



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Mental health of US undergraduate and graduate students before and during the COVID-19 pandemic: Differences across sociodemographic groups

Yuchen Liu^{a,*}, Patricia A. Frazier^b, Carolyn M. Porta^c, Katherine Lust^d

^a Department of Psychology, University of Minnesota-Twin Cities, Minneapolis, MN 55455, US

^b Department of Psychology, University of Minnesota-Twin Cities, Minneapolis, MN 55455, US

^c School of Nursing, University of Minnesota-Twin Cities, Minneapolis, MN 55455, US

^d School of Public Health, University of Minnesota-Twin Cities, Minneapolis, MN 55455, US

ARTICLE INFO

Keywords:

Mental health
stress
sleep
sexual minorities
college student health
Gender differences
Race
People with disabilities

ABSTRACT

The purposes of this study were to assess differences between sociodemographic groups in student mental health before and during the COVID-19 pandemic, to investigate whether the pandemic disproportionately affected certain groups, and to examine between-group differences in pandemic-related stressors. Data from Minnesota undergraduate and graduate students who completed an online survey in 2020 ($N = 2,067$) were compared to data collected from students in 2018 ($N = 3,627$). The survey assessed days of poor mental health, stress, stress management ability, days of adequate sleep, and pandemic-related stressors (2020 only). Multivariate analyses of variance assessed differences between study years (2020 vs. 2018), sociodemographic groups (gender, sexual orientation, race, disability, international student), and their interactions with study year in predicting mental health, and the sociodemographic groups in predicting pandemic stressors, among undergraduate and graduate students. Stress management ability decreased and sleep improved from 2018 to 2020. The sociodemographic variables most associated with poorer mental health were identifying as female, a sexual minority, or having a disability. Undergraduates reported poorer mental health than graduate students. Differences between sociodemographic groups were not larger during the pandemic, except among students with disabilities. All five sociodemographic variables were related to greater pandemic stressors in some domains.

1. Introduction

Well before the COVID-19 pandemic, mental health problems were common among both undergraduate (ACHA-NCHA, 2019a) and graduate (e.g., ACHA-NCHA, 2019b) students. Prospective studies, which have focused on undergraduates, generally have shown that the COVID-19 pandemic has contributed to worsening mental health across a range of outcomes, including more negative mood and higher levels of anxiety, depression, and perceived stress (Charles et al., 2021; Copeland et al., 2021; Fruehwirth et al., 2021; Huckins et al., 2020; Wilson et al., 2021). Although no prospective studies of graduate students were located, graduate students also have reported high rates of mental health problems during the pandemic (Wasil et al., 2021).

It is important to identify students who are at higher risk during the pandemic so that campus leaders and health care providers can direct

limited resources and services to those students. Although many factors are related to student mental health, sociodemographic variables tend to be more readily available to campus administrators, allowing outreach to specific groups. Gender has been most widely studied in relation to student mental health during the pandemic, with studies showing that female undergraduate and graduate students reported higher levels of anxiety and depression (Chirikov et al., 2021; Wang et al., 2020), and female undergraduate students reported higher stress, lower wellbeing, and lower sleep quality than male undergraduate students (Browning et al., 2021; Copeland et al., 2021; Chirikov et al., 2021; Hoyt et al., 2021; Kecojevic et al., 2020; Lee et al., 2021; ACHA-NCHA, 2020; Prowse et al., 2021; Wang et al., 2020). Undergraduate and graduate students who identify as sexual minorities also have reported greater anxiety and depression and lower wellbeing than heterosexual students during the pandemic (Chirikov et al., 2021; Fruehwirth et al., 2021;

* Corresponding author at: 1016 Washington Ave SE, Minneapolis, MN, 55414.
E-mail address: liux3340@umn.edu (Y. Liu).

Gratz et al., 2021; Hoyt et al., 2021). Finally, although some studies have not found differences in anxiety, stress, depression, and overall COVID-19 mental health impacts between White and racial/ethnic minoritized undergraduate students during the pandemic (Keckojevic et al., 2020; Trammell et al., 2021), other studies have shown that White students reported more symptoms, including sleep problems and perceived stress, than did African American students (Charles et al., 2021) as well as larger increases in symptoms (Fruehwirth et al., 2021). In other studies, students of color were more likely to experience COVID-19 related stressors (e.g., obstacles transitioning to remote instruction) than White students (Soria et al., 2020; Trammell et al., 2021).

The purpose of the present study was to contribute to our understanding of how undergraduate and graduate students from different sociodemographic groups have been affected by the pandemic. First, in addition to contributing to existing research on the roles of gender, sexual orientation, and race, we examined two other sociodemographic groups that to our knowledge have yet to be studied with regard to pandemic mental health - students with disabilities and international students. Students with disabilities reported poorer mental health prior to the pandemic (e.g., Coduti et al., 2016) and may experience unique stressors during the pandemic, such as difficulty physical distancing for those who rely on caregivers for daily tasks (Morchen et al., 2020). Research on differences in mental health between domestic and international students conducted prior to the pandemic has yielded mixed results (Misra & Castillo, 2004; Mitchell et al., 2007). However, given that many international students are from Asian countries and the rise in anti-Asian violence (Zhai & Du, 2020), international students may be more adversely affected during the pandemic than domestic students.

Second, we compared data collected during the pandemic (March 2020) to data collected in 2018 to examine whether students from different sociodemographic groups were disproportionately affected by the pandemic. Students with certain characteristics who reported poorer mental health during the pandemic were not necessarily disproportionately affected because these differences may reflect pre-existing differences between groups (Frazier et al., 2019; Oswalt & Wyatt, 2011). In fact, evidence from studies conducted outside of the US has suggested that undergraduate students (Hamza et al., 2020) and adolescents (Hu & Qian, 2021) with pre-existing mental health concerns had improved mental health during the pandemic. Among prospective studies of undergraduate students conducted in the US, results have been mixed in terms of whether gender and race were related to change in symptoms from before to during the pandemic (Charles et al., 2021; Copeland et al., 2021; Fruehwirth et al., 2021), although evidence has suggested disproportionate effects of the pandemic on sexual-gender minority undergraduate students (Fruehwirth et al., 2021).

Third, our samples included both undergraduate and graduate students. Research on mental health during the pandemic has tended to focus on undergraduate students, and only a few studies have compared undergraduate and graduate students, with mixed results. For example, undergraduate and graduate students did not differ in the psychological impact of the pandemic in one study (Browning et al., 2021). However, in another study, undergraduate students reported more depression and anxiety symptoms than did graduate students (Wang et al., 2020).

Finally, few studies have explored whether students from different sociodemographic groups experience unique stressors during the pandemic. In one study, some female college students described having more caretaking responsibilities than male students, and some sexual minority students described losing access to on-campus peer support and living in homophobic households (Hoyt et al., 2021). Because pandemic-related stressors can be related to poorer mental health (Wang et al., 2020), exploring differences in stressors experienced can provide insight into why some students may report poorer mental health than others during the pandemic.

In sum, the goals of the study were to assess (1) differences in commonly-assessed mental health indicators between students from

different sociodemographic groups; (2) whether differences were greater during, than prior to, the pandemic; and (3) group differences in pandemic-related stressors. We hypothesized that women, sexual minorities, and students with disabilities would score lower on indicators of mental health during the pandemic; given mixed findings regarding race/ethnicity and international student status, our hypotheses about these groups were more tentative but were that racial/ethnic minoritized and international students would score lower on mental health indicators given the racial context of the pandemic. Questions regarding whether students from different sociodemographic groups were disproportionately affected by the pandemic and the specific stressors experienced by various groups were exploratory given limited prior research. Owing to the lack of research on graduate student mental health during the pandemic, we also examined differences in indicators of mental health and pandemic-related stressors between undergraduate and graduate students.

2. Methods

2.1. Participants

Participants were two separate samples of students from two campuses of a midwestern university who completed an online survey in Spring 2018 ($N = 3627$) and May 2020 ($N = 2067$) that measures the health status and behaviors of Minnesota students. Students who completed the surveys were entered into a drawing to receive gift cards of different amounts. The response rates were 37% in 2018 and 27% in 2020. The original data collection and secondary analyses reported here received IRB approval. In 2018 and 2020 (see Table 1), most participants were undergraduates (72%, 71%), cisgender women (59%, 61%), White (77%, 76%), heterosexual (86%, 81%), domestic students (92%, 92%), and reported no disabilities (87%, 85%). Transmale, transfemale,

Table 1
Demographic Characteristics of 2018 and 2020 Samples.

		Percentage (number)	
		2018 ($N = 3627$)	2020 ($N = 2067$)
Gender	Male	39% (1222)	37% (732)
	Female	60% (1848)	62% (1210)
	Transmale ^a	0.5% (15)	0.3% (5)
	Transfemale ^a	0.2% (5)	0% (0)
	Gender queer ^a	1% (24)	1% (26)
Race	White	77% (2355)	76% (1492)
	Asian	14% (422)	12% (243)
	Black or African American	2% (57)	3% (50)
	Hispanic or Latinx	4% (113)	3% (68)
	American Indian or Alaska Native ^a	0.4% (13)	1% (10)
	Native Hawaiian or Pacific Islander ^a	0% (0)	0.05% (1)
	Multiracial	3% (100)	5% (98)
Sexual identity	Heterosexual or straight	86% (2676)	81% (1588)
	Gay or lesbian ^b	3% (92)	4% (76)
	Bisexual ^b	6% (194)	10% (197)
	Not sure ^b	2% (68)	2% (46)
	Alternative identifier ^b	2% (77)	2% (45)
Disability	At least one	13% (383)	15% (287)
	International student	8% (233)	8% (154)
School year	Undergraduate	72% (2203)	71% (1373)
	Graduate	28% (840)	29% (549)
Campus	Medium size	33% (1215)	39% (815)
	Large	67% (2412)	61% (1252)
Mean Age		22.83 (SD = 5.40)	23.23 (SD = 6.07)

Note. For gender and race, percentages do not add to 100 because respondents could choose more than one option. For sexual orientation, percentages do not add to 100 because of rounding. ^a Excluded from analyses due to small sample size. ^b Coded as sexual minority.

gender queer, American Indian/Alaska Native, and Native Hawaiian/Pacific Islander groups were excluded from the final analyses due to small samples.

2.2. Measures

2.2.1. Mental health indicators

Four items assessed various mental health indicators in the 2018 and 2020 surveys. First, one item from the Centers for Disease Control and Prevention's Behavioral Risk Factor Surveillance System (CDC, 2020) assessed how many days in the past 30 days participants felt that their mental health was not good (0 to 30). Second, participants rated their average level of stress in the past 30 days (1 = *Not stressed at all* to 10 = *Very Stressed*). Third, stress management ability was assessed by an item that asked participants to rate their ability to manage their stress in the past 30 days (1 = *Ineffective* to 10 = *Very effective*). Finally, participants reported how many of the past seven days (0 to 7) they got enough sleep so they felt rested upon awakening.

2.2.2. Pandemic-related stressors and difficulty social distancing

In the 2020 survey, participants rated how frequently they experienced 25 pandemic-related stressors within the past 7 days (1 = *Never* to 5 = *Always*) using a measure developed for students (Frazier et al., 2021). In an exploratory factor analysis in the original scale development study, 20 of the items loaded above 0.40 on one of four factors. Stressor subscales created from these items assessed: 1) school-related stressors (5 items), 2) boredom/missing out (5 items), 3) negative emotions (6 items), and 4) COVID/health stressors (4 items; see Table 4 for item list). The alpha coefficients for the four subscales ranged from 0.70 to 0.83 in the scale development study and from 0.80 to .86 in this sample. The correlations among these four subscales ranged from 0.47 to 0.75 in this sample, all $ps < 0.001$. Finally, participants also rated how difficult social distancing was for them (1 = *Very easy* to 4 = *Very difficult*). This item correlated with the stressor subscales from 0.20 to 0.47, all $ps < 0.001$.

2.3. Analysis Plan

All analyses were done in SPSS Version 27. Data from the combined 2018 and 2020 samples were analyzed to assess differences in mental health indicators between sociodemographic groups and whether those differences were greater during the pandemic than in data collected prior to the pandemic. Specifically, a multivariate analysis of variance (MANOVA) was conducted with poor mental health, stress, stress management ability, and sleep as the dependent variables and the five sociodemographic variables (gender, sexual orientation, race, disability, and international student status), student status (undergraduate vs. graduate student), and study year (2020 vs. 2018) as independent variables. Campus (large vs. medium size) and age were examined as potential covariates that could confound the relations between study year and mental health but were not included in models because differences between the 2018 and 2020 samples were small (Cramer's $V = 0.06$ for campus, Cohen's $d = 0.07$ for age). Interaction terms between the five sociodemographic variables and student status with study year were included to assess whether the relations between these variables and mental health differed between 2018 and 2020. We set alpha at $p = .004$ (0.05/13) for the multivariate tests. To assess group differences in pandemic-related stressors in the 2020 sample, a MANOVA was conducted with the four stressor factors and difficulties in social distancing as dependent variables, and the five sociodemographic variables and student status as independent variables using $p = .01$ (0.05/6).

3. Results

3.1. Preliminary Analyses

Data diagnostics were conducted before data analysis. All dependent variables were considered normally distributed based on guidelines (Kim, 2013) for sample sizes greater than 300. No outliers were identified. Because Box's M test for homogeneity of variance was significant for the MANOVA with the four mental health indicators, we used Pillai's criterion to evaluate multivariate significance, as recommended by Tabachnick and Fidell (2019). Missing data were handled using listwise deletion in the MANOVAs (~22% in the combined 2018–2020 sample; ~15% in 2020 sample). Results were similar in analyses using multiple imputation.

Prior to MANOVA analyses, t -tests were conducted comparing mental health scores between the 2020 and 2018 samples (see Table 2). Students in 2020 reported more days of poor mental health, more stress, and lower stress management ability, but more days of adequate sleep, than students in 2018, with most effect sizes in the small to moderate range.

3.2. Comparing 2018 and 2020 Mental Health Data

In the MANOVA conducted with the 2018 and 2020 mental health data, the multivariate tests were significant for study year, $F(4, 4187) = 8.96, p < 0.001$, Pillai's trace = 0.008, partial $\eta^2 = 0.008$; gender, $F(4, 4187) = 32.69, p < 0.001$, Pillai's trace = 0.030, partial $\eta^2 = 0.030$; sexual orientation, $F(4, 4187) = 20.58, p < .001$, Pillai's trace = 0.019, partial $\eta^2 = 0.019$; and disability, $F(4, 4187) = 86.47, p < .001$, Pillai's trace = 0.076, partial $\eta^2 = 0.076$, but not race, $F(16, 16,760) = 1.20, p = .261$, Pillai's trace = 0.005, partial $\eta^2 = 0.001$, or international student status $F(4, 4187) = 3.38, p = .009$, Pillai's trace = 0.003, partial $\eta^2 = 0.003$. Undergraduate students also differed from graduate students, $F(4, 4187) = 8.42, p < .001$, Pillai's trace = 0.008, partial $\eta^2 = 0.008$. There were no significant interactions between the sociodemographic variables and study year for any mental health indicator (all $ps > 0.004$), except for disability status, $F(4, 4187) = 4.97, p < .001$, Pillai's trace = 0.005, partial $\eta^2 = 0.005$.

Table 3 contains the univariate tests for the five variables with significant multivariate tests with alpha set at $p = .003$ (0.05/20 significance tests). The partial η^2 effect sizes were interpreted using the following conventions: 0.01 = small, 0.06 = medium, 0.14 = large. Students in 2020 reported significantly poorer stress management ability and *better* sleep than students in 2018. Students who identified as women or as sexual minorities reported significantly more days of poor mental health, more stress and poorer stress management ability, with small effect sizes, but not poorer sleep. Undergraduates reported more days of poor mental health and poorer stress management than graduate students. Students with disabilities reported poorer mental health on all four measures with small to medium effect sizes. At the univariate level, the significant interaction between disability status and study year was only significant for sleep, $F(1, 4190) = 12.90, p < .001$, partial $\eta^2 = 0.003$. Specifically, the improvement in sleep from 2018 to 2020 was greater for students without disabilities ($d = 0.51$) than for students with disabilities ($d = 0.17$).

An additional analysis was conducted to explore the intersectional effects of gender, sexual orientation, and disability status (the variables most related to poorer mental health). Students who were male, heterosexual, and had no disabilities ($n = 1392$) reported the fewest days of poor mental health ($M = 4.48, SD = 6.73$), whereas students who were female, sexual minorities, and had at least one disability ($n = 134$) reported the most days of poor mental health ($M = 16.57, SD = 9.32$), Cohen's $d = 1.49$. See supplement for further information.

Table 2
Correlations and descriptive statistics and for mental health variables.

	1	2	3	Overall mean	2018 Mean	2020 Mean	t (df)	Cohen's d
1. Days poor mental health				7.24 (SD=8.25)	6.28 (SD = 7.93)	8.86 (SD = 8.52)**	11.33 (1,5501)	-0.32
2. Stress	.53**			6.00 (SD=2.05)	5.94 (SD = 2.05)	6.10 (SD = 2.05)*	2.78 (1,5500)	-0.08
3. Stress management ability	-0.50**	-0.53**		6.32 (SD=2.05)	6.50 (SD = 2.02)	6.01 (SD = 2.07)**	8.63 (1,5502)	0.24
4. Days adequate sleep	-0.25** *	-0.32*	.28**	3.66 (SD=1.97)	3.42 (SD = 1.91)	4.03 (SD = 2.00)**	11.02 (1,5279)	-0.31

Note. ** $p < .001$. * $p < .01$. Ns for 2018 range from 3250 to 3473. Ns for 2020 range from 2020 to 2043. SD = standard deviation.

Table 3
Follow-up univariate tests comparing mental health indicators between 2020 and 2018 samples.

	Mental health		Stress		Stress management ability		Sleep	
	F	η^2	F	η^2	F	η^2	F	η^2
Study year	8.25	.002	.55	.000*	12.06*	.003*	9.53*	.002
Gender	97.15*	.023	91.14*	.021	46.94*	.011	2.65	.001
Sexual orientation	77.96*	.018	27.16*	.006	31.78*	.008	3.12	.001
Disability	315.88*	.070	122.99*	.029	149.22*	.034	64.74*	.015
Student status	14.90*	.004	.45	.000	18.01*	.004	7.45	.002

Note. * $p < .003$. df = 1,4190 for year, gender, sexual orientation, disability, and student status (undergraduate/vs. graduate). Bold indicates significant differences between groups. η^2 = partial eta square.

3.3. Pandemic-Related Stressors

Table 4 provides descriptive statistics for the 25 pandemic stressor items. The highest rated items were missing seeing friends in person, feeling less motivated, and uncertainty related to COVID. With regard to the four factors, school stressors and bored/missing out had the highest means. The overall sample mean indicated moderate difficulty social distancing ($M = 2.60$, $SD = 0.83$).

In the MANOVA examining whether students from various socio-demographic groups differed in scores on the four stressor factors and difficulty social distancing, all six multivariate tests were significant: gender, $F(5, 1618) = 13.64$, $p < .001$, Pillai's trace = 0.040 partial $\eta^2 =$

Table 4
Stressors in 2020 sample.

	Mean	SD
School stressors	3.26	1.02
Less motivated	3.61	1.25
Hard to do all online classes	3.48	1.26
Worried about maintaining grades	3.20	1.44
Balance school and other responsibilities	3.01	1.35
Financial problems	2.96	1.36
Bored/missing out	3.19	1.00
Miss seeing friends in person	3.92	1.23
Bored, cooped up, or antsy	3.42	1.29
Lost out on school events	3.16	1.43
Too much unscheduled time	2.81	1.38
Difficulty adjusting to new living situation	2.55	1.29
Negative emotions	2.90	0.98
Concerned about future career path	3.44	1.41
Stressed or overwhelmed	3.29	1.24
Anxious or worried	3.15	1.29
Sad or disappointed	2.93	1.26
Lonely or isolated	2.72	1.34
Interpersonal conflicts/problems	1.83	1.02
COVID/health	3.04	0.99
Uncertainty related to COVID	3.59	1.26
Health of people I care about	3.10	1.30
Number of deaths from COVID	3.05	1.32
Worried about my own health	2.42	1.16
Other		
Constant news about COVID	3.22	1.35
Miss seeing romantic partners in person	3.00	1.70
Miss seeing family in person	3.13	1.46
Worried about discrimination (NF)	2.51	1.45
Problem at/with my job	2.36	1.42

Note. $N = 2067$. Items in bold have the highest means.

0.040; race, $F(20, 6484) = 3.57$, $p < .001$, Pillai's trace = 0.044, partial $\eta^2 = 0.011$; sexual orientation, $F(5, 1618) = 3.47$, $p = .004$, Pillai's trace = 0.011, partial $\eta^2 = 0.011$; international student status, $F(5, 1618) = 3.14$, $p < .009$, Pillai's trace = 0.010, partial $\eta^2 = 0.010$; disability, $F(5, 1618) = 23.03$, $p < .001$, Pillai's trace = 0.066, partial $\eta^2 = 0.066$; and student status, $F(5, 1618) = 35.99$, $p < .001$, Pillai's trace = 0.100, partial $\eta^2 = 0.100$. In the follow-up univariate tests (see Table 5), using $p = .002$ (0.05/30), women reported more stressors than men in all four stressor domains and more difficulty social distancing, with small effect sizes. Students with at least one disability reported more stressors than students without disabilities on all stressor domains but not on difficulty social distancing, and the effect sizes were small to medium. Undergraduate students reported more stressors than graduate students on all stressor domains except for COVID/health stressors and difficulty social distancing, with small to medium effect sizes. Students who identified as sexual minorities only reported more negative emotions and the effect size was small. No significant differences were found between domestic and international student for any stressor factor. Finally, in follow-up tests comparing the five racial/ethnic groups, White students reported more difficulty social distancing than did Asian students.

4. Discussion

The aim of this study was to better understand how undergraduate and graduate students from different sociodemographic groups have been affected by the COVID-19 pandemic. Our study contributes to the literature by examining five sociodemographic variables, whether students from any of the sociodemographic groups were disproportionately affected by the pandemic, and whether they reported different stressors during the pandemic.

As hypothesized, students from some sociodemographic groups scored lower on various indicators of mental health than did others. The groups at greater risk were women (vs. men), sexual minorities (vs. heterosexuals), and students with (vs. without) disabilities. Findings regarding poorer mental health among these groups are consistent with other studies conducted during (Browning et al., 2021; Copeland et al., 2021; Gratz et al., 2021; Hoyt et al., 2021; Wang et al., 2020) and prior to (Eisenberg et al 2013; Frazier et al., 2019; Oswalt & Wyatt, 2011) the pandemic. These differences may reflect that these groups, especially women students and students with disabilities, also tended to report more pandemic-related stressors. Students with disabilities appeared to be at particular risk in that the differences between students with and

Table 5
Follow-up univariate tests for stressors and difficulty social distancing in 2020 sample.

	School stressors		Bored/missing out		Negative emotions		COVID/health		Difficulty social distancing	
	F	η^2	F	η^2	F	η^2	F	η^2	F	η^2
Gender	16.18*	.010	28.38*	.017	51.66*	.031	42.74*	.026	12.44*	.008
Race	1.95	.005	2.19	.005	.40	.001	1.81	.004	9.84*	.024
Sexual orientation	8.41	.005	3.68	.002	16.27*	.01	6.07	.004	.33	.000
International	7.75	.005	2.50	.002	1.22	.001	.49	.000	.01	.000
Disability	62.16*	.037	11.05*	.007	95.87*	.056	22.69*	.014	1.20	.001
Student status	74.09*	.044	90.27*	.053	20.07*	.012	.45	.000	6.35	.004

Note. * $p < .002$. $df = 1$, 1458 for gender, sexual orientation, international, disability, and student status. $df = 4$, 1458 for race. Bold indicates significant difference between groups. $\eta^2 =$ partial eta squared.

without disabilities were larger than the differences between other sociodemographic groups (e.g., men vs. women). Poorer mental health among women, sexual minorities, and students with disabilities likely has many contributors, including that all three groups are more likely to experience sexual violence (International Society for Traumatic Stress Studies, Sexual Violence Briefing Paper Work Group, 2018), prejudice and discrimination (Dammeyer & Chapman, 2018; Meyer, 2003; Starnski & Hing, 2015), and microaggressions (Blithe & Elliott, 2020; Kattari, 2020; Robinson & Rubin, 2016). Finally, students with all three sociodemographic characteristics (i.e., sexual minority women with at least one disability) reported many more days of poor mental health than did students without any of those characteristics, consistent with previous studies showing that college students with more than one of these characteristics (e.g., female and sexual minority) are at greater risk for poorer mental health (Silva et al., 2015).

In addition, undergraduates reported more days of poor mental health and lower stress management ability than did graduate students. This finding is consistent with previous studies showing that undergraduates reported poorer mental health than graduate students before (Eisenberg et al., 2013) and during (Wang et al. 2020) the pandemic. Undergraduate students also reported more school stressors, stressors related to being bored and missing out, and negative emotions than did graduate students. This is consistent with the finding prior to the pandemic that undergraduate students reported more stressors (e.g., family problems, academics) than did graduate students (Wyatt & Oswalt, 2013).

Although students from some groups (i.e., females, sexual minorities, students with disabilities, undergraduates) reported poorer mental health, they did not appear to be disproportionately affected by the pandemic in that differences between groups were not larger in data collected during the pandemic than in data collected in 2018. The only exception was that there was a greater improvement in sleep from 2018 to 2020 for students without disabilities than for those with disabilities. The lack of disproportionate effects is consistent with previous studies that did not find significant interactions between gender (Copeland et al., 2021) and race (Charles et al., 2021; Copeland et al., 2021) and year of data collection. This lack of difference also is consistent with a meta-analysis of longitudinal cohort studies comparing the mental health of the general population before versus during the pandemic which found no evidence of gender differences in change in mental health symptoms (Robinson et al., 2022).

Students reported poorer mental health in some domains in 2020 than did students in 2018 (e.g., more days of poor mental health), consistent with other studies that used similar designs (Charles et al., 2021), but also reported better sleep. After sociodemographic variables and student status were taken into account, differences in stress management ability and sleep remained significant, with students reporting poorer stress management abilities and *better* sleep in 2020 than in 2018. When asked retrospectively about changes in sleep from before to during the pandemic, the majority of US college students in another study reported disruptions in sleep patterns, some of which were positive and some of which were negative (Son et al., 2020), and another sample

reported better sleep as a benefit of the pandemic (Frazier et al., 2021). It is not clear why there were larger differences between 2018 and 2020 in perceived stress management ability than in perceived stress although it may be related to the unprecedented nature of the stressors associated with the pandemic.

There were few differences across racial groups in mental health, other than that Asian students reported less difficulty social distancing than did White students. Although we had anticipated that racial/ethnic minorities might report more distress than White students, our findings are consistent with others that have found no differences in mental health among different racial groups during the pandemic (Kecojevic et al., 2020; Trammell et al., 2021). There also were no differences between international and domestic students in any aspect of mental health or any stressor factors, consistent with some studies conducted prior to the pandemic (Mitchell et al., 2007).

Several limitations of this study need to be acknowledged. First, the pandemic and pre-pandemic data were not collected from the same students. Truly prospective studies allow stronger conclusions to be made regarding changes over time. Second, due to very small samples, transgender and gender queer students were not included in the analyses. We also combined specific sexual minority groups (e.g., gay, bisexual) together to increase the overall size of the sexual minority sample for analysis purposes. We also did not include some racial groups (e.g., American Indian/Alaska Native) due to small sample sizes and some samples that were included were relatively small (i.e., Black students). Future studies should recruit and examine mental health among minoritized sociodemographic groups and students with intersecting identities (e.g., sexual minority students with disabilities). Relatedly, the list of pandemic-related stressors used in this study was developed based on qualitative responses from a general sample of undergraduate students and may not reflect the stressors experienced by specific sociodemographic groups, especially those from groups who may be marginalized in US society (e.g., sexual minorities). To improve understanding of the experiences of students from different sociodemographic groups, future research should gather information from these groups and develop stressor lists specific to them. Finally, indicators of mental health were assessed with one item measures, which may not adequately represent the constructs of interest.

Despite these limitations, these findings have implications for campus leaders and health care professionals to help improve student mental health during and after the pandemic. First, students from some groups (i.e., females, sexual minorities, with disabilities, undergraduates) reported lower scores on mental health indicators before and during the pandemic. Importantly, these sociodemographic variables and student status were more strongly related to mental health than whether or not the data were collected during the pandemic. More prevention and intervention resources should be directed to students from these groups to meet their mental health needs. Second, previous studies have shown that poorer mental health is associated with greater risk of getting sick if exposed to a virus (Cohen, 2021) and poorer immune system response to vaccines (Madison et al., 2021). As a result, ongoing attention to student mental health remains vitally important.

CRediT authorship contribution statement

Yuchen Liu: Conceptualization, Methodology, Formal analysis, Writing – original draft. **Patricia A. Frazier:** Conceptualization, Methodology, Writing – original draft, Supervision. **Carolyn M. Porta:** Writing – review & editing. **Katherine Lust:** Methodology, Resources, Writing – review & editing, Project administration.

Declaration of Competing Interest

None.

Acknowledgement

We acknowledge the assistance of Henry Wyneken and Allie Cooperman with statistical assistance. Informed consent was obtained for research with human subjects. The research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.psychres.2022.114428](https://doi.org/10.1016/j.psychres.2022.114428).

References

- American College Health Association-National College Health Assessment. 2019a. *Undergraduate Student Reference group: Data report*. ACHA Home. https://www.acha.org/documents/ncha/NCHA-II_SPRING_2019_UNDERGRADUATE_REFERENCE_GROUP_DATA_REPORT.pdf.
- American College Health Association-National College Health Assessment. 2019b. *Graduate & Professional Student Reference groups: Data report*. ACHA Home. https://www.acha.org/documents/ncha/NCHA-II_SPRING_2019_GRADUATE_AND_PROFESSIONAL_REFERENCE_GROUP_DATA_REPORT.pdf.
- American College Health Association-National College Health Assessment. 2020. *Undergraduate Student Reference group: Data report*. ACHA Home. https://www.acha.org/documents/ncha/NCHA-III_Fall_2020_Undergraduate_Reference_Group_Data_Report.pdf.
- Blithe, S.J., Elliott, M., 2020. Gender inequality in the academy: Microaggressions, work-life conflict, and academic rank. *J. Gender Stud.* 29 (7), 751–764. <https://doi.org/10.1080/09589236.2019.1657004>.
- Browning, M.H.E.M., Larson, L.R., Sharaisvska, I., Rigolon, A., McAnirlin, O., Mullenbach, L., Cloutier, S., Vu, T.M., Thomsen, J., Reigner, N., Metcalf, E.C., D'Antonio, A., Helbich, M., Bratman, G.N., Alvarez, H.O., 2021. Psychological impact from COVID-19 among university students: Risk factors across seven states in the United States. *PLoS One* 16 (1). <https://doi.org/10.1371/journal.pone.0245327>.
- CDC. 2020 *BRFSS Questionnaire*. Centers for Disease Control and Prevention. Published 2020. Accessed August 10, 2020. <https://www.cdc.gov/brfss/questionnaires/pdf-ques/2020-BRFSS-Questionnaire-508.pdf>.
- Charles, N.E., Strong, S.J., Burns, L.C., Bullerjahn, M.R., Serafine, K.M., 2021. Increased mood disorder symptoms, perceived stress, and alcohol use among college students during the COVID-19 pandemic. *Psych. Res.* <https://doi.org/10.1016/j.psychres.2021.113706>.
- Chirikov, I., Soria, K.M., Horgos, B., Jones-White, D., 2021. Undergraduate and graduate students' mental health during the COVID-19 pandemic. *eScholarship*. <https://escholarship.org/uc/item/80k5d5hw>.
- Coduti, W.A., Hayes, J.A., Locke, B.D., Youn, S.J., 2016. Mental health and professional help-seeking among college students with disabilities. *Rehabil. Psychol.* 61 (3), 288–296. <https://doi.org/10.1037/rep0000101>.
- Cohen, S., 2021. Psychosocial vulnerabilities to upper respiratory infectious illness: implications for susceptibility to coronavirus disease 2019 (COVID-19). *Perspec. Psychol. Sci.* 16 (1), 161–174. <https://doi.org/10.1177/1745691620942516>.
- Copeland, W.E., McGinnis, E., Bai, Y., Adams, Z., Nardone, H., Devanadam, V., Rettew, J., Hudziak, J.J., 2021. Impact of the COVID-19 pandemic on college student mental health and wellness. *J. Am. Acad. Child Adolesc. Psychiatry* 60 (1), 134–141. <https://doi.org/10.1016/j.jaac.2020.08.466>.
- Dammeyer, J., Chapman, M., 2018. A national survey on violence and discrimination among people with disabilities. *BMC Pub. Health* 18 (1). <https://doi.org/10.1186/s12889-018-5277-0>.
- Eisenberg, D., Hunt, J., Speer, N., 2013. Mental health in american colleges and universities: variation across student subgroups and across campus. *J. Nerv. Ment. Dis.* 201 (1), 60–67. <https://doi.org/10.1097/NMD.0b013e31827ab077>.
- Frazier, P., Gabriel, A., Merians, A., Lust, K., 2019. Understanding stress as an impediment to academic performance. *J. Am. Coll. Health* 67 (6), 562–570. <https://doi.org/10.1080/07448481.2018.1499649>.
- Frazier, P., Liu, Y., Asplund, A., Meredith, L., Nguyen-Feng, V., N., 2021. US college student mental health and COVID-19: Comparing prepandemic and pandemic timepoints. *J. Am. Coll. Health.* <https://doi.org/10.1080/07448481.2021.1987247>.
- Fruehwirth, J.C., Biswas, S., Perreira, K.M., 2021. The COVID-19 pandemic and mental health of first-year college students: examining the effect of COVID-19 stressors using longitudinal data. *PLoS One* 16 (3). <https://doi.org/10.1371/journal.pone.0247999>.
- Gratz, K.L., Mann, A.J.D., Tull, M.T., 2021. Suicidal ideation among university students during the COVID-19 pandemic: Identifying at-risk subgroups. *Psychiatry Res.* <https://doi.org/10.1016/j.psychres.2021.114034>.
- Hamza, C.A., Ewing, L., Health, N.L., Goldstein, A.L., 2020. When social isolation is nothing new: A longitudinal study of psychological distress during COVID-19 among university students with and without preexisting mental health concerns. *Canad. Psychol.* 62 (1), 20–30. <https://doi.org/10.1037/cap0000255>.
- Hoyt, L.T., Cohen, A.K., Dull, B., Castro, E.M., Yazdani, N., 2021. “Constant stress has become the new normal”: stress and anxiety inequalities among U.S. college students in the time of COVID-19. *J. Adolesc. Health* 68 (2), 270–276. <https://doi.org/10.1016/j.jadohealth.2020.10.030>.
- Hu, Y., Qian, Y., 2021. COVID-19 and adolescent mental health in the United Kingdom. *J. Adolesc. Health* 69 (1), 26–32. <https://doi.org/10.1016/j.jadohealth.2021.04.005>.
- Huckins, J.F., daSilva, A.W., Wang, W., Hedlund, E., Rogers, C., Nepal, S.K., Wu, J., Obuchi, M., Murphy, E.L., Meyer, M.L., Wagner, D.D., Holtzheimer, P.E., Campbell, A.T., 2020. Mental health and behavior of college students during the early phase of the COVID-19 pandemic: longitudinal smartphone and ecological momentary assessment study. *J. Med. Int. Res.* 22 (6) <https://doi.org/10.2196/20185>.
- International Society for Traumatic Stress Studies, Sexual Violence Briefing Paperwork Group, 2018. *Sexual assault, Sexual abuse, and harassment: Understanding the Mental Health Impact and Providing Care For Survivors*. International Society for Traumatic Stress Studies. Published/Accessed August 3, 2021. https://istss.org/getattachment/Education-Research/Sexual-Assault-and-Harassment/ISTSS_Sexual-Assault-Briefing-Paper_FNL.pdf.aspx.
- Kattari, S.K., 2020. Ableist microaggressions and the mental health of disabled adults. *Commun. Ment. Health J.* 56 (6), 1170–1179. <https://doi.org/10.1007/s10597-020-00615-6>.
- Kecojovic, A., Basch, C.H., Sullivan, M., Davi, N.K., 2020. The impact of the COVID-19 epidemic on mental health of undergraduate students in New Jersey, cross-sectional study. *PLoS One* 15 (9). <https://doi.org/10.1371/journal.pone.0239696>.
- Kim, H.-Y., 2013. Statistical notes for clinical researchers: assessing normal distribution (2) using skewness and kurtosis. *Restor. Dent. Endodont.* 38 (1), 52–54. <https://doi.org/10.5395/rde.2013.38.1.52>.
- Lee, J., Heong, H.J., Kim, S., 2021. Stress, anxiety, and depression among undergraduate students during the COVID-19 pandemic and their use of mental health services. *Innovat. Higher Educ.* 46, 519–538. <https://doi.org/10.1007/s10755-021-09552-y>.
- Madison, A.A., Shrout, M.R., Renna, M.E., Kiecolt-Glaser, J.K., 2021. Psychological and behavioral predictors of vaccine efficacy: considerations for COVID-19. *Perspec. Psychol. Sci.* 16 (2), 191–203. <https://doi.org/10.1177/1745691621989243>.
- Meyer, I.H., 2003. Prejudice, social stress, and mental health in lesbian, gay, and bisexual populations: conceptual issues and research evidence. *Psychol. Bull.* 129 (5), 674–697. <https://doi.org/10.1037/0033-2909.129.5.674>.
- Misra, R., Castillo, L.G., 2004. Academic stress among college students: comparison of american and international students. *Intern. J. Stress Manag.* 11 (2), 132–148. <https://doi.org/10.1037/1072-5245.11.2.132>.
- Mitchell, S.L., Greenwood, A.K., Guglielmi, M.C., 2007. Utilization of counseling services: comparing international and U.S. college students. *J. College Couns.* 10 (2), 117–129. <https://doi.org/10.1002/j.2161-1882.2007.tb00012.x>.
- Mörchen, M., Kapoor, H., Varughese, S., 2020. Disability and COVID-19. *Commun. Eye Heal.* 33 (109), 10–11.
- Oswalt, S.B., Wyatt, T.J., 2011. Sexual orientation and differences in mental health, stress, and academic performance in a national sample of U.S. college students. *J. Homosex.* 58 (9), 1255–1280. <https://doi.org/10.1080/00918369.2011.605738>.
- Prowse, R., Sherratt, F., Abizaid, A., Gabrys, R.L., Hellemans, K.G.C., Patterson, Z.R., McQuaid, R.J., 2021. Coping with the COVID-19 pandemic: examining gender differences in stress and mental health among university students. *Front. Psych.* 12. <https://doi.org/10.3389/fpsy.2021.650759>.
- Robinson, J.L., Rubin, L.J., 2016. Homonegative microaggressions and posttraumatic stress symptoms. *J. Gay Lesbian Mental Heal.* 20 (1), 57–69. <https://doi.org/10.1080/19359705.2015.1066729>.
- Robinson, E., Sutin, A.R., Daly, M., Jones, A., 2022. A systematic review and meta-analysis of longitudinal cohort studies comparing mental health before versus during the COVID-19 pandemic in 2020. *J. Affect. Disord.* 296, 567–576. <https://doi.org/10.1016/j.jad.2021.09.098>.
- Silva, C., Chu, C., Monahan, K.R., Joiner, T.E., 2015. Suicide risk among sexual minority college students: A mediated moderation model of sex and perceived burdensomeness. *Psychol. Sexual Orient. Gender Divers.* 2 (1), 22–33. <https://doi.org/10.1037/sgd0000086>.
- Soria, K.M., Roberts, B. J., Horgos, B., Hallahan, K., 2020. Undergraduates' experiences during the COVID-19 pandemic: Disparities by race and ethnicity. SERU Consortium, University of California-Berkeley and University of Minnesota. <https://conservancy.umn.edu/handle/11299/218339>.
- Son, C., Hegde, S., Smith, A., Wang, X., Sasangohar, F., 2020. Effects of COVID-19 on college students' mental health in the United States: interview survey study. *J. Med. Int. Res.* 22 (9) <https://doi.org/10.2196/21279>.

- Stamarski, C.S., Hing, L.S.S., 2015. Gender inequalities in the workplace: the effects of organizational structures, processes, practices, and decision makers' sexism. *Front. Psychol.* 6 (1400) <https://doi.org/10.3389/fpsyg.2015.01400>.
- Tabachnick, B.G., Fidell, L.S., 2019. *Using Multivariate Statistics*, 7th ed. Pearson Education <https://www.pearson.com/us/higher-education/program/Tabachnick-Using-Multivariate-Statistics-7th-Edition/PGM2458367.html>.
- Trammell, J.P., Joseph, N.T., Harriger, J.A., 2021. Racial and ethnic minority disparities in COVID-19 related health, health beliefs and behaviors, and well-being among students. *J. Am. Coll. Health.* <https://doi.org/10.1080/07448481.2021.1890606>.
- Wang, X., Hegde, S., Son, C., Keller, B., Smith, A., Sasangohar, F., 2020. Investigating mental health of US college students during the COVID-19 pandemic: cross-sectional survey study. *J. Med. Int. Res.* 22 (9) <https://doi.org/10.2196/22817>.
- Wasil, A.R., Franzen, R.E., Gillespie, S., Steinberg, J.S., Malhotra, T., DeRubeis, R.J., 2021. Commonly reported problems and coping strategies during the COVID-19 crisis: a survey of graduate and professional students. *Front. Psychol.* 12 <https://doi.org/10.3389/fpsyg.2021.598557>.
- Wilson, O.W.A., Holland, K.E., Elliott, L.D., Duffey, M., Bopp, M., 2021. The impact of the COVID-19 pandemic on US college students' physical activity and mental health. *J. Phys. Activity Health* 18, 272–278. <https://doi.org/10.1123/jpah.2020-0325>.
- Wyatt, T., Oswald, S., 2013. Comparing mental health issues among undergraduate and graduate students. *Am. J. Health Educ.* 44 (2), 96–107. <https://doi.org/10.1080/19325037.2013.764248>.
- Zhai, Y., Du, X., 2020. Addressing collegiate mental health amid COVID-19 pandemic. *Psych. Res.* 288 <https://doi.org/10.1016/j.psychres.2020.113003>.