

ABSTRACT

Effects of Testing Positive for COVID-19 or Being in Close Contact with Someone Positive for COVID-19 on Anxiety Levels in University Students

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With the rise of anxiety levels in college students because of the COVID-19 pandemic, it is becoming increasingly more important to study this phenomenon. This study investigates average anxiety scores between students in close contact with a positive COVID-19 case and students who are positive cases for COVID-19. It is hypothesized that there will be a significant difference between the two groups due to each's different experiences. Anxiety scores were collected from students using the HADS survey. Then, a two-sample t-test assuming unequal variances ($n=99$) was performed to determine if a significant difference exists between the groups. Results revealed that there was no statistically significant difference ($p=0.368$). Despite this, a slightly higher mean anxiety score for close contacts (5.8) was analyzed from the test compared to positive cases (5.128). Future studies in this topic are encouraged due to its importance and the limited research involving it.

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EFFECTS OF TESTING POSITIVE FOR COVID-19 OR BEING IN CLOSE
CONTACT WITH SOMEONE POSITIVE FOR COVID-19 ON ANXIETY LEVELS IN
UNIVERSITY STUDENTS

A Thesis Submitted to the Faculty of
Baylor University
In Partial Fulfillment of the Requirements for the
Honors Program

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Waco, Texas
December 2022

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CHAPTER ONE

Introduction

The SARS-CoV-2 virus (COVID-19) was first identified in Wuhan, China in December 2019 (Deng et al., 2020). In the following months after the initial identification, there was the subsequent outbreak of the disease around the globe infecting millions and resulting in a significant loss of life. This led to the World Health Organization declaring the coronavirus (COVID-19) outbreak an official global pandemic on March 11, 2020 (Cucinotta and Vanelli, 2020). The COVID-19 pandemic and responses at attempted control have created unprecedented problems for individuals worldwide. Included among these problems is the rise in anxiety levels. Some common sources of anxiety related to the COVID-19 pandemic and responses were financial burdens, loss of loved ones, and fear of one's own health (Weiner, 2022). Particularly of concern is the rise in anxiety levels as a result of the COVID pandemic paired with the simultaneous shortage of psychiatrists nationwide (Weiner, 2022). Anxiety has many detrimental effects making it an important topic to study. These effects include physical conditions on the human body and worsened performance level, all of which will be explored in this introduction. Furthermore, we will study why studying anxiety levels in the college aged population is of particular importance.

At the height of the pandemic, nationwide, 40% of adults experienced anxiety or depression symptoms, much higher than the pre-COVID levels of 11% (Weiner, 2022). Another study supports this claim that anxiety had increased since the onset of the pandemic. This study conducted in Hong Kong during the early months of the COVID-19

pandemic, utilized a survey questionnaire conducted on 500 individuals to measure the impact the pandemic had on citizens' mental health (Choi et al., 2020). Accordingly, 14% reported having anxiety with 25.4% of all individuals claiming their mental health deteriorated because of the pandemic (Choi et al., 2020). Multiple logistic regression analysis discovered that being worried about possible COVID-19 infection was associated with poorer mental health (Choi et al., 2020). Even so, anxiety had been a growing problem for years. From 2008 to 2018 a decade-long study by Goodwin, et al, on anxiety levels, found that anxiety levels increased among adult Americans from 5.12% in 2008 to 6.68% in 2018 (Goodwin et al., 2020). In comparison, data disaggregation also demonstrated that anxiety levels increased the most in the college aged group of 18-25 year old by almost double the amount from 7.97% to 14.66% in the same time period (Goodwin et al., 2020). With millions of American college students currently enrolled and their rapidly increasing levels of anxiety compared to the general population, anxiety among college students will continue to become a bigger issue that demands research. Therefore, it is important that anxiety is studied in the college population especially during the COVID pandemic.

Anxiety has many detrimental physical health effects on the individual, especially among those diagnosed with pre-existing conditions making research in the topic imperative. A study observing the effects of anxiety in 1,204 elderly Koreans found that anxiety was associated with a higher incidence of cardiac disease (Kang et al., 2017). These elderly were evaluated and re-assessed two years later to determine differences from the measured baseline for anxiety and depression (Kang et al., 2017). Results found that when considering comorbidly with depression, anxiety was correlated with higher

incidences of persistent cough, asthma, stress-related inflammation, hypertension, and eyesight problems (Kang et al., 2017). These figures demonstrate that the detrimental effects of anxiety on a patient's physical health are numerous and can affect quality of life.

This is concerning in the college setting as well. In a study of 176 undergraduate students using the Social Interaction Anxiety Scale and the Insomnia Severity Index, found that Anxiety is associated with fatigue, muscle tension, sleeping disorders, and irritability (Buckner et al., 2008). Common symptoms of anxiety regardless of age include sweating, trembling, weakness, trouble sleeping, and increased heart rate (Mayo Clinic, 2018). If not treated, anxiety can lead to headaches and chronic pain, substance misuse, and suicide (Mayo Clinic, 2018). Furthermore, anxiety can worsen health of specific organs such as cardiac health. One meta-analysis in 2010 of around 250,000 patients found that anxiety caused a 26% increased risk of incident coronary artery disease (Celano, 2016).

One of the main reasons for college students to attend university is to excel in their academic performance during their education and excel in their new jobs; however, anxiety can lead to a worsened functioning at work or school (Mayo Clinic, 2018). A study found that mental health was a concern for college students with anxiety being the most common condition among students with a prevalence of about 9.2% (BlackDeer et al., 2021). The study used data from annual administrations of the American College Health Association (n=117,430) and concluded that due to the prevalence of the disorder, more research into effects on student GPA was needed (BlackDeer et al., 2021).

However, a separate study found that anxiety among college students may cause them to

perform worse academically and cause worsened health later in life with the additional effect of worsened relationships (Ramón-Arbués et al., 2020). Although of a slightly younger demographic, one study of elementary, middle school, and high school students tested their anxiety scale and discovered that students with insufficient grades suffered the highest percentage of anxiety at around 14.1% compared to those who had very good grades at 3.9% (Mazzone, 2007). When considering work performance at jobs, one study found that anxiety and depression impaired job performance and increased risks for accidents (Haslam et al., 2005). The study was conducted with nine focus groups of employees of varying occupations and ages diagnosed with anxiety and depression (Haslam et al., 2005). An expert panel from the study stated that removing employees from their work could limit their social network and worsen anxiety problems (Haslam et al., 2005). This is interesting as the requirements by the university to isolate and quarantine will certainly result in student removals from their jobs albeit temporarily. Anxiety negatively influences a student's academic performance and with millions of dollars being paid by college students to get an education, anything that can negatively affect their ability to learn and perform their best academically, like anxiety, must be closely studied to mitigate its effects. Furthermore, with this age group entering the workforce, often for the first time, any negative effects on work performance could affect their financial stability and ability to apply for future jobs.

The COVID-19 virus brings about many symptoms that may add to growing mental stress. These symptoms may appear 2-14 days after exposure with the virus and include but are not limited to fever, chills, cough, fatigue, shortness of breath, headache,

body aches, diarrhea, nausea or vomiting (CDC, 2021). Other symptoms may present as severe enough to cause some individuals requiring hospitalization (CDC, 2021).

Financial hardship is another example of a source of anxiety brought about by the pandemic. A study conducted on March 17th, 2020 one day after stocks fell to historic lows following news of the COVID-19 pandemic showed that different populations experience greater financial anxiety than others. It was found that younger adults reported more financial anxiety than their older peers (Mann et al., 2020). This is especially troubling for this age group as this group is often the individuals newly entering the workforce, made primarily of those without financial experience, and could become an additional stressor students face during the pandemic.

As anxiety continues to worsen in the college aged population and recently exacerbated by the ongoing COVID-19 pandemic, it is becoming more important to study anxiety levels in this population subset to avoid the health complications and later life struggles it brings. Not much study had been conducted into the health differences of close contacts and positive cases caused by the pandemic, let alone at the college age. Therefore, it is important to examine the relationship between college student anxiety levels of those in close contact with a positive case (close contact) and those tested positive for COVID (positive). The CDC and subsequently Baylor University defined close contacts and positives which had remained unchanged throughout the course of this study. Throughout the entirety of data collection, close contacts were defined as those within 6 feet from the positive with or without masks for a total of 15 minutes within a 24-hour period. Those 15 minutes could have been sporadic meaning that they could have been 5 minutes in the morning with the last 10 minutes of contact in the evening. Close

contacts were required to quarantine in their rooms 10 days after their exposure date to the virus. Positives were students who tested positive for COVID-19 and were required to stay in isolation in their rooms for 10 days as well. Positives were required to state who they had close contact with within 2 days prior to their testing date as COVID-19 is considered infectious during that period. There are many similarities between close contacts and positives. For example, both students were required to quarantine or isolate in their rooms for 10 days; however, some differences arise such as the overbearing worries close contacts suffer over if they will have COVID or not and the apparent symptoms positives must face. Knowing about the increased chance of anxiety in either group can lead to early prevention which can limit the poor effects anxiety causes. Furthermore, this information could help campus health officials create a more effective COVID-19 mitigation plan such as distribution of mental health resources to certain student groups who require it more (either close contacts or positives). Highlighting the differences in anxiety levels between both populations of students can help researchers develop better treatment plans to lessen anxiety in students who require isolation or quarantine due to COVID-19 and help understand more about the mental effects the virus has brought onto an understudied population. It could also help in prevention planning for future disease pandemics. The purpose of this study is to examine the relationship between college student anxiety levels of those in close contact with a positive case (close contact) and those tested positive for COVID-19 (positive).

CHAPTER TWO

Methods

This experiment was conducted over the phone from the period of March 2021 to May 2021. A total of 110 students (67 close contacts and 43 positives) were contacted. As a contact tracer, I had been HIPPA approved and certified in training for calling Baylor University students regarding their quarantine (for close contacts) or isolation (for positive cases) periods and for handling their private information. The experiment was conducted after each respective contact tracing call with each student. Students were picked based on availability, i.e. if other Baylor contact tracers hadn't claimed that case, then they could be chosen for the study. Students were familiar of their positive test result or were informed of their close contact status before the call was made. The students were contacted by phone call and completed answering the questions during the regular contact tracing portion of the call. The questions included for this study was to first to receive confirmation from the student that they were the correct identity of the close contact or positive case. Later, they were asked if they were a student in Baylor. If they were not a student, but instead a professor, then they would be excluded from this study; however, no professors were encountered during this study. Afterwards, the students were asked for permission to participate in the survey and were instructed that none of their personal information would be revealed abiding to HIPPA laws. If they answered yes, then the questions would proceed according to the Hospital Anxiety and Depression Scale (HADS) survey following only the seven anxiety questions as only the anxiety

questions of the HADS survey were utilized. If answered no, then the phone call would end there. During this study none of the cases I contacted through phone call stated they did not want to participate in the HADS survey.

Of the students selected, only 11 had not responded (7 close contacts and 4 positives). These students were called and left a voicemail instructing them of how to return the call and the purpose of the call. An email and text message would be subsequently sent, yet they still never responded. This was expected from not only the study but also the contact tracing procedure as there was occasional instances where students would not respond to phone calls, emails, texts, nor voicemails. These students were left out of any statistical analysis.

When recording the students' answers, the rating of 0 through 3 was input depending on the scale the HADS survey determined their answer to be worth. Students were not aware of the ratings of the scale as the ratings were kept hidden. Instead, they would only be allowed to know which answer they chose following a multiple choice test format e.g. "a, b, c, and d". The anxiety rating for each answer only appeared for me, the researcher, as I converted the answers into an actual score. For example, some questions' answers of a, b, c, and d might correspond with anxiety ratings of 0, 1, 2, and 3 respectively. The score for each question was 0 being the lowest anxiety score and 3 being the highest. At the end, the scores for each of the 7 questions was added together to determine the level of anxiety the student was experiencing then. To analyze the data, students were broken down into their respective groups: close contacts and positives.

The response rate as a percent value was calculated as the total number of students who answered the survey in completion over the total number of students asked.

A two sample t-test assuming unequal variances was performed to determine the relationship between status of COVID infection (close contact vs positive case) and student anxiety level (numbered 0 being the lowest to 21 being the highest level of anxiety). This test was performed on excel. To complete the test, I clicked the “Data analysis” button followed by clicking the “t-test: Two-Sample Assuming Unequal Variances” option. After inputting the variable ranges for each group on excel the test would be completed by clicking “OK”. The p-value for this data was labeled under two-tail in the analysis report (on excel, labeled as “P(T<=t) two-tail”). If the p-value came out to be less than or equal to the alpha value of 0.05, then there exists a significant difference between positive case anxiety scores and close contact anxiety scores. In the instance that the p-value is greater than the alpha value of 0.05, we reject to say that there is any significant difference in anxiety scores between the two groups. During this test, a mean anxiety score of each COVID status category would be computed. According to the HADS scale, a normal anxiety case would fall between the scores of 0-7, borderline abnormal anxiety case falls between scores of 8-10, and an abnormal anxiety case would fall between scores of 11-21. Variance would also be computed from this test of which was used to calculate standard deviation for each group. This was completed by taking the square root of the variance. Finally, a bar graph of mean anxiety scores was completed with proper labels and standard deviations to visually depict the difference in anxiety scores between close contacts and positive cases.

CHAPTER THREE

Results

The survey response rate was 90%. In this, 11 students (7 close contacts and 4 positives) of the 110 students selected to complete the survey did not respond. A total of 99 students were used for data analysis as a result. 60 Close Contacts were surveyed to completion and analyzed whereas 39 Positive Cases were surveyed into completion and analyzed. The p-value for this test was 0.368 (**Table 1**). The mean anxiety score for close contacts was 5.8 (**Table 1**) whereas the mean anxiety score for positive cases was less at around 5.128 (**Table 1**). The standard deviation for each group was 3.4385 for Close Contacts and 3.7147 for Positive Cases (**Table 1**).

Table 1: Results of the Two Sample T-test Assuming Unequal Variances. The Mean values for both close contacts and positive cases are displayed here. The number of observations are displayed along with the p-value. The p-value used for analysis is labeled “P(T<=t) two-tail”. The Standard deviations for each group is depicted in this table.

t-Test: Two-Sample Assuming
Unequal Variances

	<i>Close Contact</i>	<i>Positive Case</i>
Mean	5.8	5.128205
Standard Deviation	3.438565	3.71469
Observations	60	39
P(T<=t) two-tail	0.368223	

As both Close Contacts and Positive Cases had mean anxiety scores between 0-7, they both would be considered normal cases of anxiety according to the HADS survey.

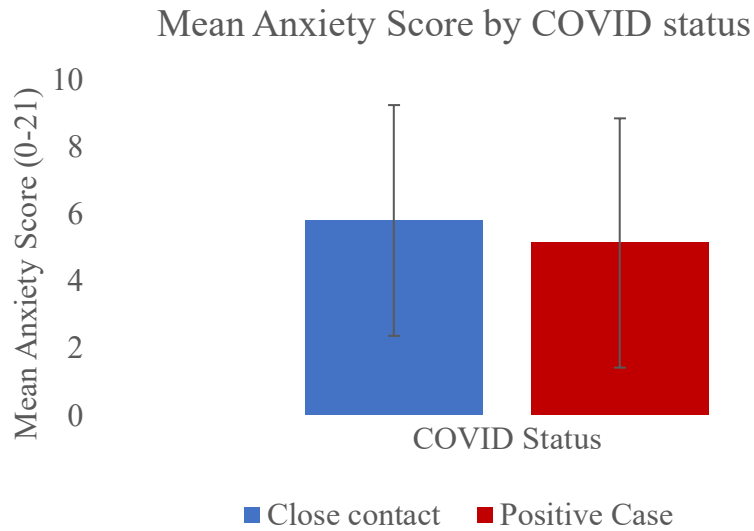


Figure 1: Bar graph visually depicting mean anxiety scores for Close Contacts and Positive Cases. Close Contacts had a mean anxiety score of 5.8. Positive Cases had a mean anxiety score of around 5.128. The lowest possible mean could have been 0 whereas the highest possible mean could have been 21. One standard deviation above and below each mean is depicted as error bars on this graph.

CHAPTER FOUR

Discussion

This study looked to see if differences that arose between anxiety scores of Close Contacts and Positive Cases were statistically significant. As such my original hypothesis inferred that a student's COVID-19 status did affect anxiety levels. However, the results from this Two Sample T-test computed a p-value of 0.368223 which is higher than the alpha value of 0.05 (**Table 1**). As the p-value is higher than the alpha value, I cannot say that there is a statistically significant difference between the mean anxiety scores of each group and thus my original hypothesis is not supported by the data.

The standard deviations of both groups were relatively large at around 3.4385 for Close Contacts and 3.7147 for Positive Cases (**Table 1**). This reveals that the observed data is spread rather far from their respective mean values which could indicate an underlying error which caused the rather high differences in anxiety scores for each survey participant. This could be in part by the sources of error that occurred from my study.

The first source of error was the 11 no responses received during the survey. This could have significantly impacted the results of the study. As a recommendation for future studies, I would recommend researchers try to incentivize responses from students. One example would be to offer a \$5 coupon for respondents who complete the survey. This would increase the participation rate and make the analysis of the data more accurate.

Another source of error was that students were aware of their COVID infection status ahead of the call, however, the time difference between each student from when they knew of their status to when they were surveyed could potentially affect the results. I would recommend having future tests ask the student what date they found out about their positive status or close contact status then use that to find the time they knew to when I called to find any correlation of effect on their anxiety score.

Another source of error could be the higher number of females I contacted in my survey. This meant that the anxiety tests of females were more represented than males in the analysis which could have affected the final results and interpretation of the data. This is supported as a variable of concern as studies have shown that there are differences in prevalence of anxiety disorders between males and females, with women having a higher prevalence for anxiety disorder than men. One study looking at a large sample (N = 20,013) of American adults found that lifetime male:female prevalence ratios for anxiety disorder was 1:1.7 (McLean et al., 2011). Another study of 1,115 Dutch subjects, more females were diagnosed with lifetime overall anxiety disorder at 77.6% compared to 71.4% for men (Schuch et al., 2014). With more time, I would recommend studying differences in sex as studies show how anxiety levels affect women more than men.

Another possible source of error was how there were more close contacts surveyed than positive cases. In total, almost one third more close contacts were surveyed in this study than positive cases (**Table 1**). This was expected as there were naturally more close contacts than positive cases due to the many possible contacts positive cases had. For example, just one positive case could have two or more close contacts simply due to their apartment style living quarters and having roommates. Despite, this natural

occurrence, this meant that close contacts were more represented in this study than positive cases creating a better analysis for close contacts but at the expense of positive case accuracy.

A last possible source of error was how I picked the cases for this survey. Although I picked without any biased purpose or intent, it is still possible I might have implicitly favored picking a group over another. Another problem with this method is that other contact tracers might have picked more cases from one demographic, e.g. males, which would have limited me from having the chance to claim cases from said demographic.

Although my data analysis did not find any statistical significance in the difference between the mean anxiety scores, the mean anxiety score for Close Contacts was 5.8 (**Table 1**) which is slightly higher than the mean anxiety score for Positive Cases which was around 5.128 (**Table 1**). This finding is supported by other studies.

One study which reviewed psychological impacts of quarantining (Close Contacts) in 24 papers found that worsened psychological effects such as anger, confusion, and post-traumatic stress occurred in Close Contacts (Brooks et al., 2020). Additionally, Close Contacts regularly faced stressors during their quarantine including infection fears, boredom, frustration, confusion over the purpose of quarantining, and longer duration of quarantine (Brooks et al., 2020). This review found that a study of hospital staff who might have been in close contact with SARS discovered that being quarantined was the most predictive factor of acute stress disorder symptoms with a higher chance of reporting exhaustion, poor concentration, and deteriorating work performance (Brooks et al., 2020). Although this review did not compare anxiety of

Close Contacts to Positive Cases, it did provide possible explanations as to the observed higher incidence in my study. For example, Close Contacts do have the additional anxiety of possible infection, have frustration for quarantining despite not presenting any physical symptoms, and might have a higher likelihood of quarantining longer than Positive Cases as it is more likely that Positive Cases did not find out about their positive status until a few days after their isolation period begins.

Another study which conducted a cross-sectional study between 1169 close contacts and 1290 non-close contacts found that the close contact group had significantly more fatigue and depression during the post-COVID-19 period than non-close contacts (Zhao et al., 2021). The study stated that factors such as anxiety due to increased infection risk contributed to a greater severity of depression and fatigue (Zhao et al., 2021) similarly I expect this to be a leading cause for the observed the higher mean anxiety score for close contacts in my study. Poor perception of one's health could create worsened anxiety as well (Zhao et al., 2021). Although this 2021 study did not investigate anxiety, the results of the study could be considered closely with anxiety. If positive cases were among those studied in the non-close contact group, it could be possible to infer that close contacts had higher severity of anxiety than positive cases which was the result found in my investigation. A separate journal which was a review of literature also found that consistently throughout multiple studies, identifying as a close contact was a predictor of higher anxiety levels (De Kock et al., 2021).

One cross sectional study of frontline workers in a Bornean population looked into sociodemographic factors and psychopathology (e.g. depression, anxiety and stress, and fear of COVID-19) during the pandemic (Pang et al., 2021). Two of the

sociodemographic factors were a classification as a positive case or a person under investigation (PUI) (Pang et al., 2021). A PUI is defined as a close contact of a positive case who as a result had to quarantine for two weeks (Pang et al., 2021). Due to the similarities of a PUI from this 2021 study and a close contact in my study results can be compared. Fear of COVID-19 scores were found to be higher in positive cases than in PUIs with the stigma attached of being diagnosed with COVID-19 as a likely reason (Pang et al., 2021) which doesn't support my findings. Interestingly however, anxiety scores were higher in PUIs than positive cases despite the greater fear from COVID present in positive cases (Pang et al., 2021). This could be attributed to the different circumstances positive cases and close contacts go through. For example, positive cases have a higher fear of stigma, anxiety about symptoms, and according to this Bornean study, a greater stress level due to possible risk of COVID spread to co-workers and loved ones.

Although my study did not find any significant difference between the two groups of students in anxiety scores, the slightly higher anxiety score found in close contacts could be explained by the studies mentioned above. This study's results will be used in determining better methods of care for students either in isolation or in quarantine. For example, knowing which group suffers more from anxiety will bring light to the topic and help public health officials organize attention to more vulnerable populations of students. It could also provide insight into possible causes of anxiety during the pandemic. For instance, although my study did not ask close contact and positive case students the source of their anxiety, it could be inferred why close contacts exhibited greater anxiety due to the differences in circumstance between the two groups such as

close contact's fear from catching the virus. Furthermore, this information will bring to people's attention the trend of heightened anxiety caused by the pandemic, a problem often overlooked. Due to the limited knowledge over anxiety caused by the pandemic especially among groups of college students, this study provides valuable information. Future studies regarding this topic are also encouraged due to the limited research performed in this topic of interest.

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