressure. High-intensity interval training (HIIT) has been found[58] to effectively alleviate anxiety and maintain metabolism.

Our research also has some limitations. First, this research was cross-sectional, only identifying estimates and correlates of anxiety and depression rather than their potential impacts over time. However, our study provides important suggestions for improving the mental health level of Chinese college students in the early stage of the COVID-19 outbreak. Second, most of the study participants were female, and this group might be more prone to negative emotions than their male counterparts. The associations between the COVID-19 outbreak and psychological health may differ between the sexes. Third, as the study was focused on college students, the results may not apply to other adults or the general population. The major strength of our study is the large sample size (n=1156). Second, our exploration of the effects of the COVID-19 lockdown restrictions on undergraduate students' mental health outcomes is innovative.

Conclusion

Our results characterize college students with an elevated risk of anxiety or depression during the period following the first acute phase of the pandemic. Living far from the worst-hit areas, being an only child, being a junior or senior student

and engaging in high-intensity physical exercise were protective factors against anxiety and depression among college students during the COVID-19 outbreak. Therefore, governments and universities should implement appropriate and pragmatic preventive interventions, such as mental health services and organized daily exercises, during COVID-19 lockdowns.

Research Ethics and Consent

The Ethics Committee of Sir Run Run Hospital of Nanjing Medical University approved this study's ethical admission [grant number: (2020) 569]. This study complies with the Declaration of Helsinki. The informed consent information was presented on the first sheet of the questionnaire. Each participant completed the questionnaire after providing informed consent. All surveys were anonymous.

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Disclosure

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