Abstract

Objective: To evaluate COVID-19 pandemic impacts on college student mental health and the relationship between pandemic behavior and mental health.

Participants: Participants included three cohorts of college students (2018 *n*=466; 2019 *n*=459; 2020, *n*=563; *N*=1488) from three American universities. Participants were 71.4% female, 67.5% White, and 85.9% first-year students.

Methods: Multivariable regression models and bivariate correlations were used to compare anxiety, depression, well-being, and search for meaning before and during the pandemic, and the relationships between pandemic health-compliance behaviors and mental health, respectively.

Results: Levels of anxiety, depression, and well-being did not differ before (2019) and during the pandemic (*P*s=.329–.837). During the pandemic, more frequent in-person social interactions were correlated with lower anxiety (*r*=-0.17, *P*<.001) and depressive symptoms (*r*=-0.12, *P*=.008), and higher well-being (*r*=0.16, *P*<.001), but also less handwashing (*r*=-0.11, *P*=.016) and face mask wearing (*r*=-0.12, *P*=.008).

Conclusions: In cross-sectional cohort analyses, we observed little evidence for pandemic-specific deleterious impacts on college student mental health. In a potential mental health-physical health tradeoff, lower compliance with some pandemic health guidelines was associated better mental health.

Key words
COVID-19; College students; Anxiety; Depression; Well-being; Social interactions; Health tradeoffs

COVID-19 Pandemic Effects on College Student Mental Health: A Cross-Sectional Cohort Comparison Study

The COVID-19 pandemic and associated public health responses have disrupted or significantly altered many features of college life, especially social elements. Virtual learning and the cancellation of campus-wide activities have not only limited social interactions, but also opportunities for students to express interests, talent, and leadership. These changes may have impacted students' ability to foster supportive social bonds and fulfill other key developmental needs.[1,2] As a result, researchers and clinicians have raised alarms about the potential for the pandemic to negatively affect the mental health of college students. However, data on the pandemic effects on college student mental health are inconclusive,[3–5] and few studies have looked at how compliance with public health recommendations to restrict social behaviors during the pandemic was associated with college students' mental health.[6]

In this paper, we explore cohort-related differences in college student mental health and well-being in the years just before (Fall 2018 and 2019) and during the post-acute phase of the COVID-19 pandemic (Fall 2020), and the associations between compliance with public health recommendations during the pandemic (e.g., face mask wearing, handwashing, limiting in-person interactions) and mental health. Our research questions were:

1. Was the pandemic associated with worse mental health and well-being?
2. If so, were these changes indicative of a continuation of pre-pandemic rates of worsening college student mental health or an acceleration of pre-pandemic trends?
3. What were the relationships between compliance with public health recommendations and mental health and well-being among college students during the pandemic?

Background

The transition from high school to postsecondary education represents a developmental milestone for the approximately 48% of American students who enroll in higher education and for many more adolescent around the world.[7] The challenges of this transition can impact mental health. College students must learn to negotiate the academic rigor of postsecondary education while forming new social relationships and making healthy lifestyle choices (e.g., sleep patterns). Peer and non-parental adult support become increasingly focal and fulfill a larger portion of attachment needs.[8,9] Navigating new social relationships independently from parents or caregivers while developing a healthy identity within immediate and larger social spheres are important developmental milestones during this period.[10] Before the pandemic, many college students found this transition stressful, making them susceptible to increased mental health problems.[11]

Mental health can be defined as the absence of distress and the presence of well-being (e.g., life satisfaction, purpose).[12] Rates of college student stress, anxiety, and depression have significantly increased to alarming levels over the past decade while levels of well-being have declined.[13] The emergence or worsening of mental health problems during adolescence and young adulthood can impact college achievement and completion, as well as labor market outcomes later in life.[14,15] The COVID-19 pandemic and the significant alterations to college students lives resulting from it have led to concerns about the potential consequences on the mental health and well-being of this group.

Research on College Student Mental Health

A number of recent studies have documented high levels of college student stress, anxiety, and depression during the pandemic, both in American and internationally[16–19], leading to the conclusion that the pandemic has had deleterious effects on college student mental health

and well-being. However, understanding the impacts of the pandemic on college students' mental health is more complicated than it might initially appear. In America, college student mental health has been deteriorating for at least a decade, with evidence for rapid deterioration beginning around 2016.[13] Moreover, college student mental health on average declines during college, particularly across the first year.[20] Thus, regardless of any potential pandemic-related toll on mental health, college students in 2020 and 2021 would have been predicted to report greater mental health challenges than their predecessors in 2019, 2018, and before. Estimating pandemic impacts on mental health must therefore account for pre-pandemic trends in worsening mental health in some fashion – for example through longitudinal research or different kinds of cohort studies (or blends of both) that address historical trends.[21]

Additionally, decrements in mental health during the initial phase of the pandemic that involved massive disruption to daily activities through lockdowns and forced social isolation may have been transient. For example, there is evidence that increases in obsessive-compulsive symptoms observed during the peak of the pandemic mostly waned over time.[22] Either because students adapted to their new conditions or because within a matter of months routines began to return to a modified sense of normal (e.g., virtual classes), pandemic impacts may have attenuated. Alternatively, it is possible that the continual uncertainty posed by the pandemic, for example the dashed relief when an ebb in transmission was overrun by a new wave of infection, exacerbated pandemic-related decrements in mental health. Therefore, when attempting to estimate pandemic impacts on college student mental health, it is crucial that pre-pandemic trends are taken into consideration as well as the phase or phases of the pandemic during which the data was collected. Leveraging data collected from three universities across three years as

well as published longitudinal records of college student mental health (see Figure 1 for study timeline), we attempt to that in this study (see Figure 2).

Evidence for Pandemic Effects on College Student Mental Health

The evidence for initial pandemic phase negative impacts on college student mental health is equivocal. For example, a single timepoint study conducted during the initial phase of the pandemic asked 195 American college students to report on their current and retrospect on their pre-COVID-19 levels of internalizing symptoms as well as health behaviors (e.g., sleep routines). Participants reported substantial increases in stress, anxiety, and sleep disturbances, with fewer impacts on depressive symptoms.[19]

A large survey of first- and second-year students on eight American campuses examined the comparative prevalence of clinical disorders immediately before and during the initial months of the pandemic found evidence that some disorders showed small increases (e.g., major depressive disorder) and others did not (anxiety).[23] Another study also conducted during the initial phase of the pandemic in a sample of 2031 undergraduate and graduate students from a single American university reported high prevalence of moderate or greater anxiety (38.5%) and even higher prevalence of moderate or greater depression (48.1%),[24] using the standard Generalized Anxiety Disorder-7[25] and Primary Health Questionnaire-9 cut-points of 10, respectively.[26] Although reported prevalence rates are high, they are in line with extrapolated projections based on trend analyses of a decade or more of the Healthy Minds Study data (2007 – 2018), a large national survey of college student functioning.[13]

Copeland et al.[18] assessed 675 American college students just before and again in the early phase of the pandemic (late spring 2020). Students reported significant average increases in externalizing (e.g., anti-social behaviors) and attention problems, but surprisingly not in stress,

anxiety, or depression. However, experience sampling data showed a deterioration in mood and well-being. Fruehwirth et al.[27] surveyed first-year college students before and during the early phase of the pandemic (i.e., June/July 2020) and observed notable increases in moderate to severe anxiety and depressive symptoms. Although these studies benefit from longitudinal assessment within participants, the findings regarding mental health are inconsistent. It remains possible that observed impacts on mental health could reflect a transient perturbation (rather than persistent change) due to the multiple social and psychological changes characteristic of the early phase of the pandemic. Consistent with this possibility, some data suggest that negative mental health effects occurring during this phase of the pandemic attenuated as the most stringent public health restrictions began to relax and individuals became habituated to new social norms.[28]

Since 2009, Pennsylvania State University's Center for Collegiate Mental Health has been aggregating Counseling Center Assessment of Psychological Symptoms data from mental health service seeking college students nationwide.[29] Comparing data from the 2019-2020 academic year that included the onset of the pandemic in March 2020 to the prior year, the center reported no substantive differences in mental health trajectories over the course of the academic year or when comparing average symptom levels before and during the pandemic.[30] In a more recent analysis that includes fall 2021 data, the Center reported mostly small increases in various dimensions of distress (e.g., anxiety, social anxiety, depressive symptoms) relative to earlier fall semester, including fall 2020, that were in-line with pre-pandemic trends.[31]

The reviewed data paint a concerning picture of college student mental health. They do not, however, clearly identify the pandemic as a major contributor to the observed trends. Duffy and colleagues[13] analyzed more than a decade worth of data from two large (more than 800,000 students in total), nationally representative surveys of American college students. The data, all

collected before the pandemic, are a clarion call. Rates of severe depression (+34% to 125%), anxiety (+24% to 86%), self-harm (+47% to 142%), and seriously considering suicide (76% to 154%) all increased markedly across the survey period in both datasets, with particularly steep increases over more recent years. There is ample cause to be concerned about further deteriorations in mental health as a consequence of the pandemic, but informing best prevention and treatment approaches as well as understanding potential areas of resilience among college students requires that pandemic-specific effects are isolated from pre-pandemic trends and understanding more about the relationships between college student behaviors during the pandemic and their mental health and well-being.

Current Study

In this study, we seek to add clarity regarding pandemic-specific effects on college student mental health and well-being by leveraging data collected from three cohorts of undergraduate students at three large American universities in Fall 2018 (*n*=466) and 2019 (*n*=459) before the pandemic, and in Fall 2020 (*n*=563), the first full semester during the pandemic, representing the post-acute phase of pandemic. Specifically, we compare depression, anxiety, well-being, and search for meaning in life (a predictor of later depressive symptoms) between the pre-pandemic 2019 cohort and the 2020 pandemic cohort. To descriptively evaluate whether there is evidence for pandemic-related accelerations in worsening college student mental health, we plot our data as a continuation of long-term trends in anxiety (2013 to 2017-2018), depression (2007 to 2017-2018) and well-being (2012 to 2017-2018) reported in Duffy et al.[13] Finally, in the pandemic cohort, we look at the correlations between handwashing, facemask wearing, in-person social interactions, social videoconferencing, and mental health outcomes to help understand associations between health behaviors during the pandemic and mental health.

All years of data were collected in August/September at the beginning of the respective fall semester in predominately first-year college students (85.9% first-year) at the same universities. As a result, these data provide controlled comparisons of before and during pandemic mental health that avoid several important confounds (e.g., typical mental health deterioration that occurs during college, university context).

Materials and Methods

Procedure

These data are drawn from a multi-year quasi-experimental propensity-score matched study of a novel credit-bearing course on college student well-being.[32] Students who enrolled in this course were recruited to participate in research via email and an in-class announcement. Separately, general population undergraduate students were recruited via email to participate in a study on the college student well-being. Recruitment occurred independently at each of the three universities, following the same basic procedures across universities and years, and was focused on first-year college students. Emails were sent during the first and second week of Fall semester, with the enrollment and testing window open for approximately two-weeks.

Interested students clicked a link in the recruitment email that directed them to a Qualtrics web survey. After passing the prescreen (>18 years of age), participants were required to provide consent before advancing to the survey. Measures were presented in the same order for all participants. Different compensation strategies were used across years. Participants were compensated $20 (2018 and 2020) or entered into a lottery for one of 12 $200 awards (2019; each university had a separate lottery) for completing participation. All procedures and study materials were approved by each university's respective ethics board. A Certificate of Confidentiality was obtained to protect participant privacy. Due to complications arising from

multiple university ethics boards, data is not publicly available.

Statistical Analysis

Power

Sampling occurred based on a 3:1 control group to anticipated course enrolled sample to allow nearest neighbor propensity-score matching in the parent study. Although in the parent study we planned to use Hierarchal Linear Models (HLM), power analysis in HLM is complicated by the need to estimate variance at multiple levels of the model. Therefore, using G*Power[33], we instead estimated the sample required to detect a statistically significant ($P<.05$) small magnitude (i.e., Cohen's $d=0.20$) between group pre-post difference in a mixed ANOVA, resulting in a target sample of $n=200$ per study wave. To account for the fact that some outcome variance in HLM models is likely be explained by the cluster, we oversampled by allowing all interested and eligible course enrolled students to participate and set a quota on control group enrollment based on the anticipated course enrolled student enrollment (usually, the control group was restricted to no more than 200 per university each year). The present analyses made use of baseline data and includes all participants (i.e., all control group participants before propensity-score matching).

Primary Analyses

We used multivariable regression analyses to compare levels of anxiety, depression, well-being, and search for meaning in life before (2018 $n=466$; 2019 $n=459$) and during the pandemic (2020, $n=563$; $N=1488$), controlling for undergraduate year, gender, race, and university, with the contrast between the 2019 pre-pandemic and 2020 post-acute pandemic phase cohorts of primary interest. Significant differences between the 2019 and 2020 cohorts indicate significant worsening that might reflect impacts of the pandemic. For reference, we also report statistically

significant pre-pandemic 2018 to 2019 cohort differences. Significant 2018 to 2019 cohort contrasts suggest that a statistically significant worsening trajectory existed before the COVID-19 pandemic. We avoided aggregating pre-pandemic 2018 and 2019 cohorts and contrasting them combined with the pandemic cohort because doing so has the potential to conflate pre-pandemic worsening from 2018 to 2019 (which is expected based on historical trends) as pandemic impacts. A model-based Cohen's *d* or Odds ratio (*OR*) and corresponding 95% confidence interval (CI) is provided as metrics of an effect's magnitude and variability for continuous or dichotomous outcomes, respectively.[34] We plot trends in anxiety and depression, well-being, moderate or greater and severe anxiety and depression, and low well-being as an extension of Duffy et al.s[4] report to descriptively evaluate whether our data appear consistent with or an acceleration of pre-pandemic trends in deteriorating college student mental health.

In addition, we estimated Pearson correlation matrices to examine the relationships between compliance with public health guidelines and social behaviors (e.g., facemask wearing, handwashing, limiting in-person social interactions, social videoconferencing) and mental health and well-being outcomes in the pandemic cohort. We follow correlation analyses with multivariable regression to determine which pandemic behaviors were associated with significant unique variance in mental health and well-being outcomes controlling for the others.

We first examined descriptive statistics on each outcome to ensure they were normally distributed. Because some respondents may demonstrate inattentive responses on survey items that compromise the quality of the data, we examined data quality in several ways. First, we computed internal consistencies statistics as noted below. Second, using the careless package in R[35] we examined indices of potentially inattentive responding, observing little cause for concern (i.e., 0.3% of respondents exhibited patterns that may indicate inattentive response patterns).

Finally, regression diagnostics (e.g., qqplots, Cook's d>1.00)) were used to identify potential high leverage points (i.e., outliers). None were identified. Questions assessed later in the survey had more missingness, suggesting missing data was the result of survey fatigue and not response bias associated with avoiding certain items (e.g., depressive symptoms). We used complete case analysis because missingness was low, ranging from 0.10% to 5.91% per outcome. All analyses were conducted in R version 4.0.0. Statistical significance was set at a two-sided P-value<0.05.

Instruments

The Generalized Anxiety Disorder-7 (GAD-7)[25] is a clinically validated assessment of anxiety symptoms. Scale score reliability was high in all cohorts (all αs =.90). We use the standardized dichotomous cut-points of 10 for moderate or greater and 15 for severe anxiety.[13,25] In 2019, due to experimenter error the GAD-7 was collected at two of three universities.

The Primary Health Questionnaire-8 (PHQ-8)[26,36] is a clinically validated assessment of depressive symptoms. We rescaled cut-points on the PHQ-8 to make them consistent with the parent PHQ-9. Specifically, we used standardized dichotomous cut-points of 8.88 (i.e., 10 on the PHQ-9) for moderate or greater and 13.32 (i.e., 15 on the PHQ-9) for severe depression.[26] The PHQ-9 has evidenced 88% sensitivity and 88% specificity for depression at a cut-off of 10.[26] Scale score reliability was high in all cohorts (αs = .89, .86 & .87, respectively).

The Pemberton Happiness Index (PHI)[37] operationalizes well-being according to Seligman's (2011) **p**ositive emotions, **e**ngagement, supportive **r**elationships, **m**eaning, and **a**ccomplishment (PERMA) model.[2] Scale scores showed high reliability in all cohorts (αs = .90, .93, & .91, respectively). Item responses range from 1 (totally disagree) to 10 (totally agree) with higher scores representing greater well-being. We followed the approach described in Duffy et

al.[13] by categorizing participants scoring one standard deviation below their cohort mean as reporting “low well-being”.

The Search subscale of the Meaning in Life Questionnaire (MLQ)[38] assesses the active pursuit of meaning in life through three items. Reliability was adequate in all cohorts (αs = .84 .82, & .88, respectively). A higher score represents greater search for meaning and has been associated with fear, sadness, and depression.[24]

Social and health compliance behaviors were assessed with an adapted, six item version of Everett and colleagues[39] scale. Three items asked the frequency (1 = rarely, 4 = occasionally, 7 = frequently) with which participants had 1) entirely stayed home; 2) had in-person social interactions; and 3) used video conferencing for social purposes. Three additional items asked about the frequency of handwashing, facemask wearing, and social distancing.

Results

Participants

Descriptive statistics on all measures and full demographics by cohort are presented in Table 1. 2018, 2019, and the 2020 pandemic cohort were predominately female (77.7%, 71.0%, & 66.1%, respectively), White (71.2%, 65.4%, & 65.2%, respectively), and first-year college students (96.1%, 76.3%, & 85.1%, respectively).

Cohort Contrasts of Average Levels of Anxiety, Depression, Well-Being, and Search for Meaning in Life

Full results of regression models are presented in Table 2. The 2020 pandemic cohort reported significant higher levels of search for meaning in life (+4.8%, P=.014, d=0.15 95% CI [0.03, 0.28]) compared to the 2019 cohort. As noted, higher search for meaning has been associated with future depressive symptoms.[38] There were no differences between the pandemic

and pre-pandemic 2019 cohorts on anxiety or depressive symptoms, or well-being (*P*s>.300). The pre-pandemic 2019 cohort reported significantly worse depressive symptoms (+14.9%, *P*=.019, *d*=0.15 CI[0.03, 0.28]) and well-being (-4.1%, *P*=.042, *d*=0.13 CI[-0.26, -0.01]) than the pre-pandemic 2018 cohort, indicating that statistically significant worsening trends existed prior to the pandemic.

Cohort Contrasts of Prevalence of Moderate or Greater and Severe Anxiety and Depression, and Low Well-Being

Full regression model results are presented in Table 3. There were no differences between the 2020 pandemic and pre-pandemic 2019 cohorts in the prevalence of moderate or greater anxiety (31.5% and 27.9%, respectively; *P*=.351, *OR*= 0.84 CI[0.58, 1.21]) or depression (32.9% and 38.3%, respectively; *P*=.130, *OR*=1.26, CI[0.95, 1.67]), low well-being (18.1% and 17.7%, respectively; *P*=.753, *OR*=0.051 CI[0.75, 1.47]), severe anxiety (12.2% and 8.6%, respectively; *P*=.100, *OR*=1.64 CI[0.94, 2.99]), or severe depression (14.6% and 15.0%, respectively; *P*=.881, *OR*=1.00 CI[0.68, 1.47]). The pre-pandemic 2019 cohort reported a significantly higher prevalence of low well-being (17.7%) than the pre-pandemic 2018 cohort (13.7%; *P*=.031, *OR*= 1.46 CI[1.04, 2.07]), indicating that greater numbers of college students were reporting low well-being over the two years (2018 and 2019) prior to the pandemic.

Descriptive Trends in College Student Mental Health

Average anxiety symptoms (2018 *M*=13.47; 2019 *M*=13.82; 2020 *M*=14.16) as well as the proportion of students reporting moderate or greater anxiety (2018 22.79%; 2019 27.93%; 2020 31.53%), and low flourishing (2018 13.74%; 2019 17.69%; 2020 18.06%) increased each year across our data. Average depressive symptoms (2018 *M*=16.25; 2019 *M*=17.33; 2020 *M*=17.07) and the proportion of the students reporting severe depressive symptoms (2018

11.04%; 2019 15.02%; 2020 14.64%) were higher in 2019 than in 2018 and 2020 (during the pandemic). The proportion of students reporting severe anxiety symptoms (2018 11.95%; 2019 8.56%; 2020 12.19%) and average search for meaning in life (2018 *M*=3.86; 2019 *M*=3.77; 2020 *M*=3.95) declined in 2019 relative to 2018, then increased in the 2020 pandemic cohort above 2018 levels.

Visualized as a continuum of published long-term trends on these outcomes (Figure 2), our 2018 cohort began less symptomatic than the Healthy Minds Survey sample of 2017. However, trajectories over time look similar, with trends in both datasets showing a consistent longitudinal increase in symptoms and lower well-being, with no indication of a pandemic-specific discontinuity or spike in the trajectory of any outcome.

Bivariate and Multivariate Associations Between Social and Health Behaviors and Mental Health during the Pandemic

Small, significant bivariate correlations were found between higher frequency of in-person social interaction and lower anxiety and depressive symptoms (*r*=-0.17, *P*<.001 and *r*=-0.12, *P*=.008), and higher well-being (*r*=0.16, *P*<.001; Table 4). More social video conferencing was correlated with higher well-being (*r*=0.11, *P*=.010). Higher levels of in-person social interaction were also correlated with less handwashing (*r*=-0.11, *P*=.016), facemask wearing (*r*=-0.12, *P*=.008), and social distancing (*r*=-0.27, *P*<.001; Table 4).

To determine whether specific behaviors were uniquely associated with mental health outcomes, in exploratory analyses we simultaneously regressed frequency of in-person social interactions, social video conferencing, and staying at home along with standard covariates onto anxiety, depression, and well-being. Frequency of in-person social interactions explained significant unique variance in anxiety and depressive symptoms (*b*=-0.58, *P*<.001 and *b*=-0.41,

P=.004, respectively) moderate or greater anxiety and depression (*b*=-0.25, *P*<.001 and *b*=-0.12, *P*=.048, respectively) and severe anxiety *b*=-0.22, *P*=.013. Frequency of in-person social interactions and social video conferencing were significantly associated with greater well-being (*b*=0.12, *P*=.003 and *b*=0.10, *P*=.012, respectively), but only social videoconferencing explained significant unique variance in the prevalence of low well-being (*b*=-0.13, *p*=.037).

Discussion

Researchers, clinicians, and policy makers have voiced concern about the potential impacts of the COVID-19 pandemic on the mental health of college students, a group that has evidenced a steady and substantial decline in mental health over recent decades.[13] Leveraging data (*N*=1488) collected at three universities in different geographic regions of the United States (Northeast, Southeast, and Upper Midwest) from two cohorts before (Fall 2018 and 2019) and one during the pandemic (Fall 2020), we find little evidence of pandemic-specific increases in anxiety or depression, or decrements to well-being. The pandemic cohort did demonstrate statistically significantly higher search for meaning in life, which in prior research was associated with higher levels of fear, sadness, and depression.[38] We caution against making the same inference based on elevated scores in the 2020 cohort. While these scores may indicate risk for poorer future mental health, higher search for meaning in life among college students adjusting to a new phase of life during unprecedented global events can also be viewed as adaptive. When we examined long-term trajectories of symptoms in our data plotted as a continuation of 2007-2017 trendlines (Figure 2),[13] the pattern that emerged was one of continuation rather than an acceleration of pre-pandemic trends in deteriorating mental health.

Although comparisons within our data and between our data and preceding trends provide little evidence for pandemic-specific worsening in college student mental health, these

data do not allow the conclusion that the pandemic has not affected college student mental health. Our data was sampled from three large American research universities and may not be broadly representative of American college students, or college students internationally. Second, our sample was predominately first-year college students. It is possible that the pandemic affected college students differentially based on their year. If later year college students were more affected by the pandemic, our data would be unlikely to demonstrate this effect. For example, college seniors may have experienced greater distress than first-year students because the massive impacts of the pandemic on future job prospects was more salient. Finally, with respect to plotting our data as a continuation of decades long pre-pandemic trends in college student low well-being, our measure of well-being, while conceptually consistent, was different than the one used in the Healthy Minds Survey. In addition, though long-term symptom trendlines were consistent, our samples were relatively less symptomatic than Healthy Minds Survey samples. This may be the result of sampling differences between the datasets. For instance, college student mental health generally decreases over time. Our sample was predominately first-year students whereas the Healthy Minds Survey sample was older (<30% first-year) and included graduate students, which may have led to higher levels of symptoms in the Healthy Minds Survey.

In light of evidence for deleterious pandemic effects on mental health in the general public,[40,41] what might explain these findings? Data from later phases of the pandemic suggest that initial decrements to mental health, for many, recovered over time.[28] Most studies reporting negative pandemic impacts on student mental health were conducted in the early phase of the pandemic. Therefore, one possible explanation is that college student trajectories were already trending toward worse mental health and these trendlines were generally unaffected by the

pandemic. A compatible explanation is that being a college student conferred mental health benefits during the pandemic. Although important features of college continued to be impacted, students maintained core academic routines (though sometimes virtually) with greater opportunities for socialization than many other Americans (i.e., dorm life, roommates, dining halls, classes). It is also possible that being in the early years of college, as most of our sample was, may have mitigated stress associated with the pandemic labor market.

The observed correlations between social and health behaviors and mental health suggests that the relative resilience demonstrated in our sample may be related to a mental health – physical health risk tradeoff. Colleges and universities, including the ones involved in this research, have experienced waves of significant COVID-19 outbreaks among undergraduates, often precipitated by non-compliance with public health guidelines. In the 2020 pandemic cohort, higher levels of in-person social interaction were associated with lower anxiety and depressive symptoms and higher well-being. Conversely, those staying home more had higher anxiety symptoms. Social distancing, facemask wearing, and handwashing were each negatively correlated with in-person social interactions, raising the specter that social behaviors risky to physical health during a pandemic may have supported mental health. College students therefore might have been making tradeoffs during this time, perhaps to maintain their mental health.

There are important limitations to note in this study. First, the three universities participating in this research are large research institutions and do not represent the diversity of college institutions or student bodies, limiting the generalizability of these results. Second, convenience sampling may lead to non-representative samples. Third, although our sample was larger than many of the samples upon which conclusions about deleterious pandemic effects on mental health have been made, it will be important to use longitudinal or cross-sectional cohort

data in larger, more representative samples of college student to gain further insight into trajectories of college student mental health and the COVID-19 pandemic's effects on those trajectories. Fourth, cross-sectional cohort comparison designs cannot establish causal effects. Had we found significant worsening in the pandemic cohort, we would not have been able to conclude the pandemic was the cause. Similarly, the absence of significant differences or descriptive evidence indicating a more rapid worsening of mental health in the pandemic cohort does not warrant the conclusion that the pandemic had no effect on college student mental health.

Conclusions

Leveraging data on two cohorts of college students collected before than pandemic and one collected during the post-acute phase of the pandemic (Fall 2020), our central questions were whether mental health and well-being on average were worse during the pandemic compared to the pre-pandemic cohort of the year before, and whether any worsening in mental health during the pandemic reflected a continuation or pre-pandemic worsening trends in mental health or a pandemic-related acceleration of them. We observed little evidence for significantly worse mental health in the pandemic cohort, and trajectories of worsening from the pre-pandemic 2019 to pandemic cohort appeared consistent with previously identified long-term worsening trends in college student mental health.[13] These results add to research conducted before the COVID-19 pandemic highlighting the need for postsecondary education to focus attention and resources on student mental health. College students are arriving on campuses with high prevalence rates of anxiety and depressive symptoms, low well-being, and during the pandemic, less certainty about their purpose and meaning in life – which under the circumstances may be adaptive but also may portend higher rates of depressive symptoms in the future. Postsecondary institutions will need to marshal considerable resources and ingenuity to address the ongoing deterioration of student

mental health while balancing students' needs for in-person interaction and its apparent benefits to mental health against the equally important imperative to maintain public health.

Table 1.

Descriptive Statistics for Students' Demographic and Mental Health Characteristics by Cohort (Means, SDs or Percentages)

	2018	2019	2020	Equivalence Between Cohorts
Gender *No.* (%)				
Male	104 (22.3)	126 (27.5)	182 (32.3)	
Female	362 (77.7)	326 (71.0)	372 (66.1)	$\chi^2(2) = 35.73$,
Non-binary or Other	NA	5 (1.1)	9 (1.6)	$p < .0001$
Race *No.* (%)				
Asian / Pacific Islander	66 (14.2)	76 (16.6)	102 (18.1)	
Black	20 (4.3)	18 (3.9)	24 (4.26)	
Hispanic / Latinx	14 (3.0)	19 (4.1)	14 (2.5)	$\chi^2(8) = 9.24$,
Mixed or Other	32 (6.9)	39 (8.5)	56 (10.0)	$p = .322$
White	332 (71.2)	300 (65.4)	367 (65.2)	
Undergraduate year *No.* (%)				
First	448 (96.1)	350 (76.3)	479 (85.1)	
Second	9 (1.9)	32 (6.8)	34 (6.0)	$\chi^2(6) = 88.43$,
Third	7 (1.5)	53 (11.5)	23 (4.1)	$p < .0001$
≥ Fourth	2 (<1.0)	24 (5.2)	27 (4.7)	
Anxiety Symptoms				
Mean (*SD*)	6.47 (5.39)	6.82 (5.17)	7.15 (5.58)	
Moderate Anxiety *No.* (%)	103 (22.8)	62 (27.9)	163 (31.5)	
Severe Anxiety *No.* (%)	54 (11.9)	19 (8.6)	63 (12.2)	
Depressive Symptoms			7.97 (5.97)	
Mean (*SD*)	7.16 (5.99)	8.23 (5.84)		
Moderate Depression *No.* (%)	144 (31.8)	171 (38.3)	171 (33.0)	
Severe Depression *No.* (%)	50 (11.0)	67 (15.0)	76 (14.6)	
Well-being				
Mean (*SD*)	7.37 (1.38)	7.07 (1.52)	7.04 (1.62)	
Low well-being *No.* (%)	242 (53.5)	102 (45.9)	244 (47.2)	
Search for meaning in life				
Mean (*SD*)	3.85 (1.01)	3.77 (0.96)	3.95 (1.06)	

For analyses, gender was dichotomized to a binary male/female variable due to the low number of gender "Non-binary or Other" reporting participants. Greater numbers of non-first-year students in 2019 and 2020 were expected based on differences in enrollment rules for the flourishing course.

Table 2.

Mental Health Outcomes (Continuous Measures): Multivariable Regression Standardized Betas (SE), and Significance Values

	Anxiety		Depression		Well-Being		Search for Meaning	
	B (SE)	***p***	***B (SE)***	***p***	***B (SE)***	***p***	***B (SE)***	***p***
Cohort								
2018	-0.43 (0.47)	.351	**-0.87 (0.37)**	**.019**	**0.22 (0.11)**	**.042**	0.06 (0.07)	.408
2020	0.44 (0.45)	.329	-0.22 (0.36)	.539	0.02 (0.11)	.837	**0.17 (0.07)**	**.016**
Gender								
Female	**2.11 (0.36)**	**<.001**	1.21 (0.33)	.326	-0.03 (0.10)	.734	**0.20 (0.06)**	**.001**
Race								
Asian/Pacific Islander	-0.31 (0.43)	.471	-0.22 (0.40)	.568	-0.52 (0.12)	**<.001**	0.13 (0.07)	.072
Black	0.07 (0.80)	.927	0.47 (0.74)	.527	-0.11 (0.22)	.609	0.01 (0.14)	.967
Hispanic / Latinx	0.56 (0.89)	.531	0.34 (0.81)	.671	-0.17 (0.24)	.467	0.06 (0.15)	.701
Mixed or Other	-0.02 (0.57)	.973	0.73 (0.52)	.161	-0.23 (0.15)	.141	0.09 (0.15)	.373
Undergraduate year								
Second	-0.43 (0.94)	.645	0.58 (0.71)	.413	**-0.50 (0.21)**	**.017**	-0.02 (0.13)	.847
Third	0.61 (1.06)	.565	1.26 (0.68)	.060	-0.19 (0.20)	.346	0.08 (0.13)	.521
≥ Fourth	0.13 (1.14)	.911	1.09 (0.83)	.189	**-0.72 (0.24)**	**.003**	-0.05 (0.15)	.744
University								
B	0.01 (0.53)	.989	-0.04 (0.42)	.914	0.10 (0.12)	.409	-0.05 (0.08)	.589
C	-0.30 (0.37)	.409	0.33 (0.36)	.355	-0.08 (0.11)	.460	0.04 (0.07)	.569

Reference cohort is 2019, gender is male, race is White, undergraduate year is first-year, and university is a. Anxiety was assessed with the GAD-7.[25] Depression was assessed with the PHQ-8.[36] Well-being was assessed with the PHI.[37] Search for meaning in life was assessed with the MLQ.[38]

Table 3.

Mental Health Outcomes (Prevalence Measures): Multivariable Logistic Regression

Standardized Betas (SE) and Significance Values

	Moderate or Greater Anxiety		Severe Anxiety		Moderate or Greater Depression		Severe Depression		Low Well-Being	
	B (*SE*)	*p*	*B* (*SE*)	*p*	*B* (*SE*)	*p*	*B* (*SE*)	*p*	*B* (*SE*)	*p*
Cohort										
2018	-0.38 (0.20)	.060	0.42 (0.30)	.162	-0.25 (0.15)	.093	-0.27 (0.21)	.206	**-0.38 (0.18)**	**.031**
2020	0.187 (0.19)	.357	0.50 (0.29)	.093	-0.23 (0.15)	.116	< -0.01 (0.20)	.983	-0.05 (0.17)	.771
Gender										
Female	**0.51 (0.16)**	**.002**	**0.99 (0.27)**	**< .001**	**0.42 (0.14)**	**.002**	0.37 (0.19)	.051	**0.67 (0.14)**	**< .001**
Race										
Asian / Pacific Islander	-0.13 (0.19)	.491	-0.37 (0.30)	.208	-0.11 (0.16)	.499	0.14 (0.22)	.533	-0.01 (0.16)	.970
Black	-0.22 (0.35)	.528	0.46 (0.42)	.275	0.41 (0.28)	.153	0.48 (0.37)	.197	0.15 (0.31)	.619
Hispanic / Latinx	-0.04 (0.38)	.911	0.30 (0.50)	.544	0.33 (0.31)	.290	0.32 (0.43)	.452	0.45 (0.35)	.192
Mixed or Other	-0.04 (0.24)	.865	0.24 (0.32)	.456	0.11 (0.21)	.591	**0.72 (0.25)**	**.004**	-0.09 (0.21)	.685
Undergraduate year										
Second	-0.30 (0.38)	.426	-0.12 (0.54)	.817	0.08 (0.28)	.782	-0.07 (0.40)	.856	0.02 (0.36)	.952
Third	-0.02 (0.42)	.935	0.63 (0.52)	.227	0.39 (0.26)	.142	**0.82 (0.32)**	**.012**	0.14 (0.41)	.741
≥ Fourth	-0.26 (0.47)	.574	-0.45 (0.79)	.568	0.39 (0.32)	.230	0.20 (0.43)	.653	-0.10 (0.43)	.814
University										
b	0.28 (0.22)	.208	-0.20 (0.30)	.516	<0.01 (0.17)	.980	-0.04 (0.24)	.871	0.24 (0.20)	.228
c	-0.26 (0.47)	.575	-0.10 (.22)	.655	0.15 (0.15)	.300	0.07 (0.40)	.725	0.02 (0.36)	.814

Reference cohort is 2019, gender is male, race is White, undergraduate year is first-year, and university is a. Anxiety was assessed with the GAD-7[25] at cut points of 10 for moderate or greater and 15 for severe anxiety symptoms. Depression was assessed with the PHQ-8[36] at cut points of 10 for moderate or greater and 15 for severe depressive symptoms. Well-being was assessed with the PHI[37] with scores one standard deviation below the mean representing low well-being (e.g., Duffy et al.'s[13]).

Table 4.

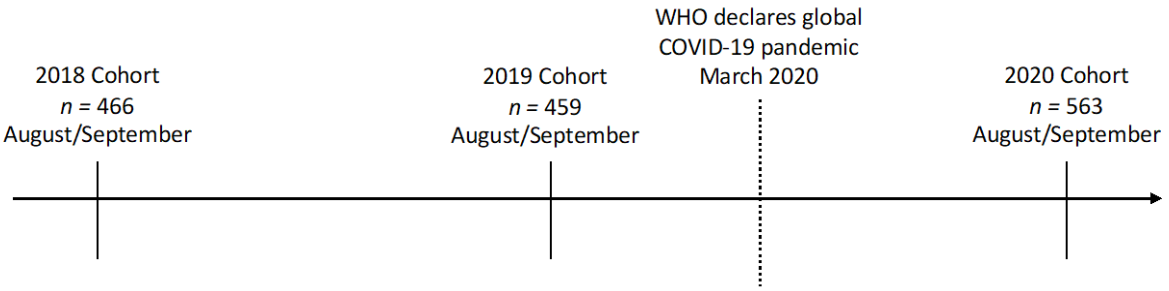
Correlations Matrix of College Student Public Health Recommended Behaviors and Mental Health During the COVID-19 Pandemic

	1	2	3	4	5	6	7	8	9
1. Hand washing	–								
2. Face mask usage	0.26***	–							
3. Stayed home	0.19***	0.18***	–						
4. Social distancing	0.19***	0.21***	0.29***	–					
5. In-person interactions	-0.11*	-0.12**	-0.50***	-0.27***	–				
6. Social video conferencing	0.16***	0.12**	0.03	0.15***	0.00	–			
7. Anxiety symptoms	0.07	0.00	0.12**	0.04	-0.17***	0.03	–		
8. Depressive symptoms	0.00	-0.05	0.07	-0.04	-0.12**	0.00	0.70***	–	
9. Well-being	0.04	-0.02	-0.07	0.01	0.16***	0.11*	-0.50***	-0.64***	–
10. Search for Meaning	0.09*	0.03	-0.01	-0.03	0.03	0.02	0.22***	0.22***	-0.15***

Anxiety symptoms are average symptom levels as assessed on the GAD-7.[25] Depressive symptoms are average symptoms as assessed by the PHQ-8.[36] Well-being was assessed with the PHI.[37] Search for meaning in life is a subscale of the MLQ.[38] *P<0.05, **P<0.01, ***P<0.001

Figure 1.

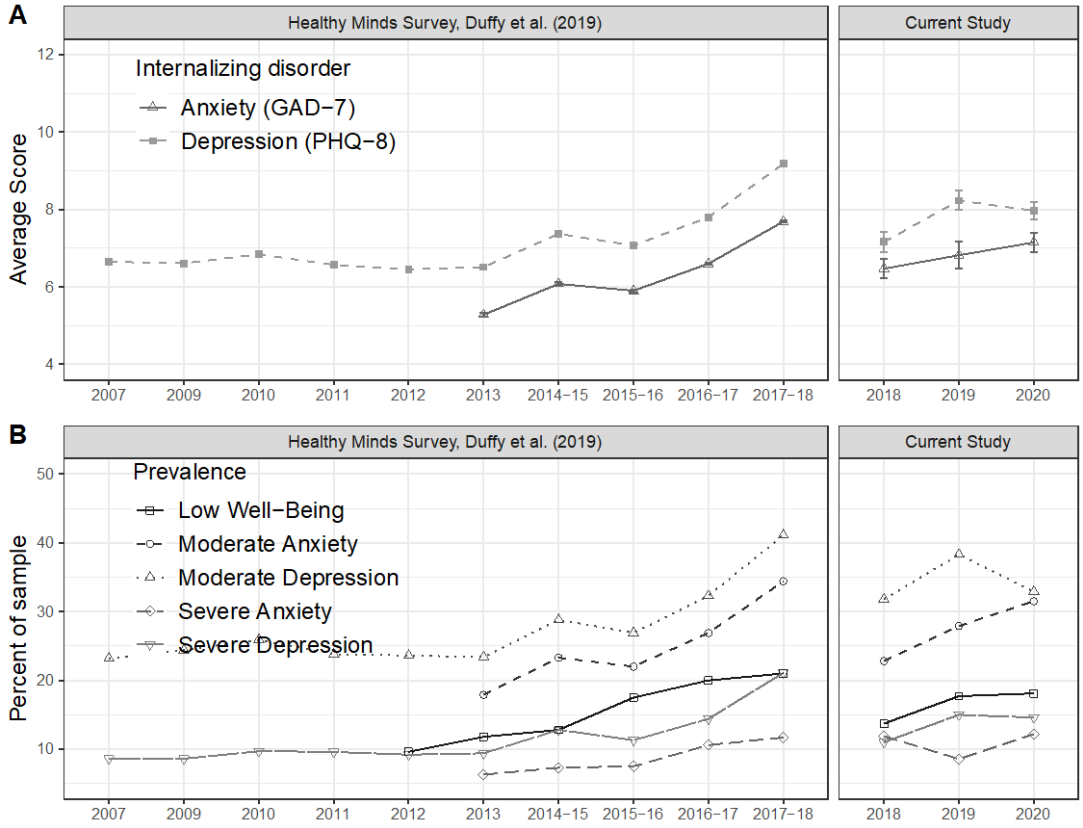
Study Timeline



WHO: World Health Organization. 2020 Cohort data was the first full semester during the global COVID-19 pandemic.

Figure 2.

Trends in Anxiety, Depression, and Well-Being Before and During COVID-19



Healthy Minds Survey data as reported in Duffy et al.[4] A, Average levels of anxiety and depressive symptoms. B, Percent of sample scoring above threshold. Moderate anxiety is a score of ≥ 10 on the GAD-7[25], moderate depression is a score of ≥ 8.88 on the PHQ-8[36], severe anxiety is a score of ≥ 15 on the GAD-7[25], severe depression is a score of ≥ 13.33 on the PHQ-8[36], and low well-being is operationalized as ≥ 1 standard deviation below the sample mean on the PHI.[37]

References

1. Dahl CJ, Wilson-Mendenhall CD, Davidson RJ. The plasticity of well-being: A training-based framework for the cultivation of human flourishing. *Proc Natl Acad Sci*. Published online December 7, 2020. doi:10.1073/pnas.2014859117

2. Seligman M. PERMA and the building blocks of well-being. *J Posit Psychol*. 2018;13(4):333-335.

3. Orben A, Tomova L, Blakemore SJ. The effects of social deprivation on adolescent development and mental health. *Lancet Child Adolesc Health*. 2020;4(8):634-640. doi:10.1016/S2352-4642(20)30186-3

4. Holmes EA, O'Connor RC, Perry VH, et al. Multidisciplinary research priorities for the COVID-19 pandemic: a call for action for mental health science. *Lancet Psychiatry*. 2020;7(6):547-560. doi:10.1016/S2215-0366(20)30168-1

5. Szlyk HS, Berk M, Peralta AO, Miranda R. COVID-19 Takes Adolescent Suicide Prevention to Less Charted Territory. *J Adolesc Health*. 2020;67(2):161-163. doi:10.1016/j.jadohealth.2020.05.046

6. Carvalho Aguiar Melo M, de Sousa Soares D. Impact of social distancing on mental health during the COVID-19 pandemic: An urgent discussion. *Int J Soc Psychiatry*. 2020;66(6):625-626. doi:10.1177/0020764020927047

7. National Center for Educational Statistics. Historical Statistics of the United States, Colonial Times to 1970; Current Population Reports. Current Population Survey (CPS), October, 1970 through 2017. Published online 2019.

8. Blakemore SJ, Mills KL. Is adolescence a sensitive period for sociocultural processing? *Annu Rev Psychol*. 2014;65:187-207.

9. Laible DJ, Carlo G, Raffaelli M. The Differential Relations of Parent and Peer Attachment to Adolescent Adjustment. *J Youth Adolesc*. 2000;29(1):45-59. doi:10.1023/A:1005169004882

10. Zimmer-Gembeck MJ, Collins WA. CHAPTER NINE Autonomy Development during Adolescence. *Blackwell Handb Adolesc*. 2008;8:175.

11. Gall TL, Evans DR, Bellerose S. Transition to First-Year University: Patterns of Change in Adjustment Across Life Domains and Time. *J Soc Clin Psychol*. 2000;19(4):544-567. doi:10.1521/jscp.2000.19.4.544

12. Kazdin AE. Adolescent mental health: Prevention and treatment programs. *Am Psychol*. 1993;48(2):127.

13. Duffy ME, Twenge JM, Joiner TE. Trends in Mood and Anxiety Symptoms and Suicide-Related Outcomes Among U.S. Undergraduates, 2007–2018: Evidence From Two National Surveys. *J Adolesc Health*. 2019;65(5):590-598. doi:10.1016/j.jadohealth.2019.04.033

14. Fletcher JM. Adolescent depression and educational attainment: results using sibling fixed effects. *Health Econ*. 2010;19(7):855-871.

15. Mojtabai R, Stuart EA, Hwang I, et al. Long-term effects of mental disorders on employment in the National Comorbidity Survey ten-year follow-up. *Soc Psychiatry Psychiatr Epidemiol*. 2015;50(11):1657-1668.

16. Ochnik D, Rogowska AM, Kuśnierz C, et al. Mental health prevalence and predictors among university students in nine countries during the COVID-19 pandemic: a cross-national study. *Sci Rep*. 2021;11(1):1-13.

17. Faisal RA, Jobe MC, Ahmed O, Sharker T. Mental health status, anxiety, and depression levels of Bangladeshi university students during the COVID-19 pandemic. *Int J Ment Health Addict*. Published online 2021:1-16.

18. Copeland WE, McGinnis E, Bai Y, et al. Impact of COVID on College Student Mental Health and Wellness. *J Am Acad Child Adolesc Psychiatry*. Published online October 19, 2020. doi:10.1016/j.jaac.2020.08.466

19. Son C, Hegde S, Smith A, Wang X, Sasangohar F. Effects of COVID-19 on College Students' Mental Health in the United States: Interview Survey Study. *J Med Internet Res*. 2020;22(9):e21279. doi:10.2196/21279

20. Pedrelli P, Nyer M, Yeung A, Zulauf C, Wilens T. College Students: Mental Health Problems and Treatment Considerations. *Acad Psychiatry J Am Assoc Dir Psychiatr Resid Train Assoc Acad Psychiatry*. 2015;39(5):503-511. doi:10.1007/s40596-014-0205-9

21. Baltes PB, Reese HW, Nesselroade JR. *Life-Span Developmental Psychology: Introduction to Research Methods*. Psychology Press; 2014.

22. Silverman ME, Nag S, Kalishman A, Cox PH, Mitroff SR. Increases in symptoms associated with obsessive-compulsive disorder among university students during the COVID-19 pandemic. *J Am Coll Health*. Published online June 3, 2022:1-7. doi:10.1080/07448481.2022.2080507

23. Kim H, Rackoff GN, Fitzsimmons-Craft EE, et al. College Mental Health Before and During the COVID-19 Pandemic: Results From a Nationwide Survey. *Cogn Ther Res*. 2022;46(1):1-10. doi:10.1007/s10608-021-10241-5

24. Wang X, Hegde S, Son C, Keller B, Smith A, Sasangohar F. Investigating Mental Health of US College Students During the COVID-19 Pandemic: Cross-Sectional Survey Study. *J Med Internet Res*. 2020;22(9):e22817. doi:10.2196/22817

25. Spitzer RL, Kroenke K, Williams JB, Löwe B. A brief measure for assessing generalized anxiety disorder: the GAD-7. *Arch Intern Med*. 2006;166(10):1092-1097.

26. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med*. 2001;16(9):606-613.

27. Fruehwirth JC, Biswas S, Perreira KM. The Covid-19 pandemic and mental health of first-year college students: Examining the effect of Covid-19 stressors using longitudinal data. *PLOS ONE*. 2021;16(3):e0247999. doi:10.1371/journal.pone.0247999

28. Fancourt D, Steptoe A, Bu F. Trajectories of anxiety and depressive symptoms during enforced isolation due to COVID-19 in England: a longitudinal observational study. *Lancet Psychiatry*. 2021;8(2):141-149. doi:10.1016/S2215-0366(20)30482-X

29. Locke BD, Buzolitz JS, Lei PW, et al. Development of the Counseling Center Assessment of Psychological Symptoms-62 (CCAPS-62). *J Couns Psychol*. 2011;58(1):97.

30. Janis, Rebecca. COVID Impact on College Student Mental Health. Published 2020. Accessed December 11, 2020. https://ccmh.psu.edu/index.php?option=com_dailyplanetblog&view=entry&year=2020&month=09&day=07&id=1:covid-impact-on-college-student-mental-health

31. Fall 2021: COVID-19 Impact on College Student Mental Health. Accessed May 9, 2022. https://ccmh.psu.edu/index.php?option=com_dailyplanetblog&view=entry&year=2022&month=03&day=21&id=23:fall-2021-covid-19-impact-on-college-student-mental-health

32. Hirshberg MJ, Colaianne BA, Greenberg MT, et al. Can the Academic and Experiential Study of Flourishing Improve College Student Functioning? A Multi-University Study. Published online May 28, 2021. doi:10.31234/osf.io/5pgms

33. Faul F, Erdfelder E, Buchner A, Lang AG. Statistical power analyses using G* Power 3.1: Tests for correlation and regression analyses. *Behav Res Methods*. 2009;41(4):1149-1160.

34. Cohen J. *Statistical Power Analysis for the Behavioral Sciences (Rev*. Lawrence Erlbaum Associates, Inc; 1977. Accessed October 20, 2015. http://psycnet.apa.org/psycinfo/1987-98267-000

35. Yentes R, Wilhelm F. careless: Procedures for computing indices of careless responding. Published online 2021.

36. Kroenke K, Strine TW, Spitzer RL, Williams JB, Berry JT, Mokdad AH. The PHQ-8 as a measure of current depression in the general population. *J Affect Disord*. 2009;114(1-3):163-173.

37. Hervás G, Vázquez C. Construction and validation of a measure of integrative well-being in seven languages: The Pemberton Happiness Index. *Health Qual Life Outcomes*. 2013;11(1):66.

38. Steger MF, Frazier P, Oishi S, Kaler M. The meaning in life questionnaire: Assessing the presence of and search for meaning in life. *J Couns Psychol*. 2006;53(1):80.

39. Everett JAC, Colombatto C, Chituc V, Brady WJ, Crockett M. *The Effectiveness of Moral Messages on Public Health Behavioral Intentions during the COVID-19 Pandemic*. PsyArXiv; 2020. doi:10.31234/osf.io/9yqs8

40. Ettman CK, Abdalla SM, Cohen GH, Sampson L, Vivier PM, Galea S. Prevalence of Depression Symptoms in US Adults Before and During the COVID-19 Pandemic. *JAMA Netw Open*. 2020;3(9):e2019686. doi:10.1001/jamanetworkopen.2020.19686

41. Lee CM, Cadigan JM, Rhew IC. Increases in Loneliness Among Young Adults During the COVID-19 Pandemic and Association With Increases in Mental Health Problems. *J Adolesc Health*. 2020;67(5):714-717. doi:10.1016/j.jadohealth.2020.08.009