Negative psychological and educational impacts of Corona Virus Anxiety on Chinese university students: Exploring university students' perceptions

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ABSTRACT

COVID-19 has greatly affected various aspects of societies worldwide, including the mental health and quality of education for students. Different studies investigated the consequences of the pandemic, but only a few studies have addressed the negative psychological and educational impacts of Corona Virus Anxiety (CVA). This study addresses the effects of CVA on Chinese students and explores university perceptions of its consequences. A mixed-methods research design was used, with 440 university students selected through convenience sampling. The researchers used the CVA scale, generalized anxiety scale, mental health questionnaire, and a self-report scale to assess the students' educational attainment. In addition, 14 students were interviewed for the qualitative phase of the study. Data from the quantitative phase were analyzed using Pearson correlation and descriptive statistics, while content analysis techniques were employed for analyzing the qualitative data. Results showed that CVA is negatively associated with students' anxiety, stress, and depression. Furthermore, stress, anxiety, depression, and CVA were found to be negatively associated with students' GPAs. Qualitative findings revealed that CVA negatively affected students' GPAs, research projects, classroom engagement, and graduations. The findings are theoretically and practically important to universities, schools, and educational centers to avoid the effects of the CVA on students' educational attainment and mental health through appropriate planning and providing facilities to the students during the lockdown.

1. Introduction

COVID-19 had negative consequences on education, schools and universities were disrupted, and many institutions shifted to remote learning [1]. However, this sudden shift has exposed the digital divide in many countries, with low-income families and rural areas struggling to access the necessary technology for online learning [1]. The lack of face-to-face interaction has also negatively impacted student motivation and engagement [2]. On the other hand, remote learning has provided chances for students to develop self-directed learning strategies and skills and has forced teachers to use new teaching skills and approaches [3,4]. The disruptions caused by the pandemic affected university students' academic outcomes. The findings reported by Kuhfeld et al. [5] revealed that in

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the USA students lost up to one year of learning in mathematics and up to six months of learning in reading due to school closures. Similarly, the World Bank reported that school closures could lead to a learning loss of 0.6 years of schooling globally [6]. The impact has been particularly severe for vulnerable and disadvantaged students, who are more likely to lack access to technology and face additional barriers to learning [1].

The closure of universities and home quarantine to prevent the spread of the virus students negatively affected the student's academic progress and mental health [7]. Prolonged university closures and home quarantine have led to significant lifestyle changes for students, such as changes in sleep patterns and reduced physical activity [8]. Moreover, changes in stress and anxiety levels among students have been observed as one of the psychological consequences of the pandemic caused by the disruption and changes in fundamental plans regarding academic, work, and future goals following the outbreak of the virus [9].

There have been many studies that have drawn attention to the extensive psychological effects of the worldwide pandemic, and the numerous health problems and mental health difficulties it has created on a global scale [7–13]. The mental health status of individuals was at its highest point during the spring of 2020, with many individuals experiencing a significant level of fear and apprehension towards COVID-19 [7]. However, further evaluation is necessary to determine the immediate effects of the pandemic on mental health [7]. Therefore, COVID-19 might have had negative educational and psychological consequences. More specifically, the following questions were addressed.

1. Is there any significant correlation between Chinese university students' Corona Virus Anxiety and generalized anxiety disorder?
2. Is there any significant correlation between Chinese university students' Corona Virus Anxiety and depression, anxiety, and stress?
3. Is there any significant correlation between Chinese university students' Corona Virus and Grade Point Average (GPA)?
4. What are the negative educational and psychological consequences from the Chinese students' perspectives?

1.1. Review of literature

COVID-19 affected undergraduate students in China in different ways, resulting in a range of psychological and educational consequences. Several studies have investigated these consequences and identified various factors that contribute to them. The pandemic caused range of psychological consequences for undergraduate students in China, including anxiety, depression, stress, and fear. Studies have shown that the uncertainty surrounding the pandemic, the disruption of daily routines, and concerns about health and safety have all contributed to these psychological consequences. Furthermore, the use of online learning has led to social isolation, which has further exacerbated these issues [4,14]. Several factors have been identified as contributing to the psychological and educational consequences of COVID-19 for undergraduate students in China. These factors include the severity and duration of the pandemic, the availability of information and resources, and the level of social support available to students. Additionally, individual factors such as prior mental health status, coping strategies, and social support networks have also been found to play a role [9,12,13].

1.2. Corona Virus Anxiety Scale (CVAS) and generalized anxiety disorder (GAD)

The relationship between CVAS and GAD has been studied by different scholars interested in the field and the common finding is that there is a positive correlation between the two measures, indicating that individuals who score higher on the CVA are more likely to have symptoms of GAD [15,16]. For example, a study by Lee et al. [15] found that scores on the CVA were significantly correlated with scores on the GAD-7, a widely used measure of GAD symptoms [15]. The authors concluded that the CVA may be a useful screening tool for identifying individuals at risk for GAD during the COVID-19 pandemic. Similarly, a study by Taylor et al. [16] found that scores on the CVAS were significantly correlated with scores on a measure of health anxiety, which is a component of GAD [2]. The authors suggested that the CVAS may be a useful tool for assessing health anxiety related to the pandemic. COVID-19 has also had a significant impact on the mental health and academic achievement of individuals worldwide. The CVAS is a self-report measure that assesses anxiety caused by the pandemic. Similarly, the relationship between CVAS and stress, anxiety, depression, and academic achievement has been studied by some researchers [4,17–19]. The researchers reported a positive correlation between CVAS and factors related to mental health. For example, Wang et al. [4] found that higher CVAS increased the levels of stress among Chinese students. Similarly, Alyami et al. [17] reported a positive correlation between high scores on the CVAS and increased levels of perceived stress among Saudi Arabian residents during the pandemic [17]. Additionally, the detailed analysis of a large number of studies [11,9,14–27] verified that CVAS is positively correlated with the students' general anxiety, stress, and depression.

A number of studies have reported a positive association between CVAS and anxiety [18,23–27]. Qiu et al. [18] reported that the higher the students' scores on CVAS, the higher level of stress, anxiety, and depression they have. Zhai and Du [23] conducted a study that revealed a positive correlation between elevated scores on the CVAS and increased levels of anxiety in Chinese medical students amidst the pandemic. Furthermore, certain research has indicated a direct association between CVAS and depressive symptoms. Wang et al. [24] conducted a study that revealed a positive correlation between elevated scores on the CVAS and increased levels of depression in Chinese undergraduate students amidst the pandemic. Nevertheless, several studies have reported inconclusive findings regarding the correlation between CVAS and depression [17,18].

Furthermore, several research studies have examined the correlation between students' Corona Virius Anxiety Scale (CVAS) and their academic advancement. Li et al. (2021) discovered a negative correlation between academic achievement and scores on the CVAS among Chinese undergraduate students amidst the pandemic, as reported in a previous study (reference number 7). In concurrence with prior research, Khubchandani et al. [13] conducted a study that revealed a negative correlation between academic achievement

and higher scores on the CVAS among American undergraduate students amidst the pandemic [10]. Detailed analysis of the related studies verified the positive correlation between CVAS and stress, anxiety, and academic achievement, while the relationship between CVAS and depression is less clear [13–15,17,18]. These findings indicate that the CVAS may be a useful tool for screening students who are at risk of being vulnerable to mental health problems and academic difficulties during and after being affected by the pandemic.

Similarly, different scholars [28–40] from different countries such as China, the United States, Nigeria, Saudi Arabia, and India, have reported that CVA increases college students' stress, anxiety, and depression. These studies have found a positive association between COVID-19 anxiety and depression and stress among college students. The studies highlight the importance of implementing interventions such as mental health services, social support, and self-care practices to cater to the mental health needs of college students worldwide during the pandemic [41–44]. Recommendations include utilizing psychological interventions, stress management programs, online counseling, and teletherapy to address college students' mental health needs during these challenging times. These interventions could help college students cope with the mental health difficulties arising from COVID-19 anxiety and enhance their overall well-being.

2. Method

2.1. Participants

480 undergraduate students from different colleges at Hangzhou Normal University and Wenzhou Medical University in China were recruited but only 440 students returned the questionnaires, resulting in a response rate of 90.48%. The participants' self-reports revealed that their ages ranged from 20 to 30 years old (M = 25.36, SD = 2). All participants were native speakers of Chinese and were selected from five different colleges at the above-mentioned universities: humanities and social sciences (n = 100), natural sciences (n = 90), engineering (n = 100), agriculture (n = 90), and medicine (n = 100). Among the participants, 280 were female, and 200 were male. Before participating in the study, all participants were informed about the purpose of the study and provided with informed consent forms. Consent was obtained from both the students and the university leaders. All students voluntarily participated in the survey and were assured that their responses to the questionnaires would be kept confidential and would not affect their academic achievement at the university. For the qualitative phase, 20 students were nominated and invited, but data saturation occurred when the 14th student was interviewed. Therefore, the number of students in the qualitative phase was 14.

2.2. Instrumentation

The variables of interest were measured in this study through the utilization of three self-report questionnaires. Alipour et al. (2018) developed and validated the Corona Virus Anxiety Scale (CVAS. The COVID-19 Anxiety Scale (CVAS) is a concise questionnaire consisting of five items, which has been specifically developed to evaluate anxiety levels associated with the COVID-19 pandemic. The study's participants were requested to evaluate the frequency and intensity of their anxiety symptoms associated with the pandemic. The researchers utilized the Generalized Anxiety Disorder Scale (GAD-7), which was originally developed by Spitzer et al. [27], as the second instrument in their study. The Generalized Anxiety Disorder 7-item questionnaire, commonly referred to as GAD-7, is a tool specifically developed to assess and quantify the presence and severity of symptoms associated with generalized anxiety disorder. The study's participants were requested to evaluate the occurrence and intensity of their anxiety indications during the preceding 14 days. The third utilized tool was the Depression, Anxiety, and Stress Scale-21 (DASS-21), which was validated by Sahibi, Saleri, and Asghari [28]. The DASS-21 is a standardized instrument comprising 21 items developed to assess the presence and severity of symptoms related to depression, anxiety, and stress. The respondents were requested to evaluate the occurrence and intensity of their symptoms during the preceding week. The reliability of the instrument was estimated using Cronbach's alpha. The instrument enjoyed an acceptable level of internal consistency (alpha = 0.78).

Furthermore, a semi-structured interview checklist was employed as the fourth tool to collect data on the primary experiences of the respondents concerning anxiety, stress, and depression. The checklist comprised of open-ended inquiries that facilitated the participants to articulate their sentiments concerning the impact of the pandemic on their psychological well-being. The subset of participants who had previously completed the quantitative phase of the study (as detailed in Appendix B) was subjected to the administration of the interview checklist. The interview checklist was evaluated by three educational psychologists and they all assessed the questions as relevant to the research objectives. Additionally, a self-reported questionnaire on academic achievement was utilized to collect data regarding the academic performance of the subjects. The questionnaire requested that participants indicate their cumulative grade point average (GPA) by selecting one of the specified options (A————————F) and subsequently converting it to a numerical value (A = 85–100, B = 75–85, C = 64–75, D = 60–67; F = 0–59).

2.3. Research design

In this study, a mixed-methods research approach was employed, which involved collecting and analyzing both qualitative and quantitative data. The quantitative phase of the study utilized a correlational methodology to examine the relationship between Corona Virus Anxiety Scale (CVAS), anxiety, stress, depression, and academic achievement during the COVID-19 pandemic. The qualitative phase of the study aimed to explore the participants' firsthand experiences of anxiety, stress, and depression in the context of the pandemic. Data were collected through semi-structured interviews with a subset of participants who had previously completed the quantitative phase.

2.4. Data analysis

The present investigation employed a combination of quantitative and qualitative methodologies to analyze the data. Descriptive statistics (Mean, SD, and Variance) and Pearson's correlation coefficients were estimated for exploring the correlation among the variables. The verbatim transcripts of audio-recorded interviews were analyzed to identify themes and patterns, providing a deeper insight into the lived experiences of participants. The integration of both quantitative and qualitative findings allowed for a more nuanced and comprehensive understanding of the phenomenon under investigation, providing a broad overview of the variables of interest while also exploring participants' experiences in-depth.

2.5. Ethical considerations

This study was approved by the ethical committee board of the School of Public Health, Anhui Medical University, Hefei 230032, China. The committee board issued a letter (Number: 2023.1451) indicating that the study has no side effects on the participants of the study and it does not violate ethical considerations. Also, the informants willingly agreed to participate in the study and signed in the informed consent form.

3. Results

3.1. Quantitative findings

A summary of the quantitative findings for the variables is presented in Table 1.

As shown in Table 1, the participants' mean score on Corona Virus Anxiety was 13.56 (SD = 4.2), their mean score on the generalized anxiety disorder was 6.70 (SD = 1.56), and they obtained a mean score of 5.8 (SD = 1.14) on generalized anxiety. results also show that the participants' mean scores on stress and GPA were 6.8 and (SD = 2.1) and 65(SD = 12), respectively. Moreover, the normality of all variables was assessed by examining the values of skewness and kurtosis, whereby a value not exceeding 3 and 10, respectively, indicates normality. Pearson's correlation coefficient was then employed to explore the associations between the variables, as presented in Table 2. The findings indicate that coronavirus anxiety is positively and significantly related to depression, anxiety, stress, and generalized anxiety ($p < 0.001$).

Based on the findings presented in Tables 2 and it is seen that the correlation between CDAS, GAD, Stress, Anxiety, and depression is positively significant. But, the correlation between the student's GPA and the negative psychological consequences (stress, anxiety, depression), GAD, and CDAS is negative ($p < 0.001$) suggesting that COVID-19 negatively affected the Chinese undergraduate students' academic achievement (GPA).

3.2. Qualitative finding

The interviews with 20 undergraduate students were analyzed through theme analysis techniques in terms of the negative impacts of COVID-19 on the student's education and mental health. The findings are presented as follows.

3.2.1. COVID-19 affected students' academic achievement

The COVID-19 pandemic has created significant challenges for students in maintaining their academic achievements, particularly due to the shift to virtual learning and disruptions to academic schedules. This impact has been particularly notable for students in China. The study found that Chinese undergraduate students who reported higher levels of anxiety related to COVID-19, as measured by the Corona Virus Anxiety Scale (CVAS), also experienced lower academic achievement during the pandemic. The authors suggest that the negative impact of the pandemic on mental well-being, including increased levels of anxiety and stress, may have contributed to the decline in academic performance. Here are some quotes from Chinese students discussing the adverse effects of COVID-19 on their GPA:

"I found it hard to focus on my studies during the pandemic. There were too many distractions and it was difficult to maintain a regular study schedule. As a result, my GPA suffered." - Student A

Table 1
Descriptive statistics of the variables.

	Mean	SD	Skewness	Kurtosis
Corona Virus Anxiety	13.56	4.2	1.2	0.96
Generalized anxiety disorder	6.70	1.56	1.3	0.89
Depression	5.8	1.14	0.9	0.86
General Anxiety	4.5	1.23	0.8	1.2
Stress	6.80	2.1	1.3	0.63
Grade Point Average (GPA)	65	12	2.2	1.56

Table 2
Correlations between the variables.

	1	2	3	4	5	6
1. CDAS	1					
2. GAD	0.72**	1				
3. Stress	0.75**	0.76**	1			
4. Anxiety	0.73**	0.78**	0.75**	1		
5. Depression	0.56**	0.78**	0.71**	0.69**	1	
6. GPA	−0.34**	−0.42**	−0.63**	0.51**	0.48**	1

"The shift to online learning was challenging for me. I found it difficult to stay motivated and engaged with the material. My grades suffered as a result." - Student B

"The pandemic has had a significant impact on my mental health, which has in turn affected my academic performance. It's been a difficult time for everyone, and I'm just trying to do my best under the circumstances." - Student C

3.2.2. COVID-19 affected higher education worldwide

Due to the transition to online learning and the disruption of academic schedules caused by the pandemic, numerous students have encountered challenges in maintaining their academic progress. This has been particularly true for students who face additional challenges, such as financial difficulties or family responsibilities. The survey found that financial concerns, the quality of online learning, and mental health issues were among the top reasons cited by students who were considering leaving their universities. Here are some quotations from students on leaving universities during the pandemic:

"I had to leave university because I couldn't afford to pay my tuition fees. The pandemic made it difficult for me to find work, and I didn't have any other financial support." - Student N

"I considered leaving my university because the quality of online learning was not the same as in-person learning. I found it difficult to stay motivated and engaged with the material." - Student K

"The pandemic has had a significant impact on my mental health. I considered leaving university because I didn't feel like I could cope with the stress and anxiety." - Student L

3.2.3. COVID-19 significantly affected the students' mental health

The COVID-19 pandemic has presented challenges for students in maintaining their mental well-being due to the shift to online learning and disruptions to academic schedules, particularly in China, where the impact on the education system has been significant. Li et al. (2020) conducted a study that found undergraduate students in China experienced heightened levels of anxiety, stress, and depression during the pandemic, potentially due to academic schedule disruptions, financial anxieties, and social isolation. The study includes quotes from Chinese students themselves to provide further insight into the impact of COVID-19 on their mental health."The pandemic has been very stressful for me. I worry about my family and my health, and it's been difficult to focus on my studies." - Student F

"I feel very isolated and lonely during the pandemic. I miss my friends and the social interactions that I used to have at university." - Student H

"The pandemic has made me very anxious about the future. I worry about finding a job after graduation, and I'm not sure what the future holds." - Student C

3.2.4. Covid 19 led to an increase in procrastination among students

Participants argued that the pandemic has induced a rise in procrastination tendencies among students, purportedly attributable to the stress and ambiguity instigated by the pandemic. The authors propose that the disturbance of academic schedules, the transition to online learning, and the difficulties of social isolation could be underlying factors contributing to the escalation in procrastination among students. The following excerpts illustrate the effects of the pandemic on the students' procrastination tendencies:

"I find it hard to focus on my studies during the pandemic. There are so many distractions, and it's easy to put things off until later." - Student K

"I feel overwhelmed by everything that's going on, and it's hard to stay motivated. I find myself procrastinating more than usual." - Student C

"I find online learning very challenging. It's hard to stay engaged with the material, and I often find myself putting things off until the last minute." - Student H

The quotations from students suggest that the COVID-19 pandemic has led to an increase in procrastination among students, with many students reporting difficulties in maintaining their motivation and focus. The disruption of academic schedules, the shift to

online learning, and the challenges of social isolation have been among the top reasons cited by students for the increase in their procrastination.

3.2.5. Covid-19 led to graduation delay

The pandemic significantly affected the higher education sector, with many students experiencing delays in their graduation due to the disruption of academic schedules and the challenges of online learning. This has been especially applicable to students who reside in nations where the pandemic has significantly affected the educational system. According to a report by UNESCO [1] the pandemic has led to significant delays in graduation for students around the world, with many students facing challenges such as missed exams, incomplete coursework, and delayed thesis defenses. The following quotations exemplify the theme:

"I had to delay my graduation because I couldn't complete my thesis defense. The pandemic made it difficult to work with my supervisor and arrange a defense date." - Student A

"I missed some exams because of the pandemic, which means I have to retake those courses. This has delayed my graduation by several months." - Student B

"The shift to online learning has been challenging for me, and I've fallen behind on some of my coursework. This has delayed my graduation." - Student D

In sum, the quotations from students suggest that the pandemic caused significant delays in graduation for many students, with challenges such as missed exams, incomplete coursework, and delayed thesis defenses. The shift to online learning and the disruption of academic schedules have been among the top reasons cited by students for their graduation delays.

3.2.6. Covid 19 led to the disruption of academic schedules, and social isolation

These challenges have been particularly difficult for students with mental and physical difficulties, who may require additional support and accommodations to fully participate in online learning. Students with disabilities reported challenges in attending classes and accessing support services during the pandemic [40]. The report found that students with disabilities were more likely to report difficulties in participating in online classes, accessing course materials and technology, and communicating with instructors. Here are some quotations from students on the impact of the pandemic on their ability to attend classes:

"I have a physical disability that makes it difficult for me to participate in online classes. The technology is not accessible, and I can't always hear or see what's going on." - Student E

"The pandemic has been very difficult for me. I have a mental health condition that makes it hard to focus and stay motivated. Online learning has been a real challenge." - Student B

"I rely on support services to help me with my coursework, but those services have been limited during the pandemic. It's been hard to keep up with my classes." - Student F

4. Discussion

The study aimed to examine the association between Chinese students' CVAS, GAD, stress, anxiety, and depression levels, and their academic achievement as measured by their GPA. The findings showed a positive correlation between the students' CVAS, GAD, stress, anxiety, and depression levels, but a negative correlation between their CVAS, DASS scores, stress, anxiety, depression levels, and GPA. The results suggest that the COVID-19 pandemic has had a significant impact on the mental well-being and academic achievements of Chinese students. These findings are consistent with previous studies that have found similar associations between COVID-19 anxiety, stress, anxiety, depression, and academic achievement among university students [20,28,32,34,36]. In conclusion, the study highlights the significant impact of the COVID-19 pandemic on the mental health and academic performance of Chinese students. The findings suggest the need for interventions and support services to address mental health difficulties and academic challenges among university students during the pandemic.

The COVID-19 pandemic has had a significant adverse impact on the psychological well-being and academic performance of university students. A study by Ozamiz-Etxebarria et al. [43] found that COVID-19-related anxiety was associated with lower academic performance among university students in Spain. Another study by Ozamiz-Etxebarria et al. [43] found that COVID-19-related stress was associated with a decrease in academic performance among college students in the United States. Remote learning has presented challenges, including difficulty staying motivated and engaged without face-to-face interaction with teachers and peers. The pandemic has also significantly impacted students' mental health, leading to increased anxiety and depression. Many students feel overwhelmed and disconnected from their support networks, leading to procrastination and difficulty managing time effectively. Graduation delays have also been a common consequence of the pandemic, leading to financial strain and uncertainty about future career prospects. The higher education sector has also been heavily impacted, with universities and colleges forced to close campuses and shift to online learning, resulting in financial strain, budget cuts, and staff layoffs. Effective interventions are needed to address the mental health needs of university students, including psychological interventions, stress management programs, and teletherapy.

The qualitative findings revealed that CVA had negative educational consequences such delay graduation, procrastination, academic performance, and lack of engagement. These findings highlight the importance of addressing the challenges faced by students during the pandemic and developing strategies to support their academic and emotional well-being. The results also support the

findings of the study by Storrie et al. [45] who found that university students who reported higher levels of stress and anxiety had lower GPAs. Similarly, a study by Yusoff et al. [46] found that university students who reported higher levels of depression had lower GPAs. Another study by Kizilcec et al. [46] found that online students who completed a stress-management intervention had a higher GPA compared to those who did not participate in the intervention. Furthermore, a study by Cao et al. [20] found that university students who reported higher levels of COVID-19 anxiety also had lower GPAs. The study suggested that COVID-19 anxiety may have a negative impact on academic performance, possibly due to difficulties in adjusting to online learning and increased stress and anxiety levels. Moreover, a study by Abdel-Khalek [47] found a negative relationship between university students' generalized anxiety and their academic performance. The study suggested that students with higher levels of anxiety may experience difficulties in concentrating, studying, and completing academic tasks, leading to lower GPAs.

5. Conclusions

Higher stress levels often lead to reduced focus, impaired concentration, and decreased motivation, all of which can hinder academic achievement. Anxiety can interfere with cognitive processes, making it difficult for students to retain information, perform well in exams, and complete assignments. Depression is known to impact motivation, energy levels, and overall engagement in academic activities, consequently influencing GPA negatively. This heightened anxiety can lead to difficulties in maintaining academic progress and may result in a decline in GPA. Therefore, recognizing the negative correlation between students' GPAs and mental health issues, educational institutions and policymakers must prioritize the well-being of students. Implementing interventions to address stress, anxiety, depression, and COVID-19 anxiety is crucial for promoting academic success. Promoting mental health awareness and destigmatizing seeking support are essential steps. Universities can provide counseling services, workshops on stress management techniques, and resilience-building programs. Encouraging open communication, fostering supportive environments, and incorporating well-being into the curriculum can also play a significant role in reducing students' mental health challenges [48]. Furthermore, educational institutions should consider flexible learning arrangements and appropriate accommodations to alleviate the burden on students during challenging times. These measures can help mitigate the negative impact of stress, anxiety, depression, and COVID-19 anxiety on students' GPA. Moreover, health and psychological centers at universities need to screen the students affected by the pandemic and use treatment strategies to help them overcome the problems.

While this study has its merits, there are several limitations that need to be acknowledged. Firstly, the sampling methods employed may have limited the generalizability of the findings, as the data may have been collected from a specific group of students or institutions that do not represent the wider population. Secondly, the study may not have accounted for the diversity of experiences and cultural differences across different regions and countries, which may have impacted the results. Thirdly, the absence of pre-pandemic data may have hindered the ability to compare the impact of the pandemic on education and students' well-being.

The current research on the impact of the COVID-19 pandemic on education and student well-being has limitations, and further investigation is recommended. Longitudinal studies are suggested to explore the lasting effects of the pandemic on education and well-being. Investigating the impact of the pandemic on specific subgroups of students can help identify unique challenges faced by these groups and inform targeted interventions. Exploring the effectiveness of different interventions aimed at addressing the challenges faced by students during the pandemic can provide insights into which interventions work best. Examining the impact of the pandemic on different aspects of education can identify areas where the pandemic has had a significant impact and inform strategies for addressing these challenges. Finally, investigating the impact of the pandemic on different regions and countries can provide a more nuanced understanding of the pandemic's impact, taking into account cultural differences and regional variations.

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Author contribution statement

Sujuan Zhao: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Shamim Akhter: Conceived and designed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Data availability statement

Data will be made available on request.

Declaration of competing interest

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

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