Research paper

# COVID-19 dimensions are related to depression and anxiety among US college students: Findings from the Healthy Minds Survey 2020

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## ARTICLE INFO

## ABSTRACT

*Background:* The COVID-19 pandemic has brought about tremendous social and economic turmoil, which has been associated with increased levels of depression and anxiety.
*Methods:* We analyzed data from the Healthy Minds Study (Fall Semester Cohort 2020), a non-probability sample of students across multiple colleges who completed an online survey between September – December 2020. Using multivariable logistic regression, we examined the associations between COVID-19 dimensions (concern, racial/ethnic discrimination, financial distress, infection, illness of loved one, death of loved one, caregiving) and mental health outcomes (depression, anxiety), adjusting for age, gender, race/ethnicity, and international student status.
*Results:* Nearly a fifth of the sample reported moderately severe or severe depression, and nearly a third reported moderately severe or severe anxiety over the past two weeks. When accounting for all COVID-19 dimensions in the same model, COVID-19 concern, racial/ethnic discrimination, financial distress, and infection were significantly associated with moderately severe or severe depression; COVID-19 concern, financial distress, and infection were significantly associated with moderately severe or severe anxiety.
*Conclusions:* This study showed that the COVID-19 pandemic may have shaped mental health through a range of potential social and environmental dimensions. Interventions are required that consider multiple dimensions of COVID-19 to improve mental health during and after the pandemic.

## Introduction

Since the outbreak of the coronavirus disease 2019 (COVID-19) in 2020, the United States suffered over 32 million infections, with an estimated death toll from COVID-19 of well over half a million as of April 2021. In addition to having a direct health impact through infection (the long-term effects of which are still being examined), the COVID-19 pandemic dramatically transformed how society functioned, indirectly affecting health by creating the conditions that gave rise to distressing and isolating situations (Mucci et al., 2020), experiences of discrimination (Bhanot et al., 2020), financial strain (Wilson et al., 2020), illness of loved ones and caretaker burden (Prime et al., 2020). In

a review conducted during the initial phase of the pandemic showed that subsyndromal mental health problems were common (Rajkumar; 2020), particularly in the form of symptoms of depression and anxiety, with studies from around the world showing marked increases in diagnoses (e.g. Jacob et al., 2020). A longitudinal study in the UK showed that clinically significant levels of mental distress rose as the country locked down, with the largest increases detected in the 18–24 age range (Pierce et al., 2020). A meta-analysis, covering 136 studies of populations affected by COVID-19 found that at least 15–16% of the general population experienced symptoms of anxiety or depression (Cénat et al., 2020). Further, Vindegaard & Benros (2020) conducted a systematic review and found that there was a decrease in psychological well-being

in the general public; however, the authors noted that more large-scale studies were needed.

Rajkumar (2020) noted that students might be particularly vulnerable to mental health problems during this pandemic. While university students have had lower risk for COVID-19 death when compared with older adults, they nonetheless experienced tremendous disruption in their lives during an emerging developmental life stage, which may have resulted in mental health problems. One study conducted at a US university found that 48.14% of the non-probability sample showed a moderate-to-severe level of depression, and 38.48% showed a moderate-to-severe level of anxiety (Wang et al., 2020). Most students (71.26%) in the study indicated that their stress and anxiety levels had increased during the pandemic, and less than half of the participants (43.25%) indicated that they were able to cope adequately with this stress. Another report from a US sample found that 54.5% of students had symptoms of anxiety or depression (Jones et al., 2021).

Importantly, the literature to date has seldom explored the relationship between specific COVID-19 related dimensions and mental health. While the existing literature that has demonstrated the relationship between the COVID-19 pandemic per se and mental health is informative, it is now important to identify which aspects of the COVID-19 pandemic are driving the observed relationship to inform targeted intervention. In light of this, the aim of the present study was to analyze data from a large sample of US college students to examine the relations between several COVID-19 dimensions (COVID-19 related: concern, racial/ethnic discrimination, financial distress, infection, illness of loved one, death of a loved one, and caregiving) and mental health (depression and anxiety).

## METHODS

### Sample

We analyzed data from the Fall semester cohort of the 2020 Healthy Minds Study (HMS), a cross-sectional, web-based survey examining mental health and related dimensions in undergraduate and graduate student populations ($N = 36,875$). The survey was administered at 28 universities between September through December of 2020. At each university, a random sample of 8000 students was invited by e-mail to participate, except at smaller universities (<8000 students) where all students were invited to participate. The response rate was 14%, which is typical of online surveys of university populations. The HMS was approved by the Health Sciences and Behavioral Sciences Institutional Review Boards at University of Michigan and at all participating campuses.

### Measures

*Depression and Anxiety. Depression* was measured using the Patient Health Questionnaire – 9 (PHQ-9; (Kroenke, 2002), which is validated and widely used in various populations (see Beard et al., 2016). The PHQ-9 contained nine questions eliciting the information about depression symptoms over the past two weeks, including symptoms such as anhedonia and suicidal ideation. Respondents could answer the frequency of these symptoms from 'not at all' to 'nearly every day'. The depression items were summed into a scale ranging from 0 to 27, which was dichotomized to represent the presence of 'moderately severe or severe depression' (i.e. a score of 15 or higher), in accordance with prior literature. *Anxiety* was measured using the General Anxiety Disorder – 7 (GAD-7; (Spitzer et al., 2006), which is also validated and widely used in various populations (see Lowe et al., 2008). The GAD-7 elicited information about anxiety symptoms over the past two weeks, including symptoms such as nervousness and irritability. The anxiety items were summed into a scale ranging from 0 to 12, and then dichotomized to represent 'moderately severe or severe anxiety' (i.e. a score of 11 or higher).

*COVID-19 dimensions.* We examined seven different COVID-19 dimensions:

*COVID-19 concern* was measured using ten items that asked: Over the past two weeks, on average, how much have you been concerned with the following? The ten items are listed in the **Supplemental Materials**, and included items such as "concern over your personal sense of safety and security" and "concern over not being able to spend time with the people you care about." Respondents could answer: Not concerned at all; slightly concerned; moderately concerned; very concerned; and extremely concerned. The nine items were summed into a scale between 10 and 50.

*Racial/ethnic discrimination* was measured using the binary item (yes/no): As a result of the COVID-19 pandemic, have you experienced any discriminatory or hostile behavior due to your race/ethnicity (or what someone thought was your race/ethnicity)?

*Financial distress* was measured using the item: How has your financial situation been affected by the COVID-19 pandemic? Respondents would answer, a lot less stressful, somewhat less stressful, no significant change, somewhat more stressful, a lot more stressful. This item was treated as a continuous ordinal variable.

*Infection* was measured using the item: "Have you had COVID-19 (the novel coronavirus disease)? Responses included: yes (confirmed by a test); probably (e.g., a healthcare provider told me that I likely had COVID-19); maybe (e.g., I have had symptoms consistent with COVID-19, but it was not confirmed by a test); and no (no symptoms or other reason to think I have had it). The responses 'yes', 'probably', and 'maybe' were combined to form a binary variable indicating likely COVID-19 infection.

*Infection of loved one* was assessed using the single binary item (yes/no): Has a loved one, close family member, or friend experienced significant illness as a result of COVID-19?

*Death of a loved one due to COVID-19* was assessed using the single binary item (yes/no): Have you grieved the loss of a loved one, close family member, or friend due to COVID-19?

*Caregiving* was measured using the single binary item (yes/no): Have you been a caregiver to someone who experienced illness as a result of COVID-19?

*Sociodemographic covariates.* Respondents self-reported sociodemographic characteristics, including gender (man, woman, and other), race/ethnicity (white, Black, Latinx, Asian American/Pacific Islander, Multi-racial, Other), age (continuous), and international student status (yes/no).

### Analysis

This study is a secondary analysis of public data available at https://healthymindsnetwork.org/. All college in the HMS agreed to administer a common core set of modules on the topic of mental health, but could also select into modules on specific topics. Those universities who administered questions on COVID-19 yielded a sample of 15,995 students. Missing data for individual variables was handled using listwise deletion, which is appropriate for these survey data given the low frequency of missingness (<10%). Multivariable logistic regression analyses tested for associations between COVID-19 dimensions and mental health outcomes, adjusting for age, gender, race/ethnicity, and international student status. We first examined each of the seven COVID-19 dimensions in separate adjusted models, and then examined all seven COVID-19 dimensions while including them simultaneously in the same model. Sample probability weights were used to adjust for non-response usingadministrative data on full student populations with respect to gender, race/ethnicity, academic level, and GPA. Standard errors were clustered by college. We presented all results as odds ratios with 95% confidence intervals. Statistical significance was set at $a = 0.05$, $p<0.05$. We used StataSE 15.1 to perform all statistical analyses (Stata Corps,

College Station, Texas, USA). All models without survey weights are available upon request, as well as fully adjusted multinomial logistic regression analyses that test for associations between COVID-19 dimensions and the severity of depression and anxiety, with each COVID-19 dimension included in its separate model, and then dimensions included simultaneously in a single model.

## RESULTS

### Sample characteristics

About 19.65% (n = 3217) of the sample reported moderately severe to severe depression, and 32.68% (n = 5440) reported moderately severe to severe anxiety over the past two weeks. Overall, the proportions and means of the COVID-19 dimensions were higher among those with depression and anxiety than without. [TABLE 1]

*COVID-19 dimensions and depression.* Each individual COVID-19 dimension was associated with greater odds of having moderately severe or severe depression, adjusting for age, race/ethnicity, gender, and

international student status, though caregiving did not reach a conventional level of statistical significance. When accounting for all COVID-19 dimensions in the same model, only COVID-19 concern, racial/ethnic discrimination, financial distress, and infection were significantly associated with moderately severe or severe depression. [Table 2

*COVID-19 dimensions and anxiety.* All COVID-19 dimensions were significantly associated with greater odds of having moderately severe or severe anxiety, adjusting for age, race/ethnicity, gender identity, and international student status. When accounting for all COVID-19 dimensions in the same model, only COVID-19 concern, financial distress, and infection were significantly associated with moderately severe or severe anxiety. [Table 2]

## DISCUSSION

### Main findings

Our findings showed that depression and anxiety were prevalent

**Table 1**
Descriptive statistics.

| | Moderately severe to severe depression (PHQ-9) | | | | Moderately severe to severe anxiety (GAD-7) | | | |
|---|---|---|---|---|---|---|---|---|
| | No Depression (n = 12,548) | Depression (n = 3217) | Total (15,765) | P-value | No Anxiety (n = 10,354) | Anxiety (n = 5440) | Total (15,794) | P-value |
| **COVID-19 Dimensions** | | | | | | | | |
| Concern (0–45) | 31.16 (30.18 - 32.14) | 36.31 (35.39 - 37.24) | 32.18 (31.20 - 33.15) | 0.00 | 30.36 (29.38 - 31.34) | 36.07 (34.95 - 37.19) | 32.23 (31.23 - 33.23) | 0.00 |
| Racial/ethnic discrimination | | | | 0.00 | | | | 0.03 |
| No | 11,743 (95.40%) | 2901 (91.35%) | 14,644 (94.60%) | | 9683 (95.20%) | 4988 (93.38%) | 14,671 (94.60%) | |
| Yes | 630 (4.60%) | 268 (8.65%) | 898 (5.40%) | | 514 (4.80%) | 387 (6.62%) | 901 (5.40%) | |
| Financial distress (0–4) | 2.76 (2.70 - 2.82) | 3.20 (3.13 - 3.26) | 2.84 (2.78 - 2.90) | 0.00 | 2.72 (2.66 - 2.79) | 3.10 (3.04 - 3.17) | 2.85 (2.78 - 2.91) | 0.00 |
| Infection | | | | 0.00 | | | | 0.00 |
| No | 10,007 (79.48%) | 2331 (70.78%) | 12,338 (77.77%) | | 8336 (80.56%) | 4031 (72.21%) | 12,367 (77.83%) | |
| Yes | 2541 (20.52%) | 886 (29.22%) | 3427 (22.23%) | | 2018 (19.44%) | 1409 (27.79%) | 3427 (22.17%) | |
| Illness of loved one | | | | 0.00 | | | | 0.00 |
| No | 8766 (68.69%) | 1998 (61.03%) | 10,764 (67.19%) | | 7331 (69.23%) | 3453 (62.13%) | 10,784 (66.91%) | |
| Yes | 3766 (31.31%) | 1216 (38.97%) | 4982 (32.81%) | | 3010 (30.77%) | 1981 (37.87%) | 4991 (33.09%) | |
| Death of loved one | | | | 0.00 | | | | 0.23 |
| No | 11,643 (92.10%) | 2868 (87.84%) | 14,511 (91.26%) | | 9641 (91.53%) | 4903 (89.95%) | 14,544 (91.02%) | |
| Yes | 876 (7.90%) | 344 (12.16%) | 1220 (8.74%) | | 691 (8.47%) | 525 (10.05%) | 1216 (8.98%) | |
| Caregiving | | | | 0.29 | | | | 0.01 |
| No | 11,800 (93.57%) | 2987 (92.31%) | 14,787 (93.32%) | | 9764 (94.03%) | 5050 (91.90%) | 14,814 (93.33%) | |
| Yes | 730 (6.43%) | 224 (7.69%) | 954 (6.68%) | | 575 (5.97%) | 381 (8.10%) | 956 (6.67%) | |
| Age (continuous) | 25.15 (23.81 - 26.49) | 23.10 (22.20 - 24.00) | 24.74 (23.51 - 25.98) | 0.12 | 25.29 (23.93 - 26.65) | 23.58 (22.59 - 24.56) | 24.73 (23.51 - 25.95) | 0.06 |
| Race/Ethnicity | | | | 0.00 | | | | 0.00 |
| White | 8306 (66.41%) | 2122 (66.51%) | 10,428 (66.43%) | | 6764 (65.27%) | 3682 (68.10%) | 10,446 (66.20%) | |
| Asian Pacific Islander | 1420 (6.27%) | 272 (4.74%) | 1692 (5.97%) | | 1227 (6.51%) | 464 (4.51%) | 1691 (5.86%) | |
| Black | 783 (8.80%) | 172 (5.18%) | 955 (8.09%) | | 672 (8.86%) | 281 (6.36%) | 953 (8.04%) | |
| Latinx | 831 (9.24%) | 230 (8.33%) | 1061 (9.06%) | | 722 (10.53%) | 347 (7.33%) | 1069 (9.48%) | |
| Multi-racial | 1032 (8.20%) | 367 (14.01%) | 1399 (9.34%) | | 827 (7.73%) | 576 (12.60%) | 1403 (9.32%) | |
| Other | 138 (0.74%) | 46 (0.95%) | 184 (0.78%) | | 110 (0.74%) | 75 (0.85%) | 185 (0.77%) | |
| Missing/ unknown | 38 (0.35%) | 8 (0.28%) | 46 (0.33%) | | 32 (0.36%) | 15 (0.26%) | 47 (0.33%) | |
| Gender | | | | 0.00 | | | | 0.00 |
| Man | 3721 (42.32%) | 688 (32.51%) | 4409 (40.39%) | | 3406 (46.52%) | 1017 (28.62%) | 4423 (40.67%) | |
| Woman | 8605 (56.02%) | 2328 (61.32%) | 10,933 (57.06%) | | 6769 (51.99%) | 4171 (66.56%) | 10,940 (56.75%) | |
| Other | 194 (1.49%) | 193 (6.00%) | 387 (2.38%) | | 155 (1.32%) | 240 (4.67%) | 395 (2.41%) | |
| Unknown | 28 (0.16%) | 8 (0.17%) | 36 (0.16%) | | 24 (0.17%) | 12 (0.15%) | 36 (0.16%) | |
| Transgender | | | | 0.00 | | | | 0.01 |
| No | 12,502 (99.53%) | 3171 (98.08%) | 15,673 (99.25%) | | 10,310 (99.52%) | 5390 (98.64%) | 15,700 (99.23%) | |
| Yes | 46 (0.47%) | 46 (1.92%) | 92 (0.75%) | | 44 (0.48%) | 50 (1.36%) | 94 (0.77%) | |
| International student | | | | 0.00 | | | | 0.00 |
| No | 11,850 (96.29%) | 3112 (98.27%) | 14,962 (96.68%) | | 9732 (96.15%) | 5256 (97.79%) | 14,988 (96.68%) | |
| Yes | 695 (3.71%) | 103 (1.73%) | 798 (3.32%) | | 618 (3.85%) | 183 (2.21%) | 801 (3.32%) | |

N (weighted%) or Mean (95%CI).
Depression = moderately severe or severe depression.
Anxiety = moderately severe or severe anxiety.
Descriptive statistics were calculated using all data that were available for each variable.
P-values by *t*-test for continuous variables and Chi2 test for binary/categorical variables.

**Table 2**

Multivariable logistic regression models depicting associations between COVID-19 factors and moderately severe to severe depression and anxiety, Health Minds Study, September – December 2020.

| COVID-19 Dimensions | Depression | | | | | | Anxiety | | | | | |
| | I | | | II | | | I | | | II | | |
| | aOR (95% CI) | p-value | N | aOR (95% CI) | p-value | N | aOR (95% CI) | p-value | N | aOR (95% CI) | p-value | N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Concern (10–50) | **1.05 [1.05, 1.06]** | **0.000** | 14,576 | **1.04 [1.04, 1.05]** | **<0.001** | 14,496 | **1.06 [1.05, 1.07]** | **<0.001** | 14,595 | **1.051 [1.041, 1.061]** | **<0.001** | 14,518 |
| Racial/ethnic discrimination | **2.44 [1.82, 3.26]** | **0.000** | 15,574 | **1.88 [1.37, 2.57]** | **<0.001** | | **1.74 [1.22, 2.46]** | **0.003** | 15,606 | 1.378 [0.989, 1.920] | 0.057 | |
| Financial distress (0–4) | **1.79 [1.69, 1.90]** | **0.000** | 30,728 | **1.67 [1.52, 1.85]** | **<0.001** | | **1.69 [1.60, 1.77]** | **<0.001** | 30,587 | **1.50 [1.38, 1.62]** | **<0.001** | |
| Infection | **1.539 [1.33, 1.79]** | **0.000** | 15,760 | **1.49 [1.23, 1.79]** | **<0.001** | | **1.54 [1.32, 1.79]** | **<0.001** | 15,789 | **1.53 [1.27, 1.84]** | **<0.001** | |
| Illness of loved one | **1.45 [1.22, 1.72]** | **0.000** | 15,790 | 1.09 [0.91, 1.31] | 0.338 | | **1.42 [1.26, 1.61]** | **<0.001** | 15,821 | 1.13 [0.98, 1.29] | 0.093 | |
| Death of a loved one | **1.81 [1.40, 2.34]** | **0.000** | 15,768 | 1.29 [0.97, 1.73] | 0.083 | | **1.34 [1.04, 1.72]** | **0.024** | 15,799 | 0.89 [0.65, 1.21] | 0.430 | |
| Caregiving | 1.26 [0.91, 1.73] | 0.158 | 15,777 | 0.99 [0.73, 1.36] | 0.965 | | **1.38 [1.12, 1.71]** | **0.005** | 15,809 | 1.12 [0.88, 1.43] | 0.342 | |

aOR (Adjusted Odds Ratios); 95% Confidence Intervals (CI).

Depression is defined as having a PHQ-9 score in the range of moderately severe or severe depression. Anxiety is defined as having a GAD-7 score in the range of moderately severe or severe anxiety.

I. Each COVID-19 dimension is included in a separate adjusted model.

II. All COVID-19 dimensions are included in the same adjusted model.

across the large non-probability sample of college students in the US, and that several COVID-19 dimensions were associated with greater odds of having depression and anxiety, though the strength and significance of the associations varied depending on the COVID-19 dimension, the adjustments, and the mental health outcome. We found that COVID-19 concern was associated with both depression and anxiety, which comports with prior findings from the US and across the globe (De Man et al., 2021; Faisal et al., 2021; Haliwa et al., 2021; Yu et al., 2021). We were among the first to establish that COVID-19 related racial/ethnic discrimination was associated with depression and anxiety among college students, and this is consistent with a substantial body of evidence that supports the link between discrimination and negative mental health outcomes (Lee and Ahn, 2011; Pascoe and Richman, 2009). Additionally, we found that COVID-19 related financial distress was associated with depression and anxiety, which aligns with recent studies that show that the pandemic may impacted mental health through socioeconomic pathways, such as food and housing insecurity (Jones et al., 2021) and income (Garvey et al., 2021; Browning et al., 2021). Studies have emerged showing the potential mental health effects of being infected with COVID-19, and our findings corroborate these studies (Rajkumar 2020; Jones et al., 2021). Moreover, research has underscored the social nature of the pandemic —how knowing someone who has contracted COVID-19 (Abas et al., 2021; Browning et al., 2021; Jones et al., 2021; Yu et al., 2021) or grieving the loss of a loved one due to COVID-19 (Browning et al., 2021; Garvey et al., 2021) may be linked to depression and anxiety. Our findings corroborate these studies, but we also show that social dimensions were not statistically significant net the effects of other key COVID-19 dimensions.

The COVID-19 dimensions likely operate through multiple pathways. For example, COVID-19 dimensions may affect social isolation, sleep disturbances, insufficient physical activity, and social stress, which are highly predictive of mental health outcomes, putatively via several pathways including dysregulation of the hypothalamic pituitary adrenal (HPA) axis (Zorn et al., 2017), aberrant immune activation (Takahashi

et al., 2018), and altered neuropeptide transmission (Bath et al., 2017), with a common pathway being alterations in neural plasticity in key cortical and subcortical regions of the brain (Nikulina et al., 2014). These effects depend both upon the chronicity of the stressor and the developmental stage of the exposed individual (Bath et al., 2017), which could suggest heightened vulnerability of adolescent or young adult students during an ongoing pandemic. From a biological perspective, infection with human coronaviruses, even if asymptomatic or mild, may be associated with an elevated risk of depression by triggering a systemic inflammatory response (Lamers et al., 2019; Okusaga et al., 2011), and this risk may be heightened further in those with more severe forms of COVID-19, due to direct or indirect brain involvement (Mazza, 2020); Troyer et al., 2020). In support of this possibility, a recent study of COVID-19 survivors (N = 226) found that 35.8% had persistent symptoms of psychological distress, particularly depression, and these symptoms were positively correlated with a baseline measure of systemic inflammation (Mazza et al., 2021). However, the current study found that beyond COVID-19 infection, there is a large and significant percentage of the population that were affected by other aspects of the pandemic, which impacted their mental health. From a psychosocial perspective, social interaction is critical during college years, and the social isolation caused by lockdown mandates may have been particularly harmful. In examining the biological and psychosocial origins of depression and anxiety in students affected by the pandemic, the synergy between these dimensions and causal pathways should be considered.(Mazza, 2020)

*Limitations*

Our study used a large sample of college students to examine several dimensions of COVID-19 and their effects of depression and anxiety. However, there were several potential limitations. First, data were cross-sectional and did not allow us to ascertain the temporal order of events or make causal inferences. Second, the data were self-reported, and may

have been vulnerable to recall and social desirability biases (e.g., reluctance to disclose depression symptoms or COVID-19 infection). Third, the sample consisted entirely of college students, and it remains to be seen whether findings are applicable to other populations (it is conceivable that associations may be even stronger among young adults who do not attend college). However, similar results have been obtained from studies in the African and Asian regions, with estimated rates of 25–47% for symptoms of anxiety and 57–75% for symptoms of depression (Abas et al., 2021; El-Monshed et al., 2021; Faisal et al., 2021; Yu et al., 2021), suggesting that the psychological vulnerability of college students during the COVID-19 pandemic is not restricted to the US. Fourth, the response rate was 14%, which raises concerns about selection bias and generalizability of findings, though this response rate is comparable to surveys of this nature, and survey weights were used to adjust for non-response (Lipson et al., 2019). Still, it is possible that depression and anxiety may have been overestimated or underestimated given the non-probability sampling strategy and low response rate.

*Potential implications*

There may be several potential implications based on the findings of this study. In terms of interventions, reducing COVID-19 concern may require efforts to promote active coping (see El-Monshed et al., 2021) and resilience (Chmitorz et al., 2018; Steinhardt and Dolbier, 2008). Other interventions may aim to encourage physical exercise, preferably outdoors whenever possible, which is known to improve mood (see Esteves et al., 2021; Browning et al., 2021). Many of interventions can be administered through online and mobile platforms, including loneliness interventions among college students (e.g. Bruehlman-Senecal et al., 2020). Targeted interventions may address the alarming incidence of discrimination and hate crimes perpetrated against people of color (see Anderson et al., 2019), and especially against Asian American/-Pacific Islanders (Oh and Waldman, 2020). At a policy level, it may also be imperative to call for economic relief for university students (especially policies designed to reduce racial disparities), given the prevalence of social and economic stressors (e.g. financial distress, precarious employment, food and housing insecurity) that are linked to risk for depression and anxiety.

## Conclusion

Many students grappled with depression and anxiety throughout the COVID-19 pandemic after being exposed a range of stressors. This study showed the connections between a range of potential social and environmental stressors mental health, calling for more longitudinal research and multi-pronged public health interventions to address anxiety and depression during and after the pandemic.

## AUTHOR STATEMENT

Dr. Hans Oh conceived and designed the analysis and wrote the paper. Dr. Caitlin Marinovich, Dr. Sasha Zhou, and Ms. Megan Besecker helped perform the statistical analysis. Dr. Ravi Rajkumar, Dr. Louis Jacob, Dr. Ai Koyanagi, and Dr. Lee Smith reviewed the manuscript and contributed to the writing. The authors have no funding sources or conflicts of interest to disclose.

## CONFLICT OF INTEREST

None

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None

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