

Impact of Academic Support on Anxiety and Depression of Chinese Graduate Students During the COVID-19 Pandemic: Mediating Role of Academic Performance

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Introduction: The COVID-19 pandemic broke out and has spread globally since 2019. It became a public health concern. This pandemic has brought tremendous changes in students' lives and modes of learning. Graduate students are likely to be more affected as they are a part of a special training program. According to the main-effect model, social support has a positive effect on mental health. The pandemic has exerted a negative impact on the social support of individuals, and as a result, the behavior of a person is more likely to be at risk and has resulted in psychological crisis in people/individuals.

Methods: A sample of 3137 graduate students responded to the instrument developed to assess the impact of the pandemic on the academic activities and performance, Self-rating Anxiety Scale and Self-rating Depression Scale.

Results: The results showed that: 1) the pandemic impacted the academic support and performance of graduate students in varying degrees, 21% of graduate students experienced anxiety, and 33.9% of graduate students experienced depressive symptoms in varying degrees; 2) academic support variables (ie, academic exchange with mentors and peers) and academic performance variables (ie, data collection and thesis writing) were significantly associated with anxiety and depressive symptoms; 3) the model fitted the data well (RMSEA = 0.029; SRMR = 0.014; TLI = 0.99; CFI = 0.996). The direct effects of academic support on anxiety and depressive symptoms were significant. The impact on academic performance played a mediating role between the impact on academic support, anxiety, and depressive symptoms.

Discussion: Academic support significantly affected academic performance, which in turn affected anxiety and depressive symptoms. So, it implies that, due to the pandemic, the academic support for graduate students had decreased, resulting in deterioration in academic performance, causing anxiety and depressive symptoms.

Keywords: academic support, academic performance, anxiety, depressive symptoms, COVID-19 pandemic, graduate students

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Introduction

The outbreak of the COVID-19 pandemic has become a public health emergency.¹ The large-scale, highly infectious disease having a high-lethality-rate has put tremendous pressure on people all over the world. Schools in 172 countries were closed, affecting approximately 1.5 billion students.² The sudden outbreak of the pandemic led to significant changes in the mode of learning, communication

between teachers and students, and interaction between students and their peers. The pandemic presented an undoubtedly challenging situation before the students who were used to offline learning.³ Some researchers have pointed out that the dual pressure of the sudden outbreak of the pandemic and the changes brought about in the learning mode is likely to have a negative impact on students' academic activities, and psychological health.⁴ As far as college students are concerned, they reported experiencing more negative emotions than before due to the pandemic.^{1,5,6} Especially, the graduate students who were engaged in in-depth learning and scientific research tasks, and their activities pertaining to their research which involved research guidance by mentors, data collection, recruitment of research participants and conduction of experiments, were adversely affected. Online conduction of these academic activities was challenging and hence affected the psychological health of the students to a great extent.

Relationship Between Academic Support, Anxiety and Depressive Symptoms

Academic support refers to the direct and indirect socializing resources (including emotional support, instrumental support, and cognitive support from parents, peers, and teachers) that promote student academic achievement.^{7,8} In other words, academic support is an academic assistance activity carried out by teachers, peers, or family to help students succeed in research.⁹ Multiple studies have found that the support by parents, teachers, and peers can influence students' academic lives.^{10–12} Academic support can be considered for obtaining academic guidance and help which can positively affect students' academic activities, such as academic exchanges with mentors and peers.^{13,14} When students communicate with mentors or peers, they can see their help in solving their academic problems and perform better in school.⁹ However, during the COVID-19 pandemic, academic support available from mentors and peers has been negatively impacted in varying degrees due to enforcement of measures such as studying from home and social distancing.^{15,16}

According to the main-effect model, social support refers to the individual's perception of receiving external support, including subjectively perceived social support and social support provided by others.¹⁷ As a protective factor for individuals' psychological health, social support tends to exert a positive effect and protects the individuals whose

environment is not congenial.¹⁸ If high degree of social support is available to an individual, it is easy to make oneself understood, respected, maintain a stable emotional state,¹⁹ feel less anxious and depressed,²⁰ experience less pressure and feel happier.²¹ In particular, the support by teachers and peers helps students overcome mental health problems.^{22,23} However, the question is, will mental health deteriorate if the pandemic negatively impacts social support (such as academic support by mentor and peer). Due to the Covid-19 pandemic, more than 62 countries have started conducting online classes from home.²⁴ The pandemic has negatively affected the academic support available to graduate students, but its actual effect on students' mental health is still unknown.

The Mediating Role of Academic Performance

Carrying out academic activities is a crucial task for graduate students. The goal of postgraduate training encourages them to pursue specialized knowledge and engage in scientific research. Institutions performing large-scale evaluations have outlined the significant indicators of academic performance. For example, the Times Higher Education World University Rankings (2021)²⁵ reported the following indicators of academic performance: research and paper citations. There is evidence that academic performance is significantly associated with academic competency and study strategies.²⁶ Therefore, academic performance in the present study refers to academic behavior (ie, data collection and thesis writing).

The theory of ecosystem pointed out that biological factors and environmental factors affect human development.²⁷ Ecosystems can be divided into micro-systems, intermediate systems, external systems, and macro-systems, among which micro-systems can directly influence individual development. The World Health Organization considers micro-systems vital for reduction of stress and anxiety, and for improving individuals' well-being. Thus, the support received by students from parents, teachers, and peers comprises the micro-system that directly affects individual activities and interactions. The perception of teacher support positively affects students' learning input,²⁸ and predicts their academic achievement significantly and decreases their academic concerns during the pandemic.²³ Studies on the academic performance of college students have found that students with a high level of academic performance are likely to experience more happiness and pride.²⁹ However, students with a low level of academic

performance may have a lower self-concept, receive less attention, and experience more anxiety, frustration, and depression.³⁰ Furthermore, the academic support available to graduate students can serve as a protective factor against an unhealthy environment and positively predict academic performance.³¹ Therefore, academic performance (ie, data collection and thesis writing) may have a mediating role between academic support and psychological health. If the pandemic hampers the academic support available to graduate students, it may affect their academic performance and eventually cause anxiety and depressive symptoms.

Current Study

Previous studies have primarily focused on the impact of the pandemic on the mental health of college, middle and elementary school students, but the impact of the pandemic may be even more robust due to the intensive learning and study tasks of graduate students. Therefore, investigating the impact of the pandemic on academic impact and the mechanism of mental health will be very helpful in providing robust evidence for necessary interventions which can be undertaken to deal with the mental health crisis brought forth by the pandemic.

This study examines the academic exchanges between graduate students and their mentors, and peers as indicators of measuring the impact of academic support on anxiety and depressive symptoms. The experimental data collection and thesis writing assignment activities have been analyzed to assess the impact of academic performance on anxiety and depressive symptoms. This study explores the mediating

role of academic performance between academic support and psychological health (anxiety and depressive symptoms). It hypothesized that the impact of the pandemic on academic support would predict anxiety and depressive symptoms, and the impact of the pandemic on academic performance will play a mediating role between the impact of academic support, anxiety, and depressive symptoms. The conceptual structure model is presented in Figure 1.

Materials and Methods

Participants and Procedure

A total of 3137 graduate students having 93.4% valid response rate who answered questions in more than 3 minutes were randomly selected from 33 provinces or autonomous regions in China via the popular Chinese professional survey website *Wenjuanxing* (www.sojump.com; accessed on 2 April 2021). The abnormal answers were excluded. As sample selection was difficult, all participants were recruited through the contact networks of WeChat with the help of online fliers. This enabled the participants to complete the survey online and send the link to their acquaintances. The mean age of the sample was 25.58 years (SD = 4.19). All respondents participated voluntarily and provided informed consent.

Measures

Demographic Information

Demographic information pertaining to graduate students' gender, age, residential area (ie, rural or urban), program (ie, master or doctoral), discipline (ie, science and

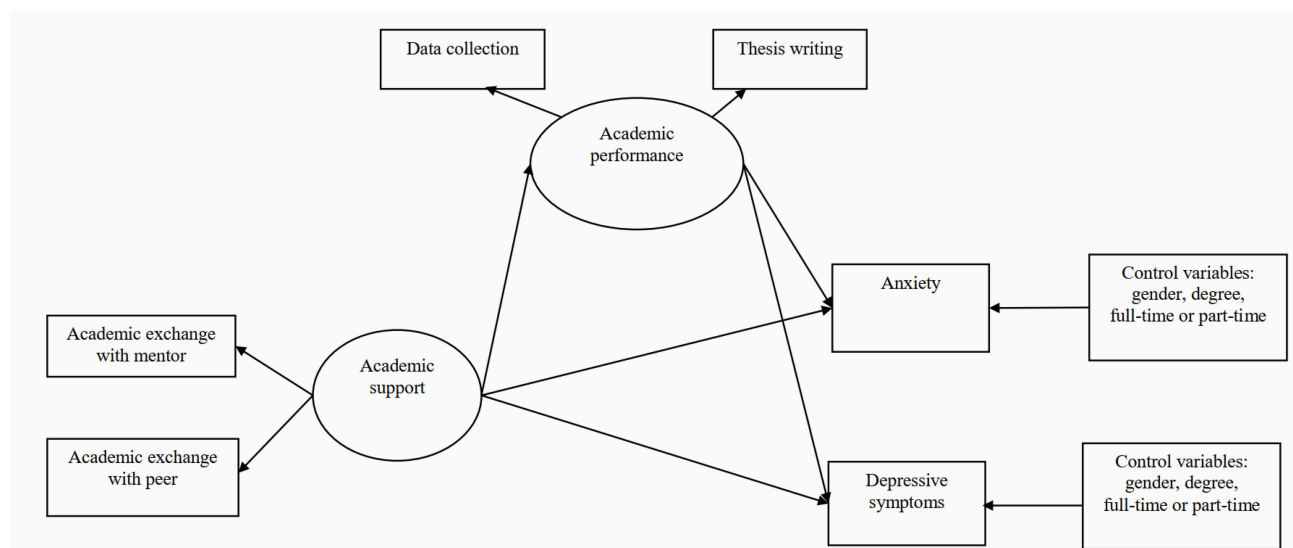


Figure 1 Conceptual model linking Academic support affected, academic performance, anxiety and depressive symptoms.

engineering, liberal arts or social science), degree type (ie, academic or professional), and forms of learning (ie, full-time or part-time) was procured.

Effect of the Pandemic on Graduate Students' Academic Activities

Consistent with the researches,^{32–34} the impact of the pandemic on graduate student's academics, the instrument was designed to measure how the pandemic affected graduate students' academic activities. This instrument consists of two parts. Part 1 relates to the academic status of graduate students, and is composed of 3 items (questions): "What's the main way you communicate with your mentor? Telephone, video, text communication (email or social software) or Face to face". "What's the main way you communicate with your peers? Telephone, video, text communication (email or social software) or Face to face". "In your opinion, what are the main factors that affected your research progress due to the pandemic (multiple choice questions): communication with mentors, communication with peers, data collection, data search, self-control or other". All respondents were asked to select from among the given options.

Part 2 related to the extent to which graduate students' academic activities were affected by the pandemic, with respect to availability of academic support and their academic performance. The dimension of academic support included academic exchanges between graduate students and their mentors and peers. The academic performance dimension included thesis writing assignments and data collection. Responses to items concerning these dimensions were collected using the following questions: "To what extent does the pandemic affect the academic exchanges between you and your mentor?"; "To what extent does the pandemic affect the academic exchanges between you and your peers?"; "To what extent does the pandemic affect your experimental data collection?"; and "To what extent does the pandemic affect your thesis writing?" The respondents gave their responses on a 4-point Likert scale which had the following options: "no impact"; "little impact"; "moderate impact"; and "great impact", which expressed the degree to which their academic activities/performance were affected. The final scores obtained ranged from 1 to 4. The higher the score, the greater the impact. Confirmatory factor analyses indicated that the model fit the data satisfactorily: $\chi^2/df = 7.927$, CFI = 0.999, TLI = 0.992, RMSEA = 0.047, SRMR

= 0.004. It had a Cronbach's alpha equal to 0.83 in the current sample.

Self-Rating Anxiety Scale (SAS)

The Self-Rating Anxiety Scale was used to assess people's anxiety in the recent week.³⁵ The scale included 20 self-evaluation items, out of which 5 items were scored in the reverse order. The scale was a 4-point Likert scale with responses ranging from 1 (occasionally) to 4 (always). According to statistical standards, the sum of scores is multiplied by 1.25. The norm of SAS is: (50–59) scores which indicated mild anxiety; (60–69) scores indicated moderate anxiety; and scores over 70 indicated severe anxiety.³⁶ The Cronbach's alpha coefficient for the anxiety scale was 0.85. During the COVID-19, this scale was widely used to measure university students' anxiety, and was found to have good reliability and validity.^{37–39}

Self-Rating Depression Scale (SDS)

The Self Rating Depression Scale was used to assess people's depressive symptoms in the recent one week.⁴⁰ The scale included 20 self-evaluation items, out of which 5 items were scored in the reverse order. The participants responded on the 4-points Likert scale with scores ranging from 1 (occasionally) to 4 (always). According to statistical standards, the total of scores was multiplied by 1.25. The norm of SDS was: (53–61) scores indicated mild; (62–71) scores indicated moderate; and scores > 72 indicated severely.⁴¹ This scale had a Cronbach's alpha equal to 0.88. During the COVID-19, this scale was widely used to measure students' depression, and was found to have good reliability and validity.^{42–44}

Data Analyses

The variables involved in the current study have been illustrated in Figure 1. The data were analyzed using SPSS26.0 and Mplus 8.3.⁴⁵ Firstly, all the variables were analyzed by SPSS26.0 to obtain the sample's descriptive statistics (N = 3137) and the normality of the data was checked using the Kolmogorov–Smirnov test.^{46,47} Secondly, the model for measuring the academic support and the academic performance was tested. Finally, the hypotheses were tested by the mediation model using Mplus 8.3.⁴⁵ Due to the non-normality condition, the bias-corrected nonparametric bootstrap with 5000 bootstrap samples was selected for data analysis and the significance of mediation effects by 95% confidence intervals was confirmed.^{48–50} In order to evaluate the quality of the

model, four goodness-of-fit indices were determined: root means square error of approximation (RMSEA); standardized root-mean-square residual (SRMR); Tucker–Lewis index (TLI), and comparative fit index (CFI). The standard criteria used were as follows: RMSEA < 0.08; SRMR ≤ 0.10; TLI and CFI ≥ 0.90, which suggested an acceptable fit.⁵¹

Results

Descriptive Statistics

The demographic information and the academic status of graduate students are displayed in Table 1. During the pandemic, at least 50% of students' research progress was affected due to the impact on academic exchanges with mentors, data collection, and self-control; 30% of students' research progress was affected due to the impact on academic exchanges with peers and data search. Table 2 shows the proportion of the variables affected by COVID-19. The pandemic had a differential effect on the academic support and academic performance indicators in varying degrees; 21% of students experienced anxiety, and 33.9% of students experienced depressive symptoms.

Table 3 displays the mean, standard deviations, and bivariate correlations among study variables. Academic support affected had an impact on the academic exchanges with mentors and peers, which were found to be positively related to anxiety and depressive symptoms ($r = 0.15$ to 0.18), academic performance exerted a significant effect on the variables such as thesis writing and data collection, which were found to be significantly related to anxiety and depressive symptoms ($r = 0.10$ to 0.17).

Model for Measuring Academic Support and Academic Performance

The model used in the study included two latent factors (academic support and performance) and four observed variables (academic exchanges with mentors and peers; experimental data collection and thesis writing assignment). The test of the measurement model demonstrated a good fit to the data: $\chi^2/df = 7.927$; RMSEA = 0.047; SRMR = 0.004; TLI = 0.992 and CFI = 0.999. Academic exchanges with mentors and peers were found to be well loaded with respect to the latent variable academic support ($\beta = 0.876$ – 0.881 ; $p < 0.001$). Thesis writing assignment and data collection were found to be well loaded with respect to the latent variable academic performance ($\beta = 0.669$ – 0.833 ; $p < 0.001$). These results indicate that all the

Table 1 Demographic Characteristics and the Academic Status Among Students (N=3137)

Variables	Value, n (%)
Demographic characteristics	
Gender	
Male	672 (21.42%)
Female	2465 (78.58%)
Age	
≤20	24 (0.8%)
21–25	1992 (63.5%)
26–30	857 (27.3%)
31–40	229 (7.3%)
>40	35 (1.1%)
Residential area	
Rural	1186 (37.8%)
Urban	1951 (62.2%)
Program	
Master	2829 (90.18%)
Doctoral	308 (9.82%)
Discipline	
Science and engineering	456 (14.5%)
Liberal arts	487 (15.5%)
Social science	2194 (69.9%)
Degree type	
Academic degree	1442 (46%)
Professional degree	1695 (54%)
Forms of learning	
Full time	2917 (93%)
Part time	220 (7%)
The academic status of graduate students	
The way of communicate with the mentor (Single choice)	
Telephone	266 (8.5%)
Video	193 (6.2%)
Text communication (email or social software)	1287 (41%)
Face to face	1391 (44.3%)
The way of communicate with peer (single choice)	
Telephone	119 (3.8%)
Video	111 (3.5%)
Text communication (email or social software)	1353 (43.1%)
Face to face	1554 (49.5%)
The main factors that affected research progress due to the pandemic (multiple choice questions)	
Academic exchange with mentors	1771 (56.5%)

(Continued)

Table 1 (Continued).

Variables	Value, n (%)
Academic exchange with peers	936 (29.8%)
Data collection	1933 (61.6%)
Data search	961 (30.6%)
Self-control	2017 (64.3%)
Other	115 (3.7%)

latent factors represented the respective observed variables well.

Mediating Effects of Academic Performance

The control variables in the mediation model were gender, degree, and forms of learning, and the dependent variables were anxiety and depressive symptoms. The mediation model concerning all paths, as depicted in Figure 1, was tested. Standardized path coefficients are presented in Figure 2. The model fitted the data well: $\chi^2(14) = 50.81$; $p < 0.001$; RMSEA = 0.029; SRMR = 0.014; TLI = 0.99 and CFI = 0.996.

All indirect effects for the mediating model are shown in Table 4. The hypotheses that the impact of academic support will predict anxiety and depressive symptoms, respectively, and the impact of academic performance will play a mediating role between the impact of academic support, anxiety, and depressive symptoms, were accepted. The indirect effect of the impact of academic support on academic performance, which consequently affected

anxiety, was significant, and the results obtained are as follows: $\beta = 0.07$; $SE = 0.03$; and 95% CI = 0.017–0.121. This indirect effect of academic support on academic performance, which consequently affected depressive symptoms, was significant: $\beta = 0.09$; $SE = 0.03$; and 95% CI = 0.033–0.140.

Discussion

It has been a year and a half since the outbreak of COVID-19 was declared a public health emergency. This study found that the pandemic had a differential effect on indicators of academic support and academic performance; varying degrees of anxiety were reported by 21% of students; and varying degrees of depressive symptoms were reported by 33.9% of students. Individuals with higher education backgrounds are prone to face mental health problems.⁵² They face many unique challenges,⁵³ such as less guidance and hence need more self-motivation.⁵⁴ Therefore, graduate students are under tremendous academic pressure and are in a unique stage of development, making them more susceptible to the negative impact of COVID-19. Additionally, this study made use of the social support theory¹⁸ to investigate the influence of academic support on graduate students' anxiety and depressive symptoms, and applied Bronfenbrenner's ecosystem theory²⁷ to comprehensively investigate the internal mechanism of academic support, as an environmental factor, on graduates' mental health, and yielded some critical findings. The direct effects of academic support on anxiety and depressive symptoms were significant. The impact of academic performance plays a mediating role between the

Table 2 Proportion About Study Variables Affected by COVID-19

Total Sample (N=3137)	No Impact	Little Impact	Moderate Impact	Great Impact	Mild	Moderated	Severe
Academic exchange with mentor	16.4% (n=513)	36.6% (n=1148)	37.2% (n=1166)	9.9% (n=310)	–	–	–
Academic exchange with peer	17.9% (n=562)	37.4% (n=1174)	35.4% (n=1111)	9.2% (n=290)	–	–	–
Thesis writing	14% (n=440)	29.7% (n=932)	39% (n=1224)	17.2% (n=541)	–	–	–
Data collection	16.8% (n=528)	32.5% (n=1018)	35.4% (n=1110)	15.3% (n=481)	–	–	–
Anxiety	–	–	–	–	14.7% (n=461)	4.7% (n=146)	1.6% (n=49)
Depressive symptoms	–	–	–	–	22% (n=690)	10.5% (n=329)	1.4% (n=44)

Note: N = 3137.

Table 3 Means, Standard Deviations, and Correlations Among Study Variables

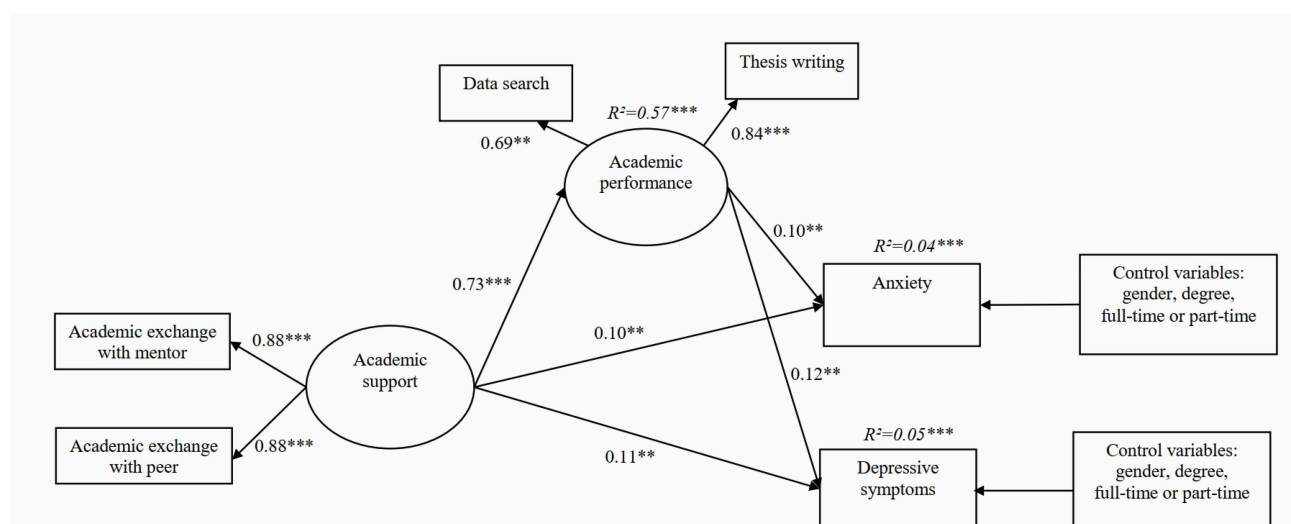
	Variables	1	2	3	4	5	6	7
1.	Gender	–						
2.	Academic exchange with mentor	–0.02	–					
3.	Academic exchange with peer	–0.01	0.77***	–				
4.	Thesis writing	–0.001	0.54**	0.53***	–			
5.	Data collection	0.02	0.42***	0.44***	0.56***	–		
6.	Anxiety	0.03	0.15***	0.16***	0.15***	0.10***	–	
7.	Depressive symptoms	0.03	0.16***	0.18**	0.17***	0.12***	0.78***	–
	M	–	2.41	2.36	2.59	2.49	42.61	47.58
	SD	–	0.88	0.88	0.93	0.95	9.85	11.03

Notes: N = 3137; **P < 0.01, ***P < 0.001.

impact of academic support, anxiety, and depressive symptoms.

This study found that most of the graduate students reported that their academic support (academic exchanges with mentors and peers) were negatively impacted due to COVID-19. And the pandemic negatively affected academic support, which was a key factor in the feelings of anxiety and depression in graduate students. The results imply that with the increased negative impact of the COVID-19 pandemic on academic support, anxiety, and depressive symptoms will also increase. Previous studies have validated the synergistic effects of social support on mental health,^{19,55} but they have not explored its impact

on mental health when it has been negatively impacted. Academic support refers to social support provided for the individuals by the society. The main effect mechanism proposes that positive effect of social support promotes a positive psychological state in individuals by enhancing their subjective well-being after obtaining social rewards.¹⁸ However, as the virus is highly contagious and there are no specific medicines, quarantine measures are strengthened in repeated outbreaks. The sudden urgency, seriousness, high level of uncertainty, and the social harm caused by the local pandemic have a negative impact on people's social support along with long-term adverse effects on people's psychological

**Figure 2** Standardized path coefficients for the mediation model linking academic support affected to graduate student anxiety and depressive symptoms.

Notes: Solid lines represent significant paths. N = 3137; **P < 0.01, ***P < 0.001.

Table 4 Tests of Indirect Effect for the Mediating Model

Meditational Pathway	Total		Direct		Indirect	
	Estimated	95% CI	Estimated	95% CI	Estimated	95% CI
Academic support → Anxiety	0.17***	0.131–0.211	0.10**	0.033–0.171	0.07*	0.017–0.121
Academic support → Academic performance → Anxiety					0.07*	0.017–0.121
Academic support → Depressive symptoms	0.20***	0.158–0.234	0.11**	0.04–0.178	0.09**	0.033–0.140
Academic support → Academic performance → Depressive symptoms					0.09**	0.033–0.140

Notes: N = 3137; * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

health. What's more, Clark and Watson⁵⁶ proposed a tripartite model to consider that depression and anxiety overlapped long-term negative emotions and lack of pleasure. High inter-correlations have been observed between anxiety and depression,⁵⁷ and individuals exposed to anxiety may also develop depression.⁵⁸ Therefore, as part of the social support for graduate students, academic support is essential for their scientific research progress and has a protective effect on their mental health. Universities should pay attention to providing academic support and assistance to graduate students during the pandemic period.

A structural equation model to study graduate students' academic support, anxiety, and depressive symptoms were constructed with the students' academic performance as the mediating variable. The results revealed that academic support, negatively affected by COVID-19, predicted anxiety and depressive symptoms directly and predicted academic performance indirectly. In other words, the more negative impact of the pandemic on graduates' academic support, the greater the impact on their academic performance, resulting in anxiety and depressive symptoms. This result confirmed the results of the previous studies on the relationship between academic performance and mental health of college and primary school students.²⁹ It was also found that academic support serves as a protective environmental factor for the individual and has a significant positive relationship with the academic performance of graduates. Bronfenbrenner's ecosystem theory explains that micro-systems such as family, teacher, and peer groups can directly influence an individual's development.²⁷ During the pandemic, preventive measures were undertaken to curtail the pandemic, hence the modes of academic exchanges between graduate students, their

mentors and peers also changed. When the pandemic broke out, most academic activities such as academic exchanges, data collection processes, participants' recruitment and experimentation were conducted using online research group meetings, email and the WeChat application. Therefore, thesis writing progress was negatively affected. Graduate students' academic support and performance are closely related to their mental health. Colleges should pay attention to the psychological problems of graduate students affected by the pandemic, and mentors should monitor the progress of their students' research closely to provide timely academic support and guidance.

Implications and Limitations

Due to the impact of COVID-19, students' academic support and academic performance have been negatively affected in varying degrees, leading to increasing anxiety and depressive symptoms among graduate students. This study expanded the scope of previous studies about the impact of the pandemic on postgraduates' academics and psychological health. Future development of the society rests on the graduate students, who are the backbone of the social development process. Hence, it is vital to investigate the mechanisms governing their mental health in the pandemic situation through: (1) provision of theoretical support for designing interventions to combat the negative impact of the pandemic on graduate students; (2) provision of academic support with the help of online and offline academic exchange programs, which offer opportunities to interact with their mentors and peers, providing platforms for academic exchanges with other colleges, and to provide opportunities for preparing academic reports and individual presentations. Additionally, attention should be paid to the challenges associated with research, data

collection, and writing of research papers in the situation created by the pandemic, and timely assistance should be provided.

There are also some limitations of this study, which can be catered to future research. Firstly, a cross-sectional study design was adopted for this study. Although previous theories and empirical evidence provide a solid foundation for this study, it was difficult to infer the causal relationship between variables and the psychological changes of individuals before and after being affected by the pandemic. Therefore, that future studies can use the experimental method or longitudinal research to explore it. Secondly, self-reporting by graduate students would have been influenced by factors such as social approval and hence might not have yielded accurate results. Data on the investigated theme can be collected in the future through multiple information sources. Third, this study included most of the students from the regions of China, which is a relatively homogeneous population. Some variables such as ethnicity or racial diversity were not taken into account. So the research design and results should be explained in the following context.

Conclusion

Academic support variables (ie, academic exchanges with mentors and peers) and academic performance variables (ie, thesis writing assignment and data collection) were positively related to anxiety and depressive symptoms. Academic support negatively affected by COVID-19 could significantly predict the anxiety and depressive symptoms of the students. The indirect effects of academic support on academic performance consequently affected the graduate students' anxiety and depressive symptoms significantly.

Ethical Approval

The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the local Ethics Committee of the School of Psychology, South China Normal University (SCNU-PSY-2021-021).

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Disclosure

The authors declare no conflicts of interest in this work.

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