



Longitudinal changes in fear and anxiety among Chinese college students during the COVID-19 pandemic: a one-year follow-up study

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Abstract

There is growing evidence that levels of fear and anxiety have increased during the COVID-19 pandemic. However, given regular epidemic prevention and control measures, longitudinal changes and causal factors in the incidence of fear and anxiety need to be measured and explored. College students completed online surveys in two wave studies a year apart. The participants who completed both of the surveys numbered 22,578. The online surveys were completed at the pandemic's normalization/prevention stage (T1, from June 1 to 15, 2020) and during a phase of new local transmission of the disease in Guangdong Province (T2, from June 10 to 18, 2021). Multiple linear regressions were used to examine fear and anxiety predictors from demographic characteristics. Fear related to COVID-19 had significantly decreased at T2 ($t = 66.64$, $p < 0.001$), however, anxiety had significantly increased at T2 ($t = -5.03$, $p < 0.001$). In particular, not implementing preventive measures (e.g., handwashing) during the COVID-19 pandemic had the greatest impact in predicting the change in fear levels. By contrast, prior poor mental health status contributed the most in predicting the change in degree of anxiety. These results suggest different changes in anxiety levels (deterioration) and degree of fear (mitigation) occurred as the COVID-19 pandemic progressed. These findings have implications for planning mental health crisis provisions and have long-term impact beyond this pandemic.

Keywords COVID-19 · Fear · Anxiety · College students · Longitudinal

Introduction

The ongoing COVID-19 pandemic poses an unparalleled threat to individual's health and life (Hasratian et al., 2021), and has the pervasive potential to cause psychological distress in large population worldwide. The pandemic in China has basically been controlled since March 2020, with Hubei province announcing zero new confirmed cases on March 18, 2020, and Wuhan declaring on April 26, 2020 that numbers of patients with COVID-19 in hospital were showing a consistent downward trend (China, 2020). Many colleges and

universities started to re-open, allowing students to return in batches from May 2020. However, new locally transmitted COVID-19 cases were still being reported in different cities or districts once the pandemic prevention and control work shifted from an emergency state to something more normal. For example, Guangzhou reported a new local case on May 21, 2021 (Commission, 2021), Local Authority COVID-19 Prevention and Control Headquarters immediately announced all residents in this district had to undergo extensive nucleic acid testing on May 26 and 27, 2021 (Daily, 2021). After that, in order to protect the population, minimize the spread of the virus, and treat COVID-19 patients, a second partial lockdown was implemented on May 31, 2021, with schools in the local district shut down, and other schools and colleges in different districts remaining open (Headquarters, 2021). One previous study suggests such measures can be expected to elevate the risk of mental illness, particularly anxiety disorders and major depression (Hasratian et al., 2021). In addition, prolonged pandemic lockdowns that continuously restrict people's routine activities for extended periods can adversely affect their daily life, including work and study habits (Brooks et al., 2020).

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Colleges had to consider taking large-scale preventive measures to keep students and professors healthy and safe, as well as create contingency plans for when infections materialize on campus (Araújo et al., 2020). During the second partial lockdown in Guangzhou, colleges and universities continued to open, but with stricter measures. Colleges and universities continue to address checking health status and other profound and complex challenges in the short term. However, the real danger may be in the long-term effects of the pandemic (Araújo et al., 2020). Emerging studies in specific contexts point to a generalized increase in mental health problems in the university community, highlighting anxiety, stress, and depression during the outbreak of COVID-19 (Cao et al., 2020; Dratva et al., 2020; Muyor-Rodriguez et al., 2021).

Fear and anxiety belong to a basic set of human emotions common to all ethnicities and cultures (P, 2016). Although fear and anxiety are the same kind of emotion, triggered by the perception of threatening stimuli (Bateson et al., 2011; de Hoog et al., 2008), the fear related to COVID-19 and the accompanying anxiety are quite distinct constructs. Fear is one common element of infectious diseases such as COVID-19, compared to other conditions (Rubin & Wessely, 2020; Shigemura et al., 2020), which can be understood as a more immediate COVID-19 related emotion, while anxiety means the sustained level of worry experienced by a person over a period of some weeks. In other words, during the outbreak, fear and anxiety behave differently. On the one hand, worries and fears about the COVID-19 stigmatization and discrimination can be a source of stress (Lin et al., 2020). Meanwhile, the fear of COVID-19 causes individuals to be on the alert to protect themselves and their loved ones from infection (Yip & Chau, 2020). Moreover, inaccurate or ineffective information communicated through the media can lead to heightened appraisals of threat resulting in fear and psychological distress (Garfin et al., 2020). On the other hand, stressful events represent urgent risk factors in the emergence of anxiety symptoms and difficulties in regulating negative emotions (Ding et al., 2020; Schneider et al., 2021). However, given that COVID-19 is influencing our lives in many ways, including the social, economic, relational and professional spheres, the levels of fear and anxiety of college students are worthy of concern, especially for their potential long term effects.

However, the COVID-19 pandemic is a consistently developed situation where mental health consequences can change unexpectedly due to changes in case numbers, governmental restrictions or media coverage. Therefore, longitudinal research, ideally with repeated measurements, is needed to provide insight into the progress of the psychological consequences of the pandemic and the associations with risk factors (Bendau et al., 2021c). However, to date, only a few longitudinal studies have explored fear related to COVID-19 and symptoms of anxiety among university students. Findings on changes in levels of fear and anxiety are

complex and mixed. One study from Germany showed that anxiety symptoms were particularly high in early 2020, but became attenuated in the following months of the pandemic (Bendau et al., 2021a, 2021b, 2021c). Two other studies (Elmer et al., 2020; Zimmermann et al., 2021) indicated an increase in the severity of anxiety. Then there was a daily survey of fear conducted in Europe over 22 days in March 2020, which led to the conclusion that the global fear of COVID-19 increased significantly over time (Lippold et al., 2020). Another survey conducted from January to September found that global fear about the COVID-19 pandemic was highest from April to May, then decreased through September (Ministry of Health LaW, 2020).

In light of the above, the first aim of the present study was to identify the changes in fear related to COVID-19, as well as in anxiety over time, using data from June 2020 and June 2021 provided by 22,578 college students in Guangzhou, China. The second aim of our study was to explore the predictive factors associated with fear and anxiety, so as to present implications for future psychological interventions to help improve the well-being of college and university students.

Methods

Participants and procedures

The first survey (T1) enrolled a total number of 159,187 students (valid questionnaire: 95.7%) at the normalization prevention stage (from June 1 to 15, 2020), and again, one year later (from June 10 to 18, 2021), the second wave survey (T2) was collected. This took place after Guangdong Province had had new locally transmitted confirmed COVID-19 cases from the middle of May 2021, with 93,413 students (valid questionnaire: 92.1%) completing the survey. Of the total participants, 22,578 students participated in both surveys. All procedures were conducted in accordance with the ethical standards of the institutional research committee.

Measures

This 1-year follow-up study was conducted on a large sample of college students from 22 colleges and universities in the Guangdong Province of China. All measures were completed at T1 and T2.

Demographic characteristics

Demographic information assessed included age and gender and basic information about respondents' perceived physical and mental health status (good, general, or poor); time spent on physical activity and online surfing two weeks

before the survey, and acknowledgement of the COVID-19 pandemic (assessed with questions such as, “How much time do you spend on COVID-19 information?”; “Do you think COVID-19 can be prevented or healed or not?”; “Have you implemented measures to prevent COVID-19?”). We also collected information on the impact of COVID-19 on respondents’ incomes and the incomes of their families, on people’s careers (their academic concerns) and social relationships (their social concern).

Generalized Anxiety Disorder-7

The Generalized Anxiety Disorder (GAD-7) is a widely-used method for measuring the frequency of emotions related to anxiety in mental health care settings (Tong et al., 2016). The cut-off point for GAD-7 was 7 and Cronbach’s alpha was 0.94 at T1 and 0.94 at T2 in the study. GAD-7 consisted of seven items, each question had four possible responses (ranging from 0 to 3), and the total score ranged from 0 to 21. The severity of anxiety symptoms was classified as none (0–4), mild (5–9), moderate (10–14), and severe (15–21).

Fear related to COVID-19

The CV-19FSS is a 12-item self-report scale adapted from the SARS Fear Emotion Screening Inventory (Gao, 2005). The CV-19FSS is designed to assess the emotion of fear during a public health emergency. The scale comprises items assessing excessive concerns about COVID-19 (e.g. ‘always worried that you and your family will be infected with COVID-19, and hope everyone will not go out’) and ways daily life has been disrupted by COVID-19 (e.g. ‘always pay attention to news about COVID-19, talk with others revolves around COVID-19’). The scores ranged from 0 to 12, with higher scores indicating higher levels of fear, as participants were asked to answer either “Yes” (1) or “No” (0). The CV-19FSS includes fear categories based on score ranges: scores of 0–4 indicate no fear, scores of 4–6 indicate mild fear, scores of 7–9 indicate moderately severe fear and scores of 10–12 indicate severe fear. The Cronbach’s alpha was 0.73 at T1 and 0.76 at T2 in the current study.

Impact of Event Scale (IES-6)

The 6-item Impact of Event Scale (IES-6) was used to assess posttraumatic stress reactions over the previous 7 days. Five response options were available on a scale of 0 (not at all) to 4 (extremely so). Higher total score indicates higher levels of post-traumatic stress symptoms (Thoresen

et al., 2010). In the current sample, Cronbach’s α was 0.82 at T1 and 0.88 at T2.

Patient Health Questionnaire (PHQ-9)

The 9-item Patient Health Questionnaire (PHQ-9) (Kroenke et al., 2001) was widely used to measure students’ depressive symptoms in the previous two weeks. PHQ-9 is a brief self-report scale, responses to each item were recorded from 0 (not at all) to 3 (nearly every day), with higher total scores indicating a greater tendency towards depressive symptoms. The Cronbach’s alpha was 0.91 at T1 and 0.92 at T2 in the study.

Statistical analysis

Analyses were conducted in SPSS Version 26 (IBM, SPSS, Armonk, NY). Paired t-tests examined changes in fear and anxiety across both time points. Partial correlations were estimated to assess bivariate associations between descriptive factors and fear and anxiety during the COVID-19 pandemic and after 1-year follow-up. Linear regression models were used to analyze the associations between demographic factors and emotional states of fear and anxiety at T1 and T2, and the associations between changes in these variables. Regression models were used to explore which demographic factors could potentially predict the emotions of fear and anxiety. All variables were entered into the linear regression simultaneously and significance was set at $\alpha = 0.05$. Continuous fear related to COVID-19 and anxiety at T1, T2 and change in fear and anxiety (change scores were calculated as T2-T1) were standardized to create Z-scores, allowing comparison of effect sizes across outcomes and cohorts.

Results

A total of 22,578 students completed both two-wave surveys. On average, participants were 19.96 years old ($SD = 1.3$, range 18–26). Approximately two-thirds of the sample identified as female (69.7%). Around 6% of students reported that they or their family’s income had been badly affected during COVID-19. And about 6.2%, and 4.5% of students respectively indicated that their academic career and social relationships had been badly impacted. All descriptive statistics are displayed in Table 1.

Means, standard deviations and comparison of fear and anxiety in a 1-year follow-up are presented in Table 2. Fear related to COVID-19 and generalized anxiety were calculated at two points with different levels. Thus 0.8% of students felt severe fear related to COVID-19 at T1 and 0.6% felt severe fear related to COVID-19 at T2, while 23.3% of

Table 1 The basic characteristics of study population (T1, Time 1)

Variables	Category	Total (N=22,578)(%)	Mean (SD), Range
Age, mean (SD), year			19.96(1.3), 18–26
Gender	Male	6841(30.3)	
	Female	15,737(69.7)	
Psychological aid	No	22,444(99.4)	
	Yes	134(0.6)	
Can COVID-19-be-healed	Yes	22,048(97.7)	
	No	530(2.3)	
Implemented preventive measures	Yes	22,175(98.2)	
	No	403(1.8)	
Mental health status	Good	20,090(89.0)	
	General	2275(10.1)	
	Poor	213(0.9)	
Physical activity time	> 30 min	8694(38.5)	
	≤ 30 min	12,609(55.8)	
	Never	1275(5.6)	
Attention on COVID-19	≤ 1 h	15,923(70.5)	
	> 1 h	6655(29.5)	
Online surfing time	≤ 2 h	1559(6.9)	
	2–5 h	6922(30.7)	
	≥ 5 h	14,097(62.4)	
Financial concern	little	3192(14.1)	
	Small	10,587(46.9)	
	Badly	8799(39.0)	
Academic concern	little	2628(11.6)	
	Small	10,452(46.3)	
	Badly	9498(42.1)	
Social concern	little	5346(23.7)	
	Small	10,713(47.4)	
	Badly	6519(28.9)	
Depression			4.66 (4.21), 0–27
Acute stress			4.32 (3.30), 0–24

SD: standard deviation; Depression calculated using the PHQ-9; Acute stress calculated using the IES-6

Table 2 Means, standard deviations and comparison of fear and anxiety in a 1-year follow-up and fear related to COVID-19 and anxiety levels of all participants (N=22,578)

		M (SD)	Minimal	Mild	Moderately severe	Severe	Time Comparison		
							<i>t</i>	<i>p</i>	<i>d</i>
Fear	T1	1.81(1.98)	91.00%	5.70%	2.50%	0.80%	66.64	0.001	0.45
	T2	0.99(1.66)	96.00%	2.40%	1.00%	0.60%			
Anxiety	T1	2.53(3.37)	73.50%	23.30%	2.40%	0.70%	-5.03	0.001	-0.28
	T2	2.64(3.36)	70.90%	26.50%	1.90%	0.60%			

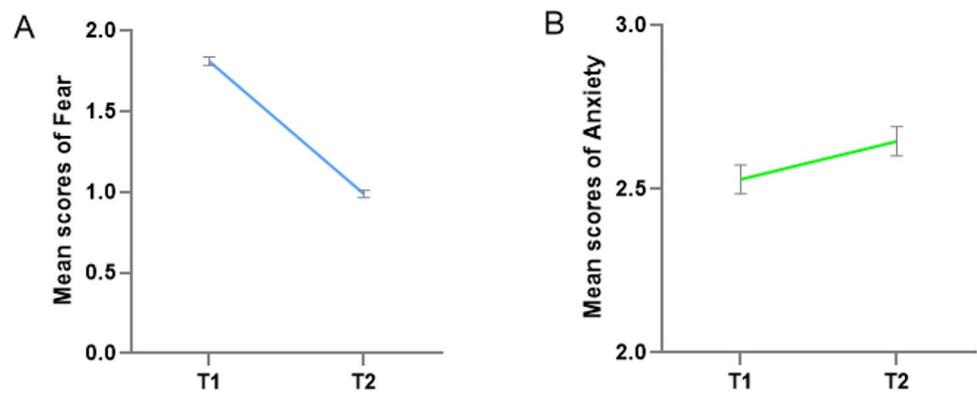
Fear: Fear related to COVID-19 (CV-19FSS); Anxiety: Generalized Anxiety Disorder (GAD-7); T1: Time 1, June 1 to 15, 2020; T2: Time 2, June 10 to 18, 2021; M (SD): mean and standard deviation

students felt mild to severe anxiety in T1 and 26.5% felt mild to severe anxiety at T2.

To determine whether fear and anxiety changed significantly between the two points, paired t-tests were calculated (see both Table 2 and Fig. 1). In Fig. 1A, fear related

to COVID-19 had significantly decreased at T2 ($t = 66.64$, $p < 0.001$). However, anxiety after the 1-year follow-up survey (T2) was significantly higher than T1, the normalization prevention stage ($t = -5.03$, $p < 0.001$) (Fig. 1B). The correlations among the predictors are shown in Table 3.

Fig. 1 Fear and anxiety change trend after 1-year follow-up. Mean scores at the fear related to COVID-19 scale (A) and generalized anxiety scale-7 (B) as predicted by the term time (from T1 to T2). Error bars represent the 95% confidence intervals



Unstandardized regression coefficients are displayed in Table 4. All regression models were significant ($p < 0.001$). Older age, female gender and non-implementation of preventive measures all positively predicted change in fear ($B = 0.03$, $p < 0.001$; $B = 0.03$, $p < 0.05$; $B = 0.18$, $p < 0.001$, respectively). The following negatively predicted change in fear: higher levels of depression ($B = -0.01$, $p < 0.001$), higher levels of acute stress ($B = -0.05$, $p < 0.001$), spending more than one hour on COVID-19 information ($B = -0.11$, $p < 0.001$), negative financial concerns ($B = -0.07$, $p < 0.001$) and negative social concerns ($B = -0.09$, $p < 0.001$). In particular, not taking preventive measures during the COVID-19 pandemic played the greatest part in predicting change in fear levels. At the same time, female gender, more than one hour spent surfing online and negative academic concerns all positively predicted change in anxiety ($B = 0.14$, $p < 0.001$; $B = 0.06$, $p < 0.05$; $B = 0.06$, $p < 0.05$, respectively). Prior poor mental health status and higher levels of depression negatively predicted change in anxiety levels ($B = -0.08$, $p < 0.001$). Prior poor mental health status was the most noticeable factor in predicting change in anxiety.

Discussion

The present study aims to explore temporal changes in fear related to COVID-19 and anxiety among 22,578 Chinese college students from June 2020 (the normalization prevention stage), to June 2021, a time when a new local cases had been transmitted in Guangzhou, Guangdong province. Furthermore, we explored several predictive factors of fear and anxiety respectively. The findings from this study indicate a significant decrease in fear related to COVID-19 over time, although a significant increase in anxiety. In a one-year follow-up survey, female gender in particular positively predicted changes in fear and anxiety; however, higher level of acute stress negatively predicted the change in fear levels. Moreover, non-implemented preventive measures and prior poor mental health contributed the most in predicting changes in fear and anxiety respectively.

Surprisingly, participants' emotional experience showed different trends during the COVID-19 pandemic. For example, fear did not mirror an infection being found and people in that district having to stay at home. Such measures decreased at the time when Guangdong province found a new local case, and so college students did not immediately feel fear. Instead emotions reverted back to normal, and students followed the order of local authorities and schools, and remained in school as usual. The reasons why fear related to COVID-19 decreased from June 2020 to June 2021 are suggested below.

One possible reason could be that during the COVID-19 pandemic, at the stage of normalization, new local cases transmitted in different districts at different periods meant people grew accustomed to the fact that COVID-19 could occur anywhere, especially at a time the global COVID-19 situation was still severe. So when college students knew that some place had a new local case, they possibly began to take this for granted and no longer feel fear.

One previous study suggested that the threat of infection posed by the virus may elicit fear (Hoffart et al., 2021). However, a vaccination strategy over the following spring months in China could be a possible reason for college students' reduced experience of fear. In fact, by 21 May 2021, those who had received at least one dose of a vaccine reached 483.343 million (Commission, 2021).

Moreover, the local authorities immediately provided correct information through the media to ensure sure the population was aware of new cases—a measure that could have made those college students who focus on case transmissions feel less fearful.

The public health countermeasures were implemented, requiring significant cognitive and behavioral modifications in the way individuals live their daily lives (Marroquín et al., 2020; O'Connor et al., 2020). For example, people were asked to wash hands more often, use facial mask and maintain physical distance. Due to the restrictive order requiring masks in public places, college students especially are asked to stay at school as much as possible, and this could be another reason why students did not feel as much fear at the emergence of local new cases.

Table 3 Correlations among the main demographic characteristics and psychological predictors

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
1.Age	1																		
2.Gender	-0.09**	1																	
3.Psychological aid	-0.01*	-0.01	1																
4.Can COVID-19-be-healed	0.01	0.00	0.02*	1															
5.Implemented measures	0.02*	0.00	0.01	0.06**	1														
6.Mental health status	0.01	0.00	0.06**	0.04**	0.08**	1													
7.Physical activity time	0.03**	0.11**	0.00	0.03**	0.06**	0.14**	1												
8.Attention on COVID-19	-0.01	0.00	0.02**	0.00	-0.02**	-0.05**	-0.15**	1											
9.Online surfing time	-0.04**	0.08**	0.00	0.02*	0.01*	0.08**	0.13**	-0.06**	1										
10.Financial concern	0.08**	-0.02**	0.02**	0.02*	0.02**	0.07**	0.04**	0.07**	0.05**	1									
11.Academic concern	0.07**	-0.06**	0.02**	0.02**	0.03**	0.12**	0.07**	0.03**	0.08**	0.38**	1								
12.Social concern	0.06**	-0.13**	0.03**	0.03**	0.03**	0.11**	0.03**	0.03**	0.06**	0.29**	0.44**	1							
13.Depression	0.00	0.03**	0.05**	0.05**	0.07**	0.42**	0.16**	0.00	0.14**	0.16**	0.24**	0.24**	1						
14.Acute stress	0.01	-0.10**	0.03**	0.03**	0.00	0.07**	-0.05**	0.21**	-0.04**	0.17**	0.19**	0.21**	0.31**	1					
15.Fear(T1)	-0.06**	0.02**	0.06**	0.04**	0.00	0.10**	0.01	0.19**	0.01	0.15**	0.17**	0.16**	0.29**	0.45**	1				
16.Anxiety(T1)	0.03**	0.00	0.06**	0.05**	0.06**	0.40**	0.12**	0.02**	0.09**	0.15**	0.21**	0.21**	0.80**	0.33**	0.30**	1			
17.Fear(T2)	-0.03**	0.06**	0.05**	0.03**	0.02**	0.08**	0.01	0.12**	0.00	0.09**	0.11**	0.08**	0.21**	0.30**	0.49**	0.23**	1		
18.Anxiety(T2)	0.02*	0.06**	0.03**	0.04**	0.04**	0.23**	0.09**	0.03**	0.06**	0.09**	0.13**	0.12**	0.46**	0.23**	0.22**	0.47**	0.28**	1	

* $p < 0.05$; ** $p < 0.01$. Depression calculated using the PHQ-9; Acute stress calculated using the IES-6; Fear calculated using the Fear related to COVID-19 (CV-19FSS); Anxiety calculated using the Generalized Anxiety Disorder (GAD-7); T1: Time 1, June 1 to 15, 2020; T2: Time 2, June 10 to 18, 2021

Table 4 Results of linear regressions predicting fear related to COVID-19 and anxiety, including Y-standardized beta (Std. Error)

A				
Variables		Predicting Fear at T1(Model 1) ^a	Predicting Fear at T2(Model 2) ^a	Predicting Change in Fear (Model 3) ^{ab}
Age		-0.05(0.00) ***	-0.02(0.01) ***	0.03(0.01) ***
Gender (female)		0.12(0.01) ***	0.18(0.01) ***	0.03(0.02) *
Body disease (yes)		0.21(0.10) *	0.27(0.11) *	0.02(0.11)
Psychological aid (yes)		0.48(0.08) ***	0.48(0.08) ***	-0.08(0.09)
Can COVID-19-be-healed (no)		0.12(0.04) ***	0.12(0.04) ***	-0.02(0.04)
Implemented preventive measures (no)		-0.11(0.04) *	0.07(0.05)	0.18(0.05) ***
Depression		0.03(0.00) ***	0.03(0.00) ***	-0.01(0.00) ***
Acute stress		0.11(0.00) ***	0.07(0.00) ***	-0.05(0.00) ***
Mental health status	General	0.02(0.02)	0.03(0.02)	0.01(0.02)
	Poor	0.04(0.06)	-0.02(0.07)	-0.06(0.07)
Physical activity time	≤ 30 min	0.03(0.01) *	0.00(0.01)	-0.03(0.01) *
	Never	0.03(0.03)	0.03(0.03)	-0.01(0.03)
Attention on COVID-19	> 1 h	0.23(0.01) ***	0.15(0.01) ***	-0.11(0.02) ***
Online surfing time	2–5 h	-0.05(0.02)	-0.08(0.03) ***	-0.02(0.03)
	≥ 5 h	-0.05(0.02)	-0.07(0.03) ***	-0.02(0.03)
Financial concern	Small	-0.01(0.02)	-0.03(0.02)	-0.01(0.02)
	Badly	0.09(0.02) ***	0.04(0.02)	-0.07(0.02) ***
Academic concern	Small	0.01(0.02)	-0.01(0.02)	-0.02(0.02)
	Badly	0.10(0.02) ***	0.07(0.02) ***	-0.05(0.03)
Social concern	Small	-0.05(0.02) ***	-0.06(0.02) ***	-0.01(0.02)
	Badly	0.07(0.02) ***	-0.02(0.02)	-0.09(0.02) ***
B				
Variables		Predicting Anxiety at T1(Model 4) ^a	Predicting Anxiety at T2(Model 5) ^a	Predicting Change in Anxiety (Model 6) ^{ab}
Age		0.02(0.00) ***	0.01(0.00) ***	-0.01(0.01)
Gender (female)		-0.01(0.01)	0.13(0.01) ***	0.14(0.01) ***
Body disease (yes)		0.10(0.07)	0.23(0.10) *	0.13(0.11)
Psychological aid (yes)		0.15(0.05) ***	0.12(0.08)	-0.03(0.08)
Can COVID-19-be-healed (no)		0.03(0.03)	0.08(0.04) *	0.05(0.04)
Implemented preventive measures (no)		0.02(0.03)	0.04(0.05)	0.02(0.05)
Depression		0.17(0.00) ***	0.09(0.00) ***	-0.08(0.00) ***
Acute stress		0.03(0.00) ***	0.03(0.00) ***	0.00(0.00)
Mental health status	General	0.21(0.01) ***	0.18(0.02) ***	-0.04(0.02)
	Poor	0.68(0.04) ***	0.08(0.06)	-0.58(0.07) ***
Physical activity time	≤ 30 min	-0.01(0.01)	0.04(0.01) *	0.04(0.01) ***
	Never	0.02(0.02)	0.02(0.03)	0.01(0.03)
Attention on COVID-19	> 1 h	0.01(0.01)	0.02(0.01)	0.01(0.01)
Online surfing time	2–5 h	-0.05(0.02) *	0.00(0.03)	0.05(0.03)
	≥ 5 h	-0.05(0.02) ***	0.01(0.02)	0.06(0.03) *
Financial concern	Small	-0.01(0.01)	-0.02(0.02)	0.00(0.02)
	Badly	0.02(0.01)	-0.01(0.02)	-0.03(0.02)
Academic concern	Small	-0.05(0.02) ***	0.01(0.02)	0.05(0.02) *
	Badly	-0.04(0.02) *	0.03(0.02)	0.06(0.03) *
Social concern	Small	0.03(0.01) *	0.04(0.02) *	0.02(0.02)
	Badly	0.01(0.01)	0.02(0.02)	0.01(0.02)

Age was entered as continuous variables from 18 to 26-year-old; Except age, all of other variables were dummy coded. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; Depression calculated using the PHQ-9; Acute stress calculated using the IES-6; Fear calculated using the Fear related to COVID-19 (CV-19FSS); Anxiety calculated using the Generalized Anxiety Disorder (GAD-7); T1: Time 1, June 1 to 15, 2020; T2: Time 2, June 10 to 18, 2021

^aFear related to COVID-19 and anxiety at T1, T2 and change in fear and anxiety were all standardized

^bIn regression analyses predicting change (Model 3 and Model 6), predictors are the change in those constructs. Change scores were calculated as T2-T1

In contrast to reduced fear, anxiety among college students increased throughout the lockdown from June 2020 to June 2021. This finding can be explained in part because, firstly, following the local case in Guangzhou in June 2021, college students clearly felt uncertain, plus there was a sudden change to everyday life with the resumption of strict social distancing measures. After the pandemic in China entered a period of normalization in June 2020, the local authority had eased restrictions on social contact. As Holmes et al. (2020) note, consequences of the COVID-19 pandemic include increased social isolation and loneliness, which are strongly associated with anxiety (Holmes et al., 2020). For example, domestic travel agencies remain vigilant if a person wants to leave Guangdong province. Moreover, entertainment, shopping areas and canteens are not allowed to serve people, activities are still restricted with less face-to-face communication. In sum, college students are not so much anxious about the COVID-19 pandemic itself, but rather about its future impact on their lives.

In addition, our findings suggest that some factors may predict changes in mental health during the COVID-19 pandemic. Female gender, not implementing preventive measures, and higher levels of acute stress were particularly strong factors in predicting changes in fear levels, while female gender, and prior poor mental health status were factors in predicting changes in anxiety levels during the COVID-19 pandemic. To the best of our knowledge and in line with a recent systematic review (Li et al., 2021), compared with male students, female have higher prevalence of anxiety, which may be explained by the different physiological structures and functions of male and female students. Meanwhile, female students are less courageous, more dependent on others and have stronger stress responses when confronted with emergencies (Haugen et al., 2014; Hyde et al., 2008; Patel et al., 2007; Rosenfield, 2013). This might explain why in the current study gender can be predictive of change in both fear and anxiety. Previous studies indicate that preventative behaviors can stymie the spread of the virus and are most likely to prevent the transmission of COVID-19 (e.g., hand washing, mask-wearing, etc.) (Heffner et al., 2021), which might well explain that implementing preventative measures could well have buffered the spread of COVID-19, while failure to implement preventive measures might accelerate the transmission of COVID-19, and hence increase the feeling of fear. One previous study likened the outbreak of COVID-19 to an acutely stressful or traumatic event, from a psychosocial perspective, involving potential threat to self and the survival of close others (Tsur & Abu-Raiya, 2020). Acute stress disorder is characterized by intrusive, dissociative and avoidant symptoms (Association, 2013; Bryant et al., 2000), and a negative mood (Association, 2013). Meanwhile, when students were challenged by the emergency of COVID-19, extremely high levels of acute

stress could indicate that they were in fear of the COVID-19 pandemic. One previous study reported that a history of psychiatric illness was associated with experiencing anxiety and anger 4–6 months after release from quarantine (Jeong et al., 2016), which could explain why prior poor mental health can be a predictor of change in anxiety levels.

Limitations

Last but not least, the authors are aware of several limitations to this study. First, due to lack of data prior to the pandemic, our study is not able to draw conclusions regarding changes to emotional states of college students from before the pandemic, and cannot differentiate clearly between pre-existing symptoms and those which occurred newly in the context of the pandemic. Second, whilst the scales of GAD-7, CV-19FSS, IES-6 and PHQ-9 have been shown to be a valid screening instrument for assessing anxiety, fear related to COVID-19, acute stress, and depression, the scales do not provide a clinical diagnosis of any specific condition. The gold standard for establishing psychiatric diagnoses involves structured clinical interviews and functional neuroimaging. Third, all measures were self-reported, which may include bias, and which raises concerns about participants presenting a more positive view of themselves when reporting preventative behaviors (e.g., hand washing, socially isolating) and lower levels of psychological distress. Finally, our analytic approach allowed us to identify the changes and predictive factors of fear and anxiety, but not necessarily to detect other factor(s) which might be modulating how these variables influenced changes in symptoms over time. Future research will be required to identify these moderators.

Conclusions

The main purpose of the present study was to discover the different change and predictive factors related to COVID-19 fear and anxiety among Chinese college students. To conclude, the current study showed that fear had decreased after a 1-year follow-up survey, whereas anxiety had increased over time, indicating that anxiety is different from fear, especially in the context of COVID-19. College students might not be as anxious about the pandemic itself, as they are about the impact of the pandemic over time. Importantly, factors such as not implementing preventive measures and prior poor mental health status contributed the most in predicting changes in fear and anxiety, respectively. This could have implications for policy makers and schools in taking actions to alleviate college students' fear and anxiety levels, allowing them to cope well with the outbreak of COVID-19 and reduce its impact in their future lives.

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Author contribution Each author contributed substantially to the paper. Jingbo Zhao Shunwei Liang, Xiaodan Peng and Lili Liu designed the study. Jianbin Chen, Shunwei Liang and Lili Liu made contributions to the conception and design of the work. All authors collected data. Xiaodan Peng performed statistical analyses and drafted the manuscript. Jianbin Chen, Lili Liu and Shunwei Liang contributed to reviewing the literature. Jingbo Zhao revised it critically for important intellectual content, and supervised the writing of the manuscript. All authors approved the final version of the manuscript.

Data availability The datasets generated during and/or analyzed during the current study are available from the author on reasonable request.

Declarations

Ethical statement All procedures conducted were approved by the Southern Medical University.

Consent to participate Informed consent was obtained from all individual participants included in the study.

Declaration of competing interest The authors declare that they have no competing interests. We declare that we do not have any commercial or associative interest that represents a conflict of interest in connection with the work submitted.

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