


# A comparison of anxiety levels before and during the COVID-19 pandemic

Psychological Reports  
2022, Vol. 0(0) 1–20  
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DOI: 10.1177/00332941221093250  
[journals.sagepub.com/home/prx](https://journals.sagepub.com/home/prx)  


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## Abstract

The COVID-19 Pandemic upended the lives of nearly everyone worldwide, and recent studies have reported higher rates of anxiety, depression, and other mental health problems. Using a repeated crosssectional design, the current study compares anxiety levels from a representative sample of college students prior-to and during the COVID-19 Pandemic. Additionally, differences in anxiety prior to and following U.S. approval for use of the Pfizer-BioNTech COVID-19 vaccine were also compared. Findings indicate that state-anxiety levels did not differ significantly prior to and during the Pandemic as well as before the vaccine and during and after the vaccine ( $M = 43.01, 44.10, 44.77$ , respectively). Surprisingly, trait anxiety levels were significantly higher during the Pandemic than before ( $p = .003$ ), and anxiety levels trend down after the approval of the vaccine, but not significantly ( $M = 45.10, 48.85, 47.58$ , respectively). Future research should continue to investigate and compare anxiety levels during the COVID-19 Pandemic.

## Keywords

anxiety, COVID-19, pandemic, college students, state anxiety, trait anxiety, vaccine

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## Introduction

In recent years, levels of anxiety and depression around the globe have generally been increasing, particularly among younger generations (Auerbach et al., 2018; Goodwin et al., 2020). A survey of college students from across the globe found that anxiety and depression are widely reported, with 42% of students reporting anxiety problems and 36% reporting depression, with nearly all college counseling centers reported this to be a growing concern on their campus (American Psychological Association, 2013). About half of undergraduate students in a Malaysian sample were also found to have moderate to severe anxiety (Amir Hamzah et al., 2019). Booth et al. (2015) argue that the most significant increases in mental health problems appear in western college-age students. Specifically, anxiety and depression levels were highest among 18–24-year-old undergraduate college students and individuals who identified as female (Mahmoud et al., 2012).

Unanticipated and uncontrollable adverse life events contribute to the onset and maintenance of anxiety and depression (Calkins et al., 2009; Casline et al., 2021; Grupe & Nitschke, 2013). In March of 2020, the COVID-19 virus spread rapidly worldwide, causing many countries to impose strict lockdowns and isolation from others. Reports of increased levels of anxiety, depression, and suicidality during the Pandemic have been widely reported upon across the general population (Chang et al., 2021; Hoyt et al., 2021; Oh et al., 2021; Ornell et al., 2020; Pierce et al., 2020; Robb et al., 2020; Sher, 2020); yet these mental health outcomes and health mitigation efforts differ across countries (Chang et al., 2021). For example, during the beginning phase of the COVID-19 Pandemic, 53.8% of a Chinese sample rated the Pandemic's psychological impact as moderate to severe, with 36.4% of individuals reporting anxiety symptoms and 30.3% reporting depression symptoms (Wang et al., 2020a). Chinese citizens generally have high confidence in doctors and adhere to recommendations to wear a face mask, both of which are protective factors against adverse mental health outcomes during the Pandemic (Wang et al., 2021a). In contrast, Americans' increased subjective distress is associated with wearing a face mask and seeking out health information associated with COVID-19 (Wang et al., 2021a). Countries like China, Thailand, Armenia, Canada, and Israel have universal health care coverage for their citizens and implemented measures to prevent COVID-19, while other countries such as the United States, Brazil, Guatemala, and Nicaragua have not been able to provide their citizens with equitable health care nor consistently accurate information (Shadmi et al., 2020). During the first COVID-19 wave, individuals in Denmark did not report any major differences in worry, distress, or physical symptoms compared to before the COVID-19 Pandemic; suggesting that their high trust in authorities and the health recommendations that were being established may have contributed to the lessened effects on mental health (Peterson et al., 2021). The United States Center of Disease Control and Prevention reported that anxiety disorder was approximately three times greater in 2020 compared to 2019 (25.5% vs. 8.1%) and depression was four times greater (24.3% vs. 6.5%; Czeisler et al., 2020), and between March 2020 to October 2020, emergency room

visits for adolescents' mental health emergencies increased 31% compared to 2019 (Leeb et al., 2020).

Factors associated with the COVID-19 virus may also impact mental health. Measures such as facemasks, social distancing, lockdowns, and virtual learning may have contributed to increased depression and anxiety during this time, especially for college students. Social isolation alone is thought to increase depression and anxiety (Santini et al., 2020). One study found that residents in China (where people wear masks, cover their nose and mouth when coughing and sneezing, practice good hand hygiene, have high trust in their health care system) had significantly less anxiety and depression symptoms than residents in Poland where residents did not take similar measures nor have the same level of trust in their health care system (Wang et al., 2020b). Social distancing measures were also shown to have a negative impact on mental health. A study of health-related quality of life among Vietnamese residents found higher levels of anxiety and depression from lockdown measures (Tran et al., 2020), and factors such as being single, separated, or widowed, having a higher education level, and losing one's occupation exacerbated symptoms of anxiety and depression (Le et al., 2020). Moreover, the shift from traditional face-to-face learning to a virtual learning environment was also found to increase levels of both depression and anxiety for university students, as the overbearing workload resulted in stress for Lebanese students (Fawaz & Samaha, 2020). These factors, among others, coincided to collectively increase worldwide mental health concerns throughout the global COVID-19 pandemic.

Consistent with literature before the Pandemic indicating that college students often reported the highest rates of depression and anxiety (Amir Hamzah et al., 2019; Booth et al., 2015; Mahmoud et al., 2012), this trend continued during the Pandemic. A longitudinal study from the United Kingdom found levels of mental distress rose significantly in April 2020 as the country locked down due to COVID-19, with the largest increase in 18–34-year-olds. (Pierce et al., 2020). A recent meta-analysis found 40% of Brazilian college students presented with high levels of anxiety (Demenech et al., 2021), and a different meta-analysis of 16 studies focused on college students across the world, which concluded the prevalence of anxiety and depression was relatively high during the COVID-19 Pandemic (Chang et al., 2021), but varied across countries. Oh et al. (2021) found that almost a third of U.S. college students reported moderately severe to severe anxiety, which were primarily a result of financial stress and fear of COVID-19 infection.

### *Purpose and hypotheses*

While stress can have a beneficial impact on functioning, such as increased adaptation (McEwen, 2004), too much stress can lead to maladaptive coping and mental health disorders. For college students, academic performance, finances, pressure to succeed, and post-graduation plans have long contributed to stress (Beiter et al., 2015). Unfortunately, outcome uncertainty and long-term chronic stress can interfere with

information processing, affect memory, and lead to poor mental health, including higher rates of anxiety (McEwen, 2004; Wilder & Shapiro, 1989). In 2009, fears over the A/H1N1 virus led to poorer problem solving and coping and greater uncertainty and anxiety (Taha et al., 2013). Taha and colleagues' findings are consistent with Lazarus and Folkman's (1984, 1986) Cognitive Appraisal Theory, which argues that one's personal beliefs, resources for coping, and coping strategies, influence anxiety and depression levels. One potential resource for college students is their social connection with others. Positive social connections serve as a buffer against anxiety and depression in college students. Indeed, pre-pandemic research by Hefner and Eisenberg (2009) found that college students with lower perceived social support had a significantly increased risk of isolation, loneliness, and anxiety. Thus, the stress of college and the stress of the COVID-19 Pandemic and its concomitant isolation likely exacerbated the levels of anxiety seen in college students.

Given this increased stress and poor psychological well-being amongst college students, the purpose of this study is to investigate the impact of COVID-19 on anxiety; specifically, trait- and state-anxiety among college students using a repeated cross-sectional design. Trait- and state-anxiety are important to look at as they are thought to be two different constructs mapped in different regions of the brain (Saviola et al., 2020). Thus, we hypothesize that state-anxiety will be significantly higher during the COVID-19 Pandemic, but trait-anxiety levels will remain consistent given that trait-anxiety is a personality disposition that describes a person's tendency to perceive situations as threatening (Gaudry et al., 1975). It is important to investigate the long-term repercussions the Pandemic has on young adults, and to monitor psychological well-being over time.

## Method and material

### Participants

Each semester between the spring semester of 2016 through the spring semester of 2021, data were collected from students in undergraduate psychology classes from a large public university ( $n = 556$ ). Age ranged from 18 to 54 years old ( $M = 21.67$ ,  $SD = 4.51$ ). The majority of participants were White (36.7%,  $n = 204$ ) and female (80.9%,  $n = 444$ ). Half (50.7%,  $n = 282$ ) of the surveys were completed before the COVID-19 Pandemic (prior to March 10, 2020), 22.3% ( $n = 124$ ) were completed during the Pandemic before the approval of the first COVID-19 vaccine (December 11, 2020), and 27.0% ( $n = 150$ ) were completed during the Pandemic after the approval of the first vaccine. Demographic data are consistent across the three groups, which is presented in Tables 1 and 2.

### Measures

**Demographic questionnaire.** As part of a larger study, demographic data were collected following informed consent. Depending on when the survey was conducted, different demographic data were collected. The majority of surveys collected asked about age,

**Table 1.** Race/ethnicity by pandemic time.

	Native American/ Alaskan Native		Asian/Pacific Islander		White	Latinx/Hispanic	Multi-ethnic	Other	Missing	Total
	Black									
Pre pandemic	11 (4.3%)	4 (1.6%)	37 (14.5%)	105 (41.0%)	72 (28.1%)	21 (8.2%)	6 (2.3%)	26	282	
Pandemic - pre vaccine	6 (5.0%)	1 (0.8%)	12 (10.1%)	42 (35.5%)	32 (26.9%)	23 (19.3%)	3 (2.5%)	5	124	
Pandemic - post vaccine	6 (4.1%)	1 (0.7%)	17 (11.6%)	57 (39.0%)	36 (24.7%)	27 (18.5%)	2 (1.4%)	4	150	
Total	23 (4.4%)	6 (1.2%)	66 (12.7%)	204 (39.2%)	140 (26.9%)	71 (13.6%)	11 (2.1%)	35	556	

Percentages given exclude missing data.

**Table 2.** Gender by pandemic time.

	Male	Female	Transgender	Other	Prefer not to Respond	Missing	Total
Pre pandemic	54 (19.4%)	222 (79.9%)	2 (0.7%)	0 (0.0%)	0 (0.0%)	4	282
Pandemic - pre vaccine	23 (18.9%)	98 (80.3%)	0 (0.0%)	1 (0.8%)	0 (0.0%)	2	124
Pandemic - post vaccine	24 (16.0%)	124 (82.7%)	0 (0.0%)	1 (0.7%)	1 (0.7%)	0	150
Total	101 (18.4%)	444 (80.7%)	2 (0.4%)	2 (0.4%)	1 (0.2%)	6	556

Percentages given exclude missing data.

gender, race/ethnicity, relationship status, religion, and class level over the 4-year time period. The demographic data used in the current study was age, gender, and race/ethnicity.

**State-trait anxiety inventory.** The State-Trait Anxiety Inventory (STAI; [Spielberger, 1983](#)), is a commonly used scale for reports on anxiety levels. This scale is a self-report measure that consists of 40 items. The first 20 items measure state-anxiety levels, which is a temporal condition that consists of qualities such as worry, nervousness, tension, and apprehension that is in response to stress or danger ([Spielberger, 1983](#)). The STAI-State (STAI-S) asks to rate feelings “at this moment,” such as: “I feel nervous,” “I am worried,” “I feel calm,” and “I am relaxed.” Items were measured on a 4-point Likert scale, ranging from 1 (not at all) to 4 (very much so), with total scores ranging from 20 to 80. Higher scores indicate higher levels of state-anxiety. The last 20 items measure trait-anxiety levels, which are long-standing anxious qualities within a person ([Spielberger, 1983](#)). The STAI-Trait (STAI-T) asks individuals to rate feelings that one feels “in general” such as: “I feel like a failure,” “I have disturbing thoughts,” “I am happy,” and “I am a steady person.” Items are measured on a 4-point Likert scale, ranging from 1 (almost never) to 4 (almost always), with a total score ranging from 20 to 80, and higher scores indicating higher levels of trait-anxiety.

The STAI is a widely used measure for anxiety. Internal consistency coefficients for the scale range from .86 to .95 ([American Psychological Association, 2011](#)), with internal consistency among undergraduate male and female students reported at 0.90 and 0.89, respectively ([McDowell, 2006](#)). On the STAI-S, men have an average score of 35.7 ( $SD = 10.4$ ) and women have an average score of 35.2 ( $SD = 10.6$ ); on the STAI-T, men have an average score of 34.9 ( $SD = 9.2$ ) and women have an average score of 34.8 ( $SD = 9.2$ ; [Antony et al., 2001](#)). In more recent studies, the average score for the STAI-S was 29.03 ( $SD = 7.44$ ) and the average STAI-T score for adults in a study was reported to be 31.45 ( $SD = 7.47$ ) ([Weeks et al., 2019](#)). Individuals diagnosed with Generalized Anxiety Disorder fall in the range 47–61 on the STAI-T ([Fisher & Durham,](#)

1999). In the current study, the Cronbach alpha coefficient for STAI-S and STAI-T were both .89.

## Procedure

The study design was submitted to the Institutional Review Board (IRB) at San Diego State University. Once approved, each scale was delivered either in the classroom or input into Qualtrics. Participants were recruited in undergraduate psychology classes in exchange for extra credit; other opportunities for extra credit were also offered if students did not want to take part in the study. Participants gave informed consent, and data were collected each semester beginning in the Spring semester of 2016 through the Spring semester of 2021. The date for each survey were recorded, and were then grouped into “pre-Pandemic,” “during Pandemic pre-vaccine,” and “during Pandemic post-vaccine.” Data collected before March 10, 2020, were termed “pre-Pandemic.” Data collected between March 10, 2020, and December 11, 2020 (the date on which the United States Food and Drug Administration authorized emergency use of the Pfizer-BioNTech COVID-19 vaccine) were grouped as “during Pandemic before the vaccine.” Data gathered after December 11, 2020, were grouped as “during the Pandemic post vaccine.” The data was combined, cleaned, and analyzed with IBM SPSS (version 27).

## Data analysis

This study uses a repeated cross-sectional design due to a new sample being collected at each time frame (Rafferty et al., 2015). Repeated cross-sectional data can be used to consider patterns of change at the aggregate level (Rafferty et al., 2015). To test the impact of the Pandemic on anxiety levels among college-students, a one-way between-groups analysis of variance (ANOVA) was conducted with post-hoc comparisons using Games-Howell tests to compare participants’ anxiety in a group of students before the Pandemic and two groups during the Pandemic (Caruana et al., 2015). Given that data collection was conducted to similar groups of students based on demographics, it was appropriate to compare groups as previous studies using college students during the COVID-19 Pandemic have used similar methods (Debowska et al., 2020; Rogowska et al., 2021; Wang et al., 2020b; Zurlo et al., 2022).

## Results

An ANOVA was conducted to explore the impact of time during the Pandemic on state-anxiety levels, as measured by the STAI-S. Participants were divided into three groups according to the different times of survey completion surrounding the Pandemic (Group 1: Before the onset of COVID-19; Group 2: After the onset of COVID-19 and before FDA emergency use approval of the Pfizer-BioNTech COVID-19 vaccine [December 11, 2020]; and Group 3: After Pfizer-BioNTech vaccine approval). Prior to the Pandemic, the mean state-anxiety level was 43.01 ( $SD = 9.48$ ). During the Pandemic

and prior to the approval of the vaccine, the mean state-anxiety level was 44.10 ( $SD = 12.28$ ), and following the vaccine approval, the mean state-anxiety level was 44.77 ( $SD = 12.52$ ). The mean difference between these groups was not statistically significant. Levene's  $F$  test revealed that the homogeneity of variance assumption was not met ( $p < .001$ ). As such, Welch's  $F$  test was used. An alpha level of .05 was used for all subsequent analyses. The one-way Welch ANOVA measuring time of COVID-19 Pandemic on state-anxiety levels revealed there was not a statistically significant main effect, Welch's  $F(2, 254.94) = 1.30, p = .274$ .

An ANOVA was conducted to explore the impact of time during the Pandemic on trait-anxiety levels, as measured by the STAI-T. Participants were divided into the three groups previously mentioned. Levene's  $F$  test revealed that the homogeneity of variance assumption was not met ( $p < .001$ ). As such, Welch's  $F$  test was used. An alpha level of .05 was used for all subsequent analyses. The one-way Welch ANOVA measuring time of COVID-19 Pandemic on trait-anxiety levels revealed a statistically significant main effect with a small effect size, Welch's  $F(2, 257.96) = 6.65, p = .002$ , est.  $\omega^2 = .02$ . Indicating that not all times before and during the Pandemic have the same average score of trait-anxiety levels. See [Table 3](#) for the means and standard deviations of STAI-T scores for each of the three groups.

Post hoc comparisons, using the Games-Howell post hoc procedure, were conducted to determine whether the three group means differed significantly. These results are given in [Table 4](#) and indicate that prior to the Pandemic ( $M = 45.10, SD = 8.84$ ), participants experienced significantly ( $p = .003$ ) higher average trait-anxiety than during the Pandemic before the vaccine ( $M = 48.85, SD = 11.41$ ). Trait-anxiety was also higher during the Pandemic after the vaccine ( $M = 47.48, SD = 11.42$ ) compared to before; however, this was a non-significant trend ( $p = .07$ ). There was no significant difference between STAI-T scores before and after vaccine approval.

## Discussion

The purpose of this study was to investigate the differences in anxiety levels prior to and during the COVID-19 Pandemic and investigate the difference in anxiety before and after vaccine approval. We hypothesized that state-anxiety levels would increase during the Pandemic and trait-anxiety levels would stay consistent. Neither of these hypotheses were proven true. Surprisingly, state-anxiety levels did not differ significantly

**Table 3.** Means and standard deviations of trait-anxiety scores by pandemic time.

	<i>n</i>	Mean	Standard Deviation
Pre COVID	282	45.1	8.84
During COVID, pre vaccine	124	48.85	11.09
During COVID, post vaccine	150	47.58	11.24
Total	556	46.58	10.21



**Table 4.** Games-Howell post hoc results for trait-anxiety scores by pandemic time.

Comparison	Mean Difference	Standard Error	Significance
Pre COVID – during COVID, pre vaccine	−3.75	1.13	$p = .003$
Pre COVID – during COVID, post vaccine	−2.38	1.07	$p = .070$
During COVID: Pre vaccine – post vaccine	1.37	1.36	$p = .573$

when comparing levels before the Pandemic to during the Pandemic; however, trait-anxiety levels significantly increased during the Pandemic. The average trait-anxiety levels among the current sample prior to the COVID-19 Pandemic ( $M = 45.10$ ) were already higher than the “average” levels: 34.8–34.9 as reported by McDowell (2006) and 31.45 as reported by Weeks et al. (2019). These scores increased significantly during the Pandemic to an average of 48.10 and 47.48, which falls within the levels for Generalized Anxiety Disorder (47–61; Fisher & Durham, 1999). The current study also investigated whether anxiety levels began to diminish once a vaccine was approved by the FDA. Trait-anxiety levels did decrease slightly after the approval of the Pfizer-BioNTech vaccine (from 48.85 to 47.58), although this difference was at the non-significant trend level.

Although we hypothesized that trait-anxiety levels would remain consistent given trait-anxiety is a thought to be a personality disposition that remains stable over time (Gaudry et al., 1975), previous literature has questioned the discriminative validity of the STAI-T. In some cases, it may be a better predictor of depression levels than anxiety (Antony et al., 1998; Creamer et al., 1995; Orme et al., 1986) and that the STAI does not strictly evaluate anxiety but, rather, negative affect (Bados et al., 2010; Knowles & Olatunji, 2020). A recent meta-analysis of the STAI, consisting of 388 studies, confirmed that anxiety and depression symptom severity were correlated with the STAI-T, but those with a depressive disorder had higher scores than those with anxiety disorder (Knowles & Olatunji, 2020). Another study concluded similar findings: the STAI-T has a stronger correlation with depression than anxiety (Bieling et al., 1998). Thus, the findings of the current study would be consistent with the literature that depression levels have increased since the Pandemic’s onset.

Spielberg’s early formulation explains anxiety as a unidimensional construct including both state- and trait-anxiety (1972). Recently, researchers have found that state- and trait-anxiety are mapped differently in the brain (Saviola et al., 2020). High trait-anxiety individuals are vulnerable to develop stress-induced depression or anxiety disorders because they display hyper-responsivity to stressful situations, increased passive coping responses to environmental challenges, and alterations in cognitive functions (Weger & Sandi, 2018). Shafraan et al. (2021) found that during the Pandemic, people with preexisting anxiety disorders experienced greater stress than people with mood disorders or no previous mental health problems. This may further explain the results of the current study given the challenges and stressors of the COVID-19 Pandemic.

Other researchers have proposed that the STAI-T has both an emotional and a cognitive component (Steyer et al., 1990). Liao et al. (2014) used the STAI and other surveys conducted during the influenza A/H1N1 pandemic to examine anxiety, worry, and cognitive associations, specifically perceived risk. It was found that anxiety and worry were strongly associated with individuals' adoption of health protective behaviors, while cognitive associations were weaker and inconsistent. Given that cognitive appraisal theory suggests the personal interpretation of a situation ultimately influences the extent to which the situation is perceived as stressful by an individual (Folkman et al., 1986; Lazarus & Folkman, 1984), this validates that anxiety and worry – emotional measures – have a stronger relationship with protective measures. While our study did not look directly at participants' perception of risk, other studies have found that countries with greater adherence to health protective behaviors during the COVID-19 Pandemic have lower rates of depression and anxiety (Wang et al., 2020b), and that those who felt they had more control over being infected with COVID also had lower rates of anxiety (Wierenga et al., 2021).

Another possible explanation to an increase in anxiety could be that many symptoms of COVID-19 overlap with the physical symptoms of anxiety (i.e., shortness of breath, difficulty breathing, headache, and chest pain; Ames, 2020), and experiencing physical and somatic symptoms that are similar to those of COVID-19 are associated with feelings of anxiety and stress (Wang et al., 2021b). Further, university students in China with their perceived stress and worry about daily life necessities, effectiveness of the prevention measures put into place, and threats to health were risk factors for somatic symptoms, and in turn, experiencing these concerns and stress lead to increased anxiety (Liu et al., 2020). A sample of UK participants demonstrated that having high levels of anxiety about COVID-19 was positively associated with experiencing somatic symptoms, such as fatigue and gastrointestinal pain (Shevlin et al., 2020), suggesting that feeling anxious about COVID-19 plays a role in the types of somatic symptoms an individual is experiencing.

A final consideration to explain why anxiety levels did not decrease once vaccines were approved is that of vaccine hesitancy. Vaccine hesitancy is defined as a delay in acceptance or refusal of the vaccine (Centers for Disease Control and Prevention, 2021). Vaccination willingness depends on myriad factors, including mental health (Hao et al., 2021), affordability, exposure to hostile political views, misinformation, and migration status (Tankwanchi et al., 2021). Interestingly, Hao et al. (2021) found that in China, individuals who were more anxious or more depressed had less vaccine hesitancy than individuals without a mental health condition. Similarly, individuals in the southern United States with physical conditions such as high blood pressure were also less likely to have vaccine hesitancy despite being in a geographical region with higher vaccine anxiety (Moore et al., 2021). Given this, anxiety scores may have not decreased significantly upon the approval of the vaccine.

## Limitations

The sample of this study is one possible limitation. The sample is inclusive of psychology students at a large public university in the United States, consisting primarily of young white females. The sample of the current study was collected from undergraduate psychology students, and previous studies have suggested that undergraduate psychology students may not be generalizable to the public (Sears, 1986), and the majority of the sample identified as female, and women often report higher levels of anxiety compared to men (McLean et al., 2011). Lastly, this study used a repeated cross-sectional design and compared changes in different groups rather than the same one (Rafferty et al., 2015).

There may be other variables apart from the COVID-19 virus that may have contributed to increased anxiety and depression. For example, there was a drastic increase in unemployment at the beginning of the Pandemic, 20.6 million (14.7%) of employed people in the United States lost their jobs in April of 2020 (Soucheray, 2020), which may have contributed to increased financial stress and anxiety levels. The United States generally had more lackadaisical COVID-19 rules and regulations compared to other parts of the world (Shadmi et al., 2020). A study compared COVID-19 health measures and restrictions (e.g., stay-at-home orders, quarantines) around Germany, and found that different levels of restrictions had a different impact on psychological well-being, with more social isolation correlating with poorer mental health outcomes (Benke et al., 2020), suggesting different regulations yield different mental health responses. Individuals also transitioned to virtual social interaction in place of in-person gatherings and relied on the technology as a social outlet. Studies during the Pandemic found that those who spent more time in front of the screen experienced poorer mental health outcomes (Smith et al., 2020), which is consistent with previous literature that increased screen time was correlated with increased levels of anxiety and loneliness (Twenge & Campbell, 2018). Contrarily, other researchers found that an increase in screen-time during the Pandemic does not cause poor mental health outcomes, rather the Pandemic itself has negative implications (Sewall et al., 2021).

Lastly, self-report questionnaires are the mainstay of many studies such as ours. However, questions concerning the accuracy of self-report in college students have been explored (Johnson & Suhr, 2021). Despite some evidence that accuracy in self-reports is enhanced by anonymity, low-no fear of reprisal, and a clear understanding of the questions, there is evidence that self-reporting inaccuracies go up when self-report questions require introspection (Del Boca & Noll, 2000). One path forward is to use neuroimaging methods to confirm self-reported information. Functional near-infrared spectroscopy (fNIRS) is a non-invasive optical imaging technique that has been used to distinguish between neurotypical controls and individuals with a variety of mental health conditions, including major depression (Husain et al., 2020), PTSD (Gramlich et al., 2017), and anxiety (Duan et al., 2020). The ability of fNIRS to detect changes in cortical oxy-hemoglobin during a task provides a more objective measure of neural activity between groups. Because of the introspection required in self-report measures

like the STAI, future studies should examine the benefits of using neuroimaging to validate self-report measures for individuals with anxiety or depression.

### *Future direction and implications*

Future studies should continue to analyze the anxiety levels during and after the COVID-19 Pandemic. The current study demonstrates a slight downward trend for anxiety levels following the authorization of the vaccine. Future studies should compare data as more people are vaccinated, cases fluctuate, and rules and regulations are modified. Furthermore, when the COVID-19 Pandemic has been declared “over,” or classified as an “epidemic” rather than a “Pandemic,” researchers should examine if anxiety scores have returned to pre-Pandemic levels, as with the A/H1N1 pandemic, anxiety was higher in the beginning phases than at the peak (Karademas et al., 2012). We hypothesize that anxiety and depression levels will decrease compared to levels seen at the beginning of the COVID-19 Pandemic.

Future research should also examine the access and use of Internet cognitive behavioral therapy (I-CBT) as this could be beneficial in reducing anxiety among college students. I-CBT for both psychiatric and medical conditions is an effective treatment option that can eliminate barriers that some may face with in-person care (Soh et al., 2020; Zhang & Ho, 2017). Ho et al. (2020) recommend the use of cognitive behavioral therapy (CBT) and mindfulness-based cognitive therapy (MBCT) to reach the general population during the COVID-19 Pandemic. In a sample of French college students, the use of mental health services was considered remarkably low during the Pandemic with only 6.8% seeing a professional for mental health concerns (Wathelet et al., 2020). This is consistent with previous literature that has found college students have been significantly less likely to seek treatment for mental health problems (Blanco et al., 2008); however, many have turned to the internet to seek medical information (Pedrelli et al., 2014). Future studies should investigate how to best treat mental health problems among college students and attempt to find solutions using internet-based therapy.

### **Declaration of Conflicting Interests**

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

### **Funding**

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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