

Impacts of COVID-19: A Longitudinal Study on University Students' Mental Health during the COVID-19 Pandemic

Sabrina Williamson*, Laura Packel, Lauren Hunter, Shelley Facente, Mariah De Zuzuarregui, Yi Li, Maya Peterson, Arthurr Reingold

Division of Epidemiology and Biostatistics, University of California, Berkeley, California, USA

ABSTRACT

Objectives: To evaluate baseline and longitudinal mental health indicators and predictors among university student participants of the COVID-19 Safe Campus Initiative (CSCI) - a prospective cohort study from summer 2020. We hypothesized there to be a longitudinal change in mental health over the course of the study and for suspected predictors to be associated with these changes.

Methods: A survey was administered to university students living near the campus at baseline and end line to evaluate mental health indicators (anxiety and depression) and predictors. Univariate logistic regression analyses were completed to find longitudinal and baseline associations between mental health status and predictors.

Results: Baseline surveys were completed by 2409 students, including 782 undergraduate students (32.5%) and 1121 graduate students (46.5%). Participants with perceived concern about economic or housing stability, living alone, or food insecurity had a higher odd of baseline anxiety and depression. Participants who had a high concern of economic strain or housing stability, lived in campus housing, or experienced food insecurity had higher odds of incident anxiety or depression.

Conclusion: Universities may be able to make a difference in student mental health by providing further assistance that mitigates food insecurity, alleviates economic strain, and supports housing stability. Universities should frequently assess the mental health of students, investigate predictors unique to their campus, and target variables that university officials can effectively influence.

Key Words: COVID-19; Mental health; Anxiety; Depression; University students

INTRODUCTION

Before the COVID-19 pandemic, university students were already at an elevated risk of psychological problems, such as depression and anxiety [1]. This predisposition, compounded with the challenges brought on by the pandemic, was and remains a recipe for mental health decline among university students. An evaluation showed 71% of students indicated an increase in stress and anxiety due to the COVID-19 outbreak, [2] while a similar assessment reported a prevalence of post-traumatic stress disorder of 30.8%³ - a figure comparable to that following the 2008 Sichuan earthquake in China which killed 69227 people [3].

While these mental health evaluations were critical during the initial global emergency, their cross-sectional design prevented a longitudinal analysis of mental health indicators and predictors.

The few longitudinal studies conducted were limited by low participation/response rates [4-6], short observation periods [7], or they were unable to follow a cohort over time [6,7]. Additionally, these studies focused on mental health risk factors such as family background, marital status, and other variables that university interventions cannot influence.

To address these limitations, we used baseline and endline survey data from the COVID-19 Safe Campus Initiative (CSCI) - a prospective cohort study that followed a sample of 2409 university students from June to August 2020 as the pandemic unfolded [8]. The survey instrument not only captured anxiety and depression, but also focused on points at which university officials might be able to intervene, such as campus housing and food insecurity. Our primary goal was to investigate the university population's mental health status and predictors during the COVID-19 pandemic.

Correspondence to: Sabrina Williamson, Division of Epidemiology and Biostatistics, University of California, Berkeley, California, USA, Tel: +916-764-7716, E-mail: swilliamson5@berkeley.edu

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Our cohort design allowed us to assess mental health at a cross-sectional and longitudinal level. We expected our large sample size and high participant retention to allow us to detect associations between mental health indicators and predictors. Our aim with the longitudinal data was to detect significant changes in anxiety and depression over time. We also aimed to identify mental health predictors among those who experienced incident mental health decline.

MATERIALS AND METHODS

Study design

The study enrolled students from a large public university and followed them from June to August of 2020. Participants completed SARS-CoV-2 testing and a survey at both baseline and at endline. We describe the study in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement checklist for cohort studies [9]. All surveys were administered via Research Electronic Data Capture (REDCap) [10,11].

Recruitment

The study was promoted through targeted messages from university officials to campus listservs, social media platforms, and flyers from early June to mid-July of 2020. We recruited students intending to oversample those from suspected high-risk groups, such as those in co-operative housing and student-athletes training on campus. Participants were eligible if they were at least eighteen years of age and planned to live in or near the university during the study period. Participants signed online consent and medical record release forms. As compensation for participating, students received a \$50 gift card after completing baseline testing and ten daily surveys, as well as a second \$50 gift card at their endline testing appointment.

Survey instrument

Our survey instrument included information on basic sociodemographic factors and 13 items about mental health indicators and predictors. Items about predictors included reported economic strain, housing stability, living alone, living in campus group housing, housing displacement during the study period, working outside of the home, and reported food insecurity. Items about mental health indicators included questions about anxiety and depression. The full survey instrument can be found in the supplemental material.

Anxiety was measured using the Generalized Anxiety Disorder-2 (GAD-2) [12] scale while depression was measured using the Patient Health Questionnaire-2 (PHQ-2) [13] scale. GAD-2 questions were about: (1) Feeling nervous, anxious, or on edge; (2) Not being able to stop or control worrying. PHQ-2 questions were about: (1) Little interest or pleasure in doing things; (2) Feeling down, depressed or hopeless. Each question used a four-point scale: 0=not at all, 1=several days, 2=more than half the days, 3=nearly every day. Composite scores for GAD-2 and PHQ-2 could range from 0-6, with scores of 3 or higher indicating depression or anxiety.

Economic strain and housing stability Likert responses were preserved in the analysis as collected. The remaining variables on living alone, living in group university housing, housing displacement, working status, and food insecurity were made into dichotomous variables. Food insecurity questions were derived

from the two-item food insecurity screening questions in the US Household Food Security Survey [14]. Analysts were blinded throughout.

Statistical methods

To compare baseline and endline mental health indicators, we summarized the responses from the completed baseline and endline surveys. Univariate logistic regression models were created to assess whether economic strain and housing stability concern levels, living alone, living in campus group housing, housing displacement, working outside of the home, or food insecurity were associated with the odds of depression or anxiety. We also assessed whether these variables measured at baseline were predictors of incident anxiety or depression (i.e., being anxious/depressed at endline but not baseline). All analyses were conducted in RStudio Version 1.3.1093 [15].

RESULTS

A total of 2409 students completed the baseline survey, 2003 (83.1%) of whom also completed the endline survey. Among students who specified their education level, 782 (32.5%) were undergraduate students, and 1121 (46.5%) were graduate students, while 506 (21.0%) did not specify. The majority of the students were aged 18-25 (65.3%), White (57.5%), and single (64.9%). Of those who specified a gender, 1319 (54.8%) identified as women, 1014 (42.1%) as men, 50 (2.1%) as non-binary, and 4 (0.2%) identified as another gender (Table 1).

Mental health indicators

Baseline and endline mental health evaluations showed little change in depression or anxiety between the two time points. 825/2409 (34.2%) reported anxiety at baseline, compared to 679/2003 (34.3%) at endline, while 631/2409 (26.2%) reported depression at baseline, compared to 553/2003 (28.0%) at endline. Among students who completed both surveys and did not have anxiety or depression at baseline, 12.5% and 11.6%, respectively, experienced new cases of anxiety and depression over the study period.

Predictors of mental health at the baseline

At baseline, a majority of students were at least slightly concerned about their economic status (57.4%) or housing stability (52.1%), were living at their primary residence (88.9%), and were experiencing food security (81.9%), while 19% were working outside of the home (Table 2).

At baseline, participants had a significantly higher odds of anxiety if they were at least slightly concerned over economic strain (OR: 1.51, 95% CI 1.22 - 1.87) or housing stability (OR: 1.26, 95% CI 1.02 - 1.55). We also observed a significantly higher odds of depression (OR: 1.40, 95% CI 1.11 - 1.77) among those who were at least slightly concerned about economic strain (Table 3). A dose-response effect was observed, such that as the level of concern about economic strain increased, the odds of depression and anxiety also increased. Participants with food insecurity also had a significantly higher odds of baseline anxiety (OR: 2.41, 95% CI 1.94 - 3.00) or depression (OR: 2.89, 95% CI 2.31 - 3.61). Participants living alone had a significantly higher odds of anxiety (OR: 1.36, 95% CI 1.03 - 1.79) or depression (OR: 1.52, 95% CI 1.14 - 2.01), while living in campus group housing, housing displacement, and working

Table 1: Baseline sociodemographic characteristics of the university student sample from June to August 2020.

Variables	Total Participants N=2409 (100%)
Age (years)	
18-25	1572 (65.3%)
26-30	571 (23.7%)
31-40	229 (9.5%)
41-50	25 (1.0%)
51+	12 (0.5%)
Race/Ethnicity	
Hispanic, Latino, Spanish	373 (15.5%)
White	1386 (57.5%)
Black/African American	96 (4.0%)
American Indian/Alaskan Native	38 (1.6%)
Asian/Pacific Islander	801 (33.2%)
Marital status	
Single	1564 (64.9%)
Married/Living with partner	537 (22.3%)
Partnered, not living with a partner	252 (10.5%)
Separated/Divorced	15 (0.6%)
Widowed	0 (0.0%)
Unknown	41 (1.7%)
Gender	
Woman	1319 (54.8%)
Man	1014 (42.1%)
Non-binary	50 (2.1%)
Other	4 (0.2%)
Unknown	22 (0.9%)
Education Level	
Undergraduate student	782 (32.5%)
Graduate student	1121 (46.5%)
Unknown	506 (21.0%)

Table 2: Baseline prevalence's of mental health indicators and predictors of the university student sample from June to August 2020.

Variables	Total Participants N=2409 (100%)
Anxious	
Yes	825 (34.2%)
No	1504 (62.4%)
Unknown	80 (3.3%)
Depressed	
Yes	631 (26.2%)
No	1698 (70.5%)
Unknown	80 (3.3%)
Economic strain	
Not concerned	865 (35.9%)
Slightly concerned	773 (32.1%)
Moderately concerned	418 (17.4%)
Very/Extremely concerned	191 (7.9%)
Unknown	162 (6.7%)
Housing stability	
Not concerned	1087 (46.5%)
Slightly concerned	668 (28.6%)
Moderately concerned	377 (16.1%)

Very/Extremely concerned	136 (5.8%)
Unknown	68 (2.9%)
Living in campus group housing	
No campus group housing	1922 (79.8%)
Campus group housing	435 (18.0%)
Unknown	41 (1.7%)
Housing displacement	
I am living at my primary residence	2111 (87.6%)
I am temporarily living away from my primary residence, because of the COVID-19 pandemic	174 (7.2%)
I have no regular place to stay	24 (1.0%)
Unknown	100 (4.2%)
Working outside of home	
Yes	466 (19.3%)
No	1901 (78.9%)
Unknown	42 (1.7%)
Food insecurity	
Secure	1893 (78.5%)
Insecure	417 (17.3%)
Unknown	99 (4.1%)

Table 3: Mental health predictors of the baseline mental health indicators among the student sample from June to August 2020. Below are odds ratios of baseline anxiety or depression for each response/categorization of the predictors.

Predictor	Anxiety Odds Ratio (95% CI) N=2409	Depression Odds Ratio (95% CI) N=2409
Economic Strain		
Not concerned	Reference	Reference
Slightly concerned	1.51 (1.22, 1.87)	1.40 (1.11, 1.77)
Moderately concerned	2.23 (1.74, 2.85)	2.18 (1.67, 2.84)
Very/Extremely concerned	3.88 (2.91, 5.18)	4.02 (3.00, 5.41)
Housing Stability		
Not concerned	Reference	Reference
Slightly concerned	1.26 (1.02, 1.55)	1.24 (0.98, 1.57)
Moderately concerned	2.05 (1.60, 2.61)	2.23 (1.72, 2.89)
Very/Extremely concerned	3.90 (2.86, 5.34)	4.60 (3.37, 6.31)
Living alone		
At least one person	Reference	Reference
Living alone	1.36 (1.03, 1.79)	1.52 (1.14, 2.01)
Living in campus group housing		
No campus group housing	Reference	Reference
Campus group housing	1.02 (0.81, 1.27)	1.01 (0.79, 1.28)
Housing displacement		
Living at primary residence	Reference	Reference
Displaced	1.23 (0.90, 1.66)	1.18 (0.85, 1.62)
Working status		
Not working/not working outside home	Reference	Reference
Working outside home	0.99 (0.81, 1.24)	1.12 (0.89, 1.41)
Food insecurity		
Secure	Reference	Reference
Insecure	2.41 (1.94, 3.00)	2.89 (2.31, 3.61)

outside of the home were not statistically significantly associated with anxiety or depression at baseline.

Longitudinal analysis of predictors of incident mental health measures

Longitudinal analysis showed a dose-response effect for increasing economic concern and housing stability and the incidences of the mental health indicators (Table 4). Participants who were very/extremely concerned about economic stability had higher odds of incident anxiety (OR 2.91, 95% CI 1.61 to 5.15). Students who were slightly (OR 1.68, 95% CI 1.18 to 2.14), moderately (OR 1.79, 95% CI 1.14 to 2.77), or very/extremely (OR 6.77, 95% CI 3.97 to 11.52) concerned about economic strain had increased odds of incident depression. Similarly, students who were very/extremely concerned about housing stability had statistically a significantly higher odd of developing anxiety (OR 2.69, 95% CI 1.46 to 4.82). Students slightly (OR 1.43, 95% CI 1.01 to 2.01), moderately (OR 2.04, 95% CI 1.35 to 3.05), or very/extremely (OR 3.18, 95% CI 1.72 to 5.69) concerned over housing stability also had an increased odds of incident depression. Students living in campus group housing had a significantly higher odd of incident anxiety (OR 1.49, 95% CI 1.05 to 2.01) than those not living on campus, although no significant association was found with incident depression. Participants experiencing food insecurity had a significantly higher odds of incident anxiety (OR 1.99, 95% CI 1.35 to 2.90) and depression (OR 2.63, 95% CI 1.80 to 3.79). Living alone, housing displacement, and working status were not statistically significant predictors of incident anxiety or depression.

DISCUSSION

Our longitudinal analysis showed that participants living in campus group housing had a higher odd of incident anxiety (OR 1.49, 95% CI 1.05 to 2.01), while our cross-sectional analysis at baseline showed those living alone had increased odds of anxiety and depression compared to those in group housing. Our analysis helps inform the university campus that those living in group university housing may be at higher risk of incident mental health problems, even if they appear to be faring well at a given moment in time. Additionally, group campus housing being significant predictors of anxiety, but not depression, is plausible. Being in group housing may raise anxiety because students are at higher risk of transmitting or contracting the virus. Conversely, that same closeness may reduce loneliness and therefore reduce the likelihood of depression.

Previous mental health studies have focused on other predictors, such as family function, social support, and physical exercise [4,5]. While these contributors are important to understand, universities can assist students more efficiently if they focus on areas they can directly affect. By capturing the relationship between economic and housing stability and mental health in the context of the COVID-19 pandemic, universities can create more effective outreach programs and develop policies to support students during this pandemic and similar emergencies. For example, officials may direct resources toward financial and housing relief programs for students.

Our study had limitations. Generalizability was limited, as the summer population may not fully reflect the target population of university students present during the academic school year. Because of our extended enrollment period, we had a shorter follow-up period for some participants. Under the assumption that pandemic conditions will increase anxiety or depression over time, we suspect that shorter follow-up periods may have limited our ability to capture incident mental health problems. There was a

Table 4: Longitudinal analysis of mental health predictors and incident mental health indicators of the university sample from June to August 2020. Below are odds ratios of incident anxiety or depression for each response/categorization of the predictors.

Predictor	Anxiety Odds Ratio (95% CI) N=1292	Depression Odds Ratio (95% CI) N=1448
Economic Strain		
Not concerned	Reference	Reference
Slightly concerned	1.25 (0.90, 1.75)	1.68 (1.18, 2.14)
Moderately concerned	1.46 (0.96, 2.20)	1.79 (1.14, 2.77)
Very/Extremely concerned	2.91 (1.61, 5.15)	6.77 (3.97, 11.52)
Housing Stability		
Not concerned	Reference	Reference
Slightly concerned	1.19 (0.85, 1.66)	1.43 (1.01, 2.01)
Moderately concerned	1.46 (0.96, 2.19)	2.04 (1.35, 3.05)
Very/Extremely concerned	2.69 (1.46, 4.82)	3.18 (1.72, 5.69)
Living alone		
At least one person	Reference	Reference
Living alone	1.55 (0.99, 2.38)	1.39 (0.86, 2.16)
Living in campus group housing		
No campus group housing	Reference	Reference
Campus group housing	1.49 (1.05, 2.01)	1.32 (0.92, 1.87)
Housing displacement		
Primary Residence	Reference	Reference
Displaced	0.92 (0.51, 1.57)	0.64 (0.32, 1.17)
Working status		
Not working/not working outside home	Reference	Reference
Working outside home	1.00 (0.70, 1.41)	0.95 (0.65, 1.35)
Food insecurity		
Secure	Reference	Reference
Insecure	1.99 (1.35, 2.90)	2.63 (1.80, 3.79)

limited outbreak of COVID-19 in campus Greek housing in early July 2020, where the CSCI study provided the only access for free asymptomatic testing for SARS-CoV-2. This gave students a better opportunity to get tested and prevent further spread, but also led to a spike in study enrollment, which may have introduced selection bias into our student study population. However, the resulting oversampling of students in Greek housing allowed us to measure differences between groups by housing situation, which might not have otherwise been possible, providing results that could inform more targeted mental health interventions by university officials.

With the Delta variant of SARS-CoV-2 increasing, mask mandates and other infection control strategies, such as online learning or temporary lockdowns, may return to college campuses [16,17]. Mental health assessments should be administered to students frequently to assess the long-term effects that these strategies have on an already vulnerable university population. The mental health impacts of the COVID-19 pandemic may be exacerbated by other factors; in fall 2019, wildfires prompted closures of school campuses due to dangerous air quality index levels, power outages, and evacuations [18]. Public health interventions designed to mitigate these health threats must also be coupled with mental health interventions to prevent a parallel crisis of anxiety and depression among university students.

CONCLUSION

To effectively capture the mental health status of university students during the COVID-19 pandemic, universities should consider frequent evaluations throughout the school year. Additionally, mental health status should not be the only measure. Variables and predictors that affect mental health should be considered and specific to factors that university officials can influence. Regular mental health assessments that evaluate economic stability, food security, housing stability, and group housing status, in addition to mental health indicators, can provide valuable information for focusing limited resources on those who are most likely to need mental health support.

CONFLICTS OF INTEREST AND FINANCIAL SUPPORT

There are no conflicts of interest. Funding came from private donors.

ETHICS COMMITTEE RECORD

Our data comes from a university study that was Institutional Review Board (IRB)-approved by the Committee for Protection of Human Subjects at the University of California Berkeley. All participants provided signed informed consent forms. This article was not commissioned.

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