Predictors of Depression among College Students in the Early Stages of the COVID-19 Pandemic

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Abstract

College students are disproportionately impacted by depression compared to the general population. The purpose of this study was to determine the predictors of depression among college students during the COVID-19 pandemic to inform interventions. This cross-sectional study surveyed students at a large, diverse university in the southwest United States. Students provided information regarding the severity of their depression symptoms over the past two weeks (dependent variable) along with independent demographic and educational variables (age, sex, sexual orientation, grade point average, number of credits taken, first-generation college student status, race/ethnicity, and employment status), perceived stress, hours of sleep, physical fitness, and minutes of physical activity. Univariate and multivariate linear regression analyses were conducted. Variables that were significantly associated with depression in the multiple linear regression included stress, identifying as Asian, hours of sleep, and age. There is a need for stress management and mental health promotion interventions targeting college students. Additional interventionals should also focus on those more at risk, including those who identified as Asian (almost three times more likely to report depression compared with White students) and younger college students. We also found a need to promote sleep hygiene.

Keywords: COVID-19 pandemic, mental health, college students, depression, stress management

1. Introduction

1.1 Depression in College Students

College students are disproportionately burdened with depressive symptoms. The 2019 National College Health Assessment, which included nearly 40,000 students from 58 schools, found that 19.3% of respondents had been diagnosed with depression by a healthcare professional (American College Health Association, 2020). Further, a 2013 systematic review of 24 articles reported depression prevalence rates among university students ranging from 10 to 85%, with a weighted mean of 30.6% (Ibrahim, Kelly, Adams, & Glazebrook, 2013). This contrasts with the estimated 8.1% of U.S. adults who reported experiencing depression in a two-week period (Brody, Pratt, & Hughes, 2018). Disparities also exist; particular groups of college students are at an increased risk for depression. They include: women (Jenkins, Belanger, Connally, Boals, & Durón, 2013; Liu, Stevens, Wong, Yasui, & Chen, 2019), first-generation students (Jenkins et al., 2013), and sexual minorities (Jalene, Pharr, Shan, & Poston, 2019; Liu, et al., 2019).

Many college students experience major life changes during transitions into college, including adjustments to being away from home, living with roommates, adapting to the new academic workload, autonomy changes, disruptions in personal relationships, and financial worries (Mayo Clinic, 2020; Millea, Wills, Elder, & Molina, 2018; National Institutes of Health, 2012). These stressful life events have been linked to depressive symptoms in college students, with a pooled risk ratio of 1.16 (Liu et al., 2019) and nearly 76% of college students reporting moderate to severe stress in the past 30 days before the pandemic (American College Health Association, 2020).

Fortunately, there are ways to treat or prevent the effects of stress and depression. Physical activity is a valuable tool. Physical activity is associated with a reduction of depressive symptoms and their severity (Mammen & Faulkner, 2013; Roshanaei-Moghaddam, Katon, & Russo, 2009; Schuch et al., 2016; Silveira et al., 2013; Stanton & Reaburn, 2014; Teychenne, Ball, & Salmon, 2008). Even though physical activity is known to buffer depression, students tend to become less active after transitioning from high school to college (Butler, Black, Blue, & Gretebeck, 2004; Van Dyck, De Bourdeaudhuij, Deliens, & Deforche, 2015). Physical activity is also the principal determinant of cardiorespiratory fitness (McKinney et al., 2016). In recent years, nonexercise estimated cardiorespiratory fitness (eCRF) has been found to be a valid tool for non-clinicians to assess cardiorespiratory fitness outside of a laboratory setting (Nes et al., 2011). Not surprisingly, the eCRF was linked to depressive symptom severity in college students (Jalene et al., 2019).

Depression also appears to "partner" with other health and behavioral factors. For instance, sleep disturbances or sleep hygiene have been found to have a bidirectional relationship with depression (Bao et al., 2017; Dinis & Bragança, 2018). Lund and colleagues (2010) reported that 60% of college students were poor quality sleepers, while Gaultney (2010) reported that 27% of respondents were at risk for at least one sleep disorder. Further, Jahrami and colleagues (2019) conducted a meta-analysis of 43 studies and found that medical students had a pooled prevalence rate of 55% for poor sleep quality. The 2019 National College Health Assessment (2020) reported that 48.7% of respondents attained less than the recommended 7-hours of sleep per weeknight, which is a greater proportion than the estimated 35% of U.S. adults who do not meet the recommendations (Centers for Disease Control and Prevention, [CDC], 2017). Both a lack of sleep and excessive sleep have been linked to depression (Zhai, Zhang, & Zhang, 2015).

1.2 Impact of COVID-19 on Depression

While being a college student under "normal" conditions is stressful, the COVID-19 pandemic dramatically complicated the college experience as well as health determinants and outcomes. We are only beginning to understand how the pandemic affects mental health, including depression. A recent systematic review found that, although much remains to be discovered, the pandemic is associated with escalating rates of depression and anxiety (Vindegaard & Benros, 2020). A survey conducted by Czeisler and colleagues (2020) indicates that symptoms of depressive disorders quadrupled, and anxiety disorder tripled among U.S. adults during the summer of 2020 compared to pre-COVID-19 levels in 2019. Increased suicidal ideation, pandemic-attributed substance use and trauma, and stressor-related disorders are also emerging problems (Czeisler et al., 2020). Yet again, there are disparities in the distribution of COVID-19 mental health burdens, as adults who self-reported as Black, Hispanic, younger, as having *a priori* psychiatric conditions, serving as essential workers, and being caregivers are at high risk (Czeisler et al., 2020). Depressive symptoms have been elevated among U.S. adults since the start of the pandemic (Ettman et al., 2020), and young adults appear to be especially vulnerable (Daly, Sutin, & Robinson, 2021).

1.3 Importance of Understanding the Impact of COVID-19 on College Students

Understanding the impact of COVID-19 on depression among college students is crucial. First, as discussed, young adults appear especially vulnerable to depression and other adverse mental health outcomes in the face of the pandemic (Czeisler et al., 2020; Daly et al., 2021). Second, research reveals changes to patterns of physical activity (Coughenour, Gakh, Pharr, Bungum, & Jalene, 2020; Maher, Hevel, Reifsteck, & Drollette, 2021), sleep (Hyun, Hahm, Wong, Zhang, & Liu, 2021; Wright et al., 2020), and stress (Charles, Strong, Burns, Bullerjahn, & Serafine, 2021) among college students and young adults occurred during the COVID-19 pandemic. Third, additional research focused specifically on college and university students is needed to contribute to emerging research findings. For example, a recent survey found that almost half of college students exhibited moderate to severe depression, elevated stress levels, and difficulty coping during the pandemic (Wang et al., 2020). Rudenstine and colleagues (2021) confirmed heightened depression levels and intensified depressive symptoms among college students. Additionally, college students reported a significant increase in depression severity after the issuance of pandemic-related stay-at-home orders (Coughenour et al., 2020). Fourth, during the pandemic, depression disparities became more apparent in students: students of Latinx ethnicity, women, those with fewer resources, and people reporting greater exposure to COVID-19 stressors (e.g., reduced visits with friends and family, childcare challenges, loss of loved ones to COVID-19, and economic hardships) were at higher risks for depression (Rudenstine et al., 2021). Fifth, given these disparities, colleges with differing student-body compositions may be facing starkly different depression landscapes. Many students do not have sufficient resources to protect themselves against pandemic-related stress (Ettman et al., 2020; Rudenstine et al., 2021). Finally, while depression among college students during the pandemic is itself a serious concern, depressive

symptoms were also linked to additional or worsened academic and employment challenges (Kecojevic, Basch, Sullivan, & Davi, 2020).

1.4 Purpose of the Study

Despite the alarming depression prevalence among college students and the depression disparities in this group, the body of research examining depression in this subpopulation during the pandemic is still emerging. As a result, this study aimed to add to this developing knowledge base, provide additional research on depression among diverse students, and inform potential points of intervention. The purpose of this study was to identify predictors of depression among college students during the COVID-19 pandemic.

2. Method

2.1 Design, Setting, and Participants

This cross-sectional study was conducted at a large, diverse university in the southwest United States. Data were collected via an electronic survey (hosted on Qualtrics) during the fall 2020 semester, between October 25 and December 12. This time frame was still in the early phase of the pandemic, before vaccines were widely available in the U.S. We included an invitation to participate in this study in a weekly email that is sent to all students. Participants included both graduate and undergraduate students 18 years and older. The anonymous survey took approximately 10 minutes to complete. Participants did not receive compensation for their participation. The study was approved by the University of Nevada, Las Vegas Institutional Review Board. The sample size was calculated using G*Power, Version 3.1 (Faul, Erdfelder, Lang, & Buchner, 2007). For an alpha of 0.05, a power of 0.80, 14 predictors, and a medium effect size of 0.15 (Lipsey & Wilson, 1993), a sample size of 135 was considered sufficient.

2.2 Data Sources and Measures

Participants were asked to self-report information regarding depression (dependent variable), and their demographic and educational characteristics, perceived stress, sleep, physical fitness, and physical activity (independent variables). Independent variables previously associated with depression (Jalene et al., 2019; Liu et al., 2019; Mammen & Faulkner, 2013; Salk, Hyde, & Abramson, 2017; Zhai et al., 2015) were selected. Most survey questions came from validated tools. Each tool is described in more detail below. Demographics included age, sex (male, female), sexual orientation (straight, sexual minority), grade point average (GPA), number of credits taken during the fall semester, first-generation college student status (yes, no), race/ethnicity (White, Black, Hispanic, Asian, or other/multiracial), and employment status (employed, unemployed, out of the labor force). We also asked participants to provide the number of hours they slept the night before taking the survey. We used the international physical activity questionnaire short form (IPAQ) to measure the minutes of physical activity in the seven days before taking the survey, including vigorous physical activity, moderate physical activity, minutes of walking, and minutes of sitting (Lee et al., 2011). A series of questions from a previously-validated, nonexercise algorithm were used to estimate their cardiorespiratory fitness (eCRF) (Nes et al., 2011). This score was compared with the age-predicted normative CRF values for healthy adults, and the difference between these two scores was used in this analysis (Jalene, et al. 2019). The Perceived Stress Scale (PSS) was used to determine levels of stress. Participants were asked a series of questions from the Patient Health Questionnaire—PHQ-9 to assess their level of depression.

2.2.1 Estimated Cardiorespiratory Fitness

A nonexercise algorithm that can be employed to estimate cardiorespiratory fitness (eCRF) was used in this study (Nes et al., 2011). The eCRF is acceptable for predicting sex-specific relative VO2 peak in healthy adults and has been used to examine the relationship between cardiorespiratory fitness and depression among college students (Jalene et al., 2019). Variables in the algorithm include age, body composition (body mass index), resting heart rate (RHR), and a physical activity index (PA-I). The resulting data are reported in relative terms (mL kg-1 min-1). To obtain the PA-I, questions regarding exercise frequency, duration, and intensity were scored and weighted according to a previously published PA-I (Nes et al., 2011). For RHR, participants were asked to be seated while completing the survey and to measure their RHR after 5 minutes of quiet sitting. The formulas for obtaining the eCRF for men and women are below.

Men ($R2 = 0.59$, SEE = 5.8): 92.05–(0.327 AGE)–(0.933 BMI)–(0.167 RHR) + (0.257 PA-I).

Women ($R2 = 0.57$, SEE = 5.1): 70.77–(0.244 AGE)–(0.749 BMI)–(0.107 RHR) + (0.213 PA-I). (Nes et al., 2011)

For each participant, the numeric result of the sex-specific eCRF algorithm was compared with the age-predicted normative CRF values for healthy adults, and the difference (DIFF) between the two was used in this analysis (Jalene et al., 2019).

2.2.2 Perceived Stress Scale

We used the 10-items Perceived Stress Scale (PSS-10) to measure self-reported and perceived stress. The PSS-10 is a shortened version of Cohen and colleagues' original 14 item PSS questionnaire (Cohen, Kamarck, & Mermelstein, 1983; Cohen, 1988; Smith, Rosenberg, & Haight, 2014). Both scales have been shown to have good reliability and validity, particularly with college students (Cohen et al., 1983; Cohen, 1988; Smith et al., 2014). Because psychometric properties of the 10-item PSS have been found to perform better than those of the 14-item PSS, the PSS-10 was used for this study (Cohen, 1988; Lee, 2012). Questions on the PSS-10 ask about feelings and thoughts over the past month. Participants respond to questions using a Likert-scale (0 = Never, 1 = Almost Never, 2 = Sometimes, 3 = Fairly Often, 4 = Very Often). Scores for the PSS-10 range from 0 to 40, with a higher number indicative of greater perceived stress.

2.2.3 Patient Health Questionnaire—PHQ-9

The PHQ-9 is a brief, validated depression questionnaire used for screening, monitoring, and measuring the severity of symptoms and is appropriate for both research and clinical practice (Spitzer, Kroenke, Williams, Patient Health Questionnaire Primary Care Study Group, & Patient Health Questionnaire Primary Care Study Group, 1999). Nine questions incorporate the Diagnostic and Statistical Manual of Mental Disorders, Version Four (DSM-IV) criteria. Participants were asked to report the frequency of problems occurring during the two weeks before taking the survey. Responses for each question were scored from 0–3 (0 = Not at All, 1 = Several Days, 2 = More than Half the Days, or 3 = Nearly Every Day). Internal reliability (Cronbach's α = 0.89) and test-retest reliability (kappa of 0.84) have been reported as excellent for the PHQ-9 (Kroenke, Spitzer, & Williams, 2001). The total score on this instrument can range from 0 (lowest depression) to 27 (highest depression). We used the total score for this analysis.

2.3 Statistical Analyses

SPSS Version 26.0 was used for these analyses. Descriptive characteristics of the sample included mean and standard deviation for continuous variables and number and percentage for categorical variables. Because the dependent variable (PHQ-9) was continuous, univariate and multivariate linear regression analyses were conducted. Variables that were significant in the univariate analyses were entered into the multivariate model. Significance was set at an alpha of 0.05.

3. Results

The mean PHQ-9 score was 8.4, while the mean PSS score was 19.72. The participants averaged 7 hours of sleep the night before the survey, and the average age was 23 years old. Participants in this survey had a relatively high GPA, with an average of 3.42. The majority of participants identified as female, straight, employed, and White (Table 1).

Table 1. Descriptive Characteristics of the sample of college student participants from a diverse university in the Southwest U.S. in fall 2020 (n = 142)

Variables	Mean	Standard Deviation
PHQ-9 scores	8.41	6.00
PSS-10 scores	19.72	7.47
DIFF scores	-2.20	5.88
Hours of Sleep the night before	6.98	1.35
Age (years)	23.18	6.34
Grade Point Average	3.42	0.44
# of Credits	13.38	3.83
Total minutes of PA	438.38	580.46
Total minutes of vigorous PA	212.78	304.67
Total minutes of moderate PA	89.96	140.03
	N	%
Sex		
Male	29	20.4
Female	113	79.6
SGM		
No	113	79.6
Yes	25	17.6
Missing	4	2.8
1st generation college student		
No	75	52.8
Yes	62	43.7
Missing	5	3.5
Employment		
Employed	78	54.9
Unemployed	28	19.7
OLF	33	23.2
Race/Ethnicity		
White	53	37.3
Black	10	7.0
Hispanic	32	22.5
Asian	22	15.5
Other/Multiracial	21	14.8
Missing	4	2.8

SGM = sexual gender minority, PSS = Perceived Stress Scale, PA = physical activity, DIFF = difference between the sex-specific estimated cardiorespiratory fitness (CRF) algorithm and the age-predicted normative CRF values for healthy adults, OLF = out of the labor forces.

Univariate analyses found significant associations between PHQ-9 scores and several independent variables (Table 2). There was a positive (i.e., increased PHQ-9 scores) association with PSS where identifying as a sexual minority, and identifying as Asian or other/multiracial resulted in a higher PHQ-9 score. There was a negative (i.e.,

decreased PHQ-9 scores) association with hours of sleep, age, and GPA.

Table 2. Univariate Analyses for variables of interest predicting depressive symptoms as measured by the Patient Health Questionnaire – 9 (PHQ-9) for college student participants from a diverse university in the Southwest U.S. in fall 2020 (n = 142)

Variable	β	Standard Error	t	p-value
PSS	0.535	0.051	10.578	**<0.001**
DIFF	-0.165	0.085	-1.939	0.055
Hours of sleep the night before	-1.762	0.346	-5.091	**<0.001**
Age (years)	-0.178	0.079	-2.268	**0.025**
Grade Point Average	-2.766	1.158	-2.389	**0.018**
# of Credits	0.210	0.134	1.572	0.118
Total minute of PA	0.001	0.001	1.027	0.306
Total minute of vigorous PA	0.001	0.002	0.374	0.709
Total minute of moderate PA	-0.001	0.004	-0.144	0.886
Sex				
Male	REF	REF	REF	REF
Female	0.990	1.250	0.792	0.430
SGM				
No	REF	REF	REF	REF
Yes	2.667	1.313	2.031	**0.044**
1st generation college student				
No	REF	REF	REF	REF
Yes	-0.586	1.042	-0.562	0.575
Employment				
Employed	REF	REF	REF	REF
Unemployed	-0.858	1.318	-0.651	0.516
OLF	0.945	1.241	0.761	0.448
Race/Ethnicity				
White	REF	REF	REF	REF
Black	0.130	1.977	0.066	0.948
Hispanic	0.211	1.274	0.166	0.869
Asian	4.293	1.447	2.967	**0.004**
Other/Multi	4.168	1.472	2.832	**0.005**

*SGM = sexual gender minority, PSS = Perceived Stress Scale, PA = physical activity, DIFF = difference between the sex-specific estimated cardiorespiratory fitness (CRF) algorithm and the age-predicted normative CRF values for healthy adults, OLF = Out of the labor force

Significant univariate variables were retained for the multivariate analysis. Because DIFF was approaching significance (p = 0.055), it was also included in the multivariate analysis. The final model was significant and explained 56% (R2 = 0.56) of the variance in PHQ-9 scores (F = 15.88, p = <0.01). Variables that were positively associated with PHQ-9 scores included PSS and identifying as Asian, while variables that were negatively associated with PHQ-9 scores were hours of sleep and age (Table 3).

Table 3. Multivariate Analysis predicting depressive symptoms as measured by the Patient Health Questionnaire – 9 (PHQ-9) for college student participants from a diverse university in the Southwest U.S. in fall 2020 (n = 142)

Variable	β	Standard Error	t	p-value
DIFF	-0.050	0.065	-0.781	.436
PSS	0.425	0.053	8.089	**<0.001**
Hours of Sleep	-0.961	0.285	-3.373	**<0.001**
Age (Years)	-0.137	0.059	-2.296	**0.023**
GPA	-0.532	0.909	-0.585	0.560
SGM				
No	REF	REF	REF	REF
Yes	1.181	1.017	1.161	.248
Race/Ethnicity				
White	REF	REF	REF	REF
Black	-1.497	1.478	-1.013	0.313
Hispanic	-0.368	1.040	-0.354	0.0724
Asian	2.956	1.190	2.483	**0.014**
Other/Multiple	1.450	1.137	1.274	0.205

*SGM = sexual gender minority, GPA = grade point average, PSS = Perceived Stress Scale, DIFF = difference between the sex-specific estimated cardiorespiratory fitness (CRF) algorithm and the age-predicted normative CRF values for healthy adults

4. Discussion

4.1 Discussion of Significant Findings

The purpose of this study was to identify selected predictors of depression among a sample of college students during the COVID-19 pandemic with a particular emphasis on sociodemographic variables, cardiorespiratory fitness, perceived stress, and duration of sleep. Our most interesting findings are that perceived stress (p<0.001) and identifying as Asian (p = 0.014) were positively associated with depression. In contrast, the duration of sleep (p<0.001) and age (p = 0.023) were negatively associated with depression. The study also found that the difference (DIFF) between the numeric result of the sex-specific eCRF algorithm and the age-predicted normative CRF values for healthy adults was not a significant predictor for depression (p = 0.436). The significant variables accounted for 56% of the variance in explaining depression during COVID-19, which is substantial in behavioral and social sciences (Sharma & Petosa, 2014).

Perceived stress as a determinant of depression is well known (Liu et al., 2019). During the COVID-19 pandemic, college students experienced greater stress (Wang et al., 2020) due to various factors, such as fear of infection, uncertainty for both themselves and loved ones, social isolation, worry about academic performance, and others (Son, Hegde, Smith, Wang, & Sasangohar, 2020). Our results show all these factors correlate with college students' increased symptoms of depression during the COVID-19 pandemic. For every unit increase in PSS-10 score, there was a 0.425 unit increase in depression symptomatology as measured by PHQ-9. Further, the study's descriptive results also show that mean perceived stress scores were 19.72 ±7.47 (median = 20) units in a potential range of 0-40 units on PSS-10 or right in the middle, indicating moderate stress levels.

Our results show that identifying as Asian was significantly associated with depression compared to identifying as White. The origins of depression are probably from several sources, but anger suppression and perceived burdensomeness have been found to play a mediating role in depression for Asian American college students (Carrera & Wei, 2017; Cheung & Park, 2010; Kalibatseva, Leong, Ham, Lannert, & Chen, 2017). This is interesting because, at the time of our data collection, there was an atmosphere of racial tension across the U.S., as evidenced by a dramatic rise in violence against Asian Americans (Lang, 2021). Anger suppression, perceived discrimination, and feelings of injustice could have played a role in the statistically significant link between Asian identity and the depression that we found. Another possible explanation could be the role social anxiety plays for Asian Americans, which is a mediating factor for depression in that sub-population (Okazaki, 1997). The

COVID-19 pandemic precipitated social distancing and other restrictive measures that may have contributed to increased depression symptomatology among those who identified as Asian in our sample.

Another factor that may have caused elevated depression among those college students identifying as Asian is the stigma associated with mental health problems (Gary, 2005; Maeshima & Parent, 2020). Because of this stigma, Asian-identifying college students may have eschewed treatment or mental health counseling, leading to higher levels of depression. We did not find that identifying as Black or Hispanic was associated with depression. Not detecting this relationship could be a limitation of the small sample size of these subgroups or some other unknown attributes. In any case, there is a need for mental health programs for college students, but particularly for students who identify as Asian.

We found that sleep duration was negatively associated with depression. The mean number of hours of sleep of participants was about 7-hours, which is at the lower end of the recommended levels for young adults by the National Sleep Foundation (NSF) (Hirshkowitz et al., 2015), as well as the American Academy of Sleep Medicine (AASM) and the Sleep Research Society (SRS) (Consensus Conference Panel et al., 2015). Both brief and excessive sleep durations are related to the risk of depression among adults (Zhai et al., 2015). We did not assess the quality of sleep among our sample. However, our study points to a need for sleep hygiene interventions that promote both adequate duration and sleep quality among college students.

Our study found an inverse relationship between age and depression. For every year the participant was older, there was a 0.137 unit decrease in depression symptomatology as measured by PHQ-9. These findings align with the results of a meta-analysis by Salk, Hyde, and Abramson, who found that depression effect sizes peak at adolescence, are reduced in young adulthood, and stabilize with age (Salk, Hyde, & Abramson, 2017). The findings point to a need for more mental health programming for younger college students.

Cardiorespiratory fitness as measured by DIFF was not found to be associated with depression. This is contrary to findings from a recent study where eCRF was linked to depressive symptoms among college students (Jalene et al., 2019). It is well known that physical activity is a protective factor for depression (Mammen & Faulkner, 2013; Teychenne et al., 2008). It is worth noting that in our sample, the students were quite physically active, with the mean levels of physical activity being 438.38 minutes ± 580.46 minutes per week.

4.2 Implications for Practice

Our study has important implications for practitioners and policymakers who impact college health and public health. To mitigate the current elevated levels of stress among college students, educational, counseling, and other student-oriented interventions need to be in place. This study points to the need for stress management and resource support programs for college students. In addition, because students with financial stressors appear to be especially vulnerable to depression during the pandemic (Rudenstine et al., 2021), resources to support students who exhibit the greatest need may be an important strategy to mitigate stress and depression. These efforts need to be enhanced during and after the pandemic and in the COVID-19 recovery phase. Stress management interventions should include the skills to identify stressors, manage anger and change, communicate effectively, cope with anxiety, and find balance in eating and physical activity (Romas & Sharma, 2017). Such programs can be introduced through campus wellness centers, online programming, for-credit courses, and counseling services. University policymakers should consider making stress management programs mandatory in curricular requirements for all students. This aspect has become more pronounced during the COVID-19 pandemic and requires urgent action. Such stress management interventions must be based on robust behavioral theories (Sharma, 2016). Some newer fourth-generation behavioral theories such as the Reasoned Action Approach (RAA) (Hagger, Polet, & Lintunen, 2018) or multi-theory model (MTM) of health behavior change (Sharma, 2015) can be used for developing precision interventions.

Second, our study's findings point to the need for programming to promote mental health and treatment of depressive conditions among minorities, especially Asian-identifying college students. Factors such as anger suppression, social anxiety, and stigma need to be specifically targeted in mental health promotion programs. Accessibility and availability of mental health services for the treatment of depression and related disorders among minority populations also need underscoring. Decision-makers can play an essential role in this regard. These findings also suggest that racial discrimination, at the societal level, needs to be addressed.

Third, there is a need for college health promotion programs to inculcate sleep hygiene programs. There is evidence for promoting sleep hygiene among the general population to improve the quantity and quality of sleep (Irish, Kline, Gunn, Buysse, & Hall, 2015). Sleep hygiene interventions entail the promotion of healthy sleeping habits such as being consistent with sleep time, ensuring that the bedroom is quiet and distraction-free, removing

electronic devices and sources of light, avoiding large meals, caffeine, and alcohol before sleeping, and exercising regularly (CDC, 2017). Once again, these interventions must be based on sound behavioral theories, preferably fourth-generation approaches that utilize constructs from multiple behavioral theories.

Finally, there is a need to target college students from their freshmen year, both for stress management programming and screening for signs of depression symptomatology. This aspect has grown in importance during the COVID-19 pandemic. Once again, college administrators must divert curricular changes in this direction and examine, and perhaps strengthen, services offered at campus health centers.

4.3 Strengths and Limitations of Our Study

Our study is among the few that have examined the link between stress, sleep, sociodemographic variables, and depression among college students during the COVID-19 pandemic. Further, the study used a diverse student population where several minority groups were represented. The study also utilized robust psychometric instrumentation with good validity and reliability. The study team comprised of interdisciplinary researchers who contributed to the research from different perspectives.

However, the study also has some limitations. A cross-sectional study design was employed, which restricts the ability to establish temporal relationships, thus curtailing the ability to assign causality. Perhaps future studies can use more robust longitudinal designs. The study was comprised of data from only one institution, so, strictly speaking, the results may not be generalizable. This study relied solely on self-report measures. Self-report measures are amenable to several biases, and future studies should aim to include objective measures. This study is subjected to selection bias as those who were more interested in the topic may have been more likely to participate in the survey. Recall bias may have been an issue in that we asked participants to reflect on how they had felt over the past two weeks. The response rate was low in this study and the females were overrepresented. Finally, we did not measure the quality of sleep in our study, which is important. Future studies should examine both quantity and quality of sleep as predictors of depression.

4.4 Conclusions

COVID-19 is exacting a psychological toll on the mental health of different subgroups of college students. We found that higher perceived stress and identifying as Asian were positively associated with depressive symptomatology. Hence, there is a need for stress management programs and mental health promotion programs and broader interventions targeting the Asian-identifying college students. As age was associated with increased symptomatology, programs targeted at younger college students are warrented. We also found a need to promote sleep hygiene among college students. Both practitioners and decision-makers in college health and public health must work to mitigate the adverse effects of the COVID-19 pandemic on the mental health of college students.

Competing Interests Statement

The authors declare that there are no competing or potential conflicts of interest.

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