

# The Effect of the COVID-19 Pandemic on Mental Health among College Students in the United States

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## Abstract

The COVID-19 pandemic has significantly impacted the mental health of college students in the United States (U.S.). Here, we review studies that explored the effect of the COVID-19 pandemic on mental health measures and coping strategies of university students. Previously published studies conducted in this population, using tools like the PHQ-9, GAD-7, and PSS-10 questionnaires demonstrated a notable increase in the prevalence of depression, anxiety, stress and suicidal ideation. Female and advanced college students were particularly vulnerable, consistently showing higher scores for anxiety and stress. Females also displayed greater depression severity scores compared to their male counterparts; however, some advanced students displayed lower scores compared to the first-year undergraduate students. There was an overall decrease in suicidal ideation among college students during the pandemic; however, some schools were found to have an increase in the level of suicidal ideation. The shared negative effects of COVID-19 among college students encompassed health, academic, and lifestyle domains. Coping strategies varied, with "support from friends and family" being predominant. In addition, an overall underutilization of mental health resources was reported. Non-pharmacological therapies, particularly lifestyle modifications such as regular exercise, demonstrated efficacy in alleviating symptoms; however, challenges such as underuse and patient compliance were prevalent. These findings highlight the necessity of promoting mental health resources, addressing gender and academic level-specific vulnerabilities, and implementing accessible non-pharmacological interventions to mitigate the mental health impact of pandemics on U.S. college students.

**Keywords:** COVID-19, Pandemic, Depression, Anxiety, Stress, Suicidal Ideation, Coping, Lifestyle Medicine.

## 1. Introduction

The onset of the COVID-19 pandemic in November 2019, marked by the first recorded case,

has reverberated globally, claiming over three million lives and precipitating widespread disruptions in health systems and economies (1, 2).

Faced with the highly contagious nature of the virus, universities in the United States (U.S.) implemented unprecedented measures, mandating the evacuation of students for the remainder of the 2019-2020 academic year to enforce physical distancing and impede further transmission (3). Beyond the immediate health threats posed by COVID-19, the pandemic introduced profound mental health risk factors. These factors encompass concerns about illness contraction and the loss of loved ones. The resultant isolation measures compelled students to grapple with a swift transition from in-person to online learning, job and internship losses, social isolation, and other concomitant stressors (1, 3).

Prior to the advent of the COVID-19 pandemic, U.S. college students were a demographic with heightened psychological vulnerability. This was emphasized by pre-pandemic epidemiological surveys revealing a significant prevalence of psychological disorders (2). This demographic which is a major contributor to adult depression levels in the U.S., had already witnessed escalating levels of anxiety, depression, and suicidality throughout the preceding decade (2). Furthermore, a substantial proportion of chronic psychological disorders originate during young adulthood (2, 4). As a result, college students emerged as a particularly susceptible population to exacerbated mental health challenges, notably depression, during the COVID-19 era.

The present narrative review discusses research on the effects of the COVID-19 pandemic on mental health among college students in the U.S. We present previously published data indicating altered levels of depression, anxiety, stress, and suicidal ideation during the pandemic among this population. In addition, we assess the shared negative effects of the pandemic, coping strategies implemented to mitigate stressors, and non-pharmacological therapeutics that may be effective at mitigating the unique stressors induced by the pandemic (**Figure 1, Appendix**). By considering reports of depression, anxiety, stress, and suicide vulnerabilities in the context of the unprecedented challenges posed by the COVID-19 pandemic, this review strives to foster a broader perspective on the complex relationship between mental health and societal disruptions among U.S. college students in our rapidly evolving world.

## **2. Impact of the COVID-19 pandemic on depression levels among U.S. college students**

Here, we review data from surveys assessing depression severity using the Patient Health Questionnaire-9 (PHQ-9) among college students in the U.S. The surveys discussed in this review were conducted in undergraduate and/or graduate populations consisting of students over the age of 17 from individual public or private universities located in different geographical regions across the U.S. (Southwest, Midwest, South, Southeast). We also discuss data from the 2020 Healthy Minds Study consisting of 36,875 student respondents across 28 universities in the U.S.

The PHQ-9 was chosen based on its common use, feasibility, and simple patient engagement. The PHQ-9 is a nine-item questionnaire designed to screen, measure, and monitor an individual's depression severity in accordance with the Diagnostic and Statistical Manual of Mental Disorders IV (DSM-IV). Participants are asked to report the frequency of various stressors in their lives during the two weeks prior to taking the PHQ-9, based on a scale from 0-3 (0 = not at all, 1 = several days, 2 = more than half the days, or 3 = nearly every day). The scores are summed for a final score ranging from 0 (lowest depression severity) to 27 (highest depression severity), where the clinical cut-off for moderate depression is  $\geq 10$  and severe depression is  $\geq 20$  (1, 5). Unsurprisingly, a substantial proportion of college students surveyed reported experiencing some level of depression during the COVID-19 pandemic lockdown.

81% of undergraduate and graduate students surveyed (of 1,994 total student responders) at Texas A&M University reported some level of depression in the late Spring 2020 semester: 33% mild (PHQ-9 score range: 5-9), 25% moderate (PHQ-9 score range: 10-14), 16% moderately severe (PHQ-9 score range: 15-19), and 7% severe (PHQ-9 score range: 20-27) depression (6). Similarly, 20% of the 15,765 participants that received the PHQ-9 reported moderately severe to severe depression symptoms in the 2020 Healthy Minds Study consisting of undergraduate and graduate students surveyed across 28 U.S. universities in the Fall semester of 2020 from September to December (7). A limitation in interpreting this information is that the studies

exclusively feature PHQ-9 data collected during the pandemic, thus lacking comparisons to baseline depression severity scores prior to the pandemic.

In surveys dispersed to 194 undergraduate and graduate students at the University of Southern Nevada, Las Vegas (UNLV) in May 2020, PHQ-9 scores increased in 63% of the total participants after stay-at-home orders were placed during the pandemic compared to before stay-at-home order implementation (1). Although mean PHQ-9 scores significantly increased from 5.6 to 9.6 ( $p < 0.05$ ), these scores suggest all participants were mildly depressed, as they were under the clinical cut off for moderate depression severity ( $\geq 10$ ). Stated in different words, the total number of students reporting to be mildly depressed increased, yet the severity of their depression did not worsen. The increase in PHQ-9 scores was speculated to be due to the abrupt change to the online classroom format as well as the social isolation that was associated with stay-at-home restrictions.

Likewise, a significant increase in perceived symptoms of depression was reported at a large university in the Midwest (the identity of which was not published) when comparing PHQ-9 survey data from 414 undergraduate respondents prior to the pandemic in the Fall 2016 semester to two different cohorts collectively comprised of 600 undergraduate respondents during the pandemic in the Spring and Fall 2020 semesters (8). PHQ-9 scores were significantly higher in both 2020 cohorts (mean PHQ-9 score 8.43) compared to the Fall 2016 cohort (mean PHQ-9 score 7.70,  $p < 0.05$ ); however, all scores ranged from 5-9, indicating mostly mild depression among participants despite the significant increase in mean scores.

In a study conducted at a large, private university in South Florida (the identity of which was not published) surveying 165 undergraduate and graduate students in March 2020, 35% of participants met the criteria for at least moderate depression (mean PHQ-9 score 8.44), whereas 44% of 98 participants surveyed in May 2020 met these criteria (mean PHQ-9 score 9.36) (5). Although an increase in depression severity was reported, the increase was not statistically significantly different in this study ( $p > 0.05$ ).

A summary of the findings among all studies reviewed is provided in **Table 1 (Appendix)**. While reported depression severity increased among

college students during the pandemic in the reviewed studies, the PHQ-9 scores also indicate that students were, on average, mildly depressed across different U.S. geographical regions. Essentially, no functional effect of the changes in PHQ-9 scores was reported. In certain cohorts, self-reported depression severity levels were increased at different timepoints such as after the stay-at-home orders were enacted. As mentioned, one limitation of our analysis is the absence of baseline pre-pandemic comparison groups across all cohorts, hindering our ability to discern whether the rise in depression severity resulted due to the pandemic or had been progressively occurring before and throughout the pandemic.

An interesting trend among multiple studies was that the PHQ-9 scores were significantly impacted by year of study. PHQ-9 scores among participants significantly decreased as they increased in year of schooling in both the Texas A&M study ( $p < 0.001$ ) and UNLV study, especially for seniors ( $p < 0.05$ ) (1, 6). At Texas A&M, seniors had a mean PHQ-9 score of 10.01 compared with freshman, sophomore, and junior scores of 11.61, 11.02, and 10.47, respectively [6]. These scores suggest that on average, students were classified as having moderate depression in each year of undergraduate study. The study also reported that master's students had a mean PHQ-9 score of 8.84, while doctoral students had a mean score of 8.30, suggesting that, on average, graduate students were more likely to experience mild depression [6]. In addition, the seniors in the UNLV study had the smallest change in their average PHQ-9 scores pre-lockdown compared to post-lockdown ( $p = 0.05$ ), a trend that was attributed to older students having greater adaptability with increasing rigor of coursework [1]. PHQ-9 scores may also have been the lowest in the surveyed senior undergraduate and graduate students as they had learned resiliency, self-sufficiency, and were better able to adapt to stressors.

In comparison, the study conducted at the undisclosed university in the Midwest, PHQ-9 scores increased as students progressed in their year of study ( $p = 0.008$ ) (8). This may have been due to the added stress of planning for a career after graduation during the pandemic in an unstable economy for undergraduate upperclassmen. In addition, this study was carried

out over a longer period (Spring to Fall 2020), allowing upperclassmen to experience a longer-term impact of the pandemic on their future that they may not have experienced in one semester alone. Advanced (sophomores through seniors) students who had adapted to their college routines may have had a stronger reaction to having disruptions to their practices, as opposed to the freshman students who had not yet established a daily regimen. Both the UNLV and Texas A&M studies had opposite trends to the study conducted at the undisclosed university in the Midwest. There may be several reasons for this, including geographical and cultural differences in the South-Southwest regarding implementation of COVID-19 related policies compared to the Midwest (9), and the student populations being surveyed. The Midwest university survey did not include graduate students, who were found to have lower PHQ-9 scores than undergraduate students in the other surveys.

Considering sex among the analyzed studies, approximately 70% of the participants were female in the UNLV and South Florida studies (1, 5). In the Texas A&M study, gender significantly influenced PHQ-9 scores, with female participants exhibiting markedly higher scores than male participants ( $p < 0.001$ ) (6). Interestingly, prior to the pandemic, females consistently showed a higher prevalence of major depressive disorder (MDD) compared to males (10). For instance, one pre-pandemic study reported a global 12-month prevalence of MDD at 5.8% among females, compared to 3.5% among males (11). Thus, the observation of higher PHQ-9 scores among female participants during the pandemic aligns with pre-pandemic trends.

Based on the PHQ-9 surveys analyzed, undergraduate and/or graduate students across Texas A&M, the 2020 Healthy Minds Study, UNLV, the undisclosed university in the Midwest, and the undisclosed university in South Florida had an overall increase in PHQ-9 scores during the COVID-19 pandemic. PHQ-9 scores were significantly impacted by either gender or year of study across multiple studies. A limitation of this analysis is that it is not comprehensive of all PHQ-9 surveys administered to undergraduate and graduate students in the U.S. during the COVID-19 pandemic. Sampling bias also plays a limiting role,

as these results are based off self-reported responses.

### **3. Impact of the COVID-19 pandemic on anxiety & stress levels among U.S. college students**

Here, we review data from surveys assessing anxiety and/or stress levels among college students in the U.S. using the Generalized Anxiety Disorder-7 questionnaire (GAD-7) and the Perceived Stress Scale-10 questionnaire (PSS-10). The Texas A&M, 2020 Healthy Minds, the undisclosed university in the Midwest, and the undisclosed university in South Florida studies that assessed depression severity via PHQ-9 surveys also assessed anxiety and/or stress levels via the GAD-7 and PSS-10, respectively, and are reviewed here. Additional university studies that assessed anxiety and/or stress levels and are reviewed here include an undisclosed major university system in Texas and an undisclosed public research university in Kentucky. All surveys were conducted in undergraduate and/or graduate populations consisting of students over the age of 17 from individual universities located in various geographical regions all over the U.S., with greater representation from the Midwest relative to the depression review.

The selection of the GAD-7 was driven by its widespread usage, practicality, and ease of patient involvement. The GAD-7 measures symptoms of anxiety and screens for major anxiety disorders in accordance with the Diagnostic and Statistical Manual of Mental Disorders IV (DSM-IV). It consists of seven questions, where participants are asked to report the frequency of symptoms of anxiety in their lives during the two weeks prior to taking the GAD-7 based on a scale from 0 to 3 (0 = not at all, 1 = several days, 2 = more than half the days, or 3 = nearly every day) (8).

The choice of the PSS-10 was guided by its common application, convenience, and simplicity in engaging patients. The PSS-10 is a 10-item questionnaire designed to measure the perception of stress in one's life over the past month. Participants rate how often they have felt or thought a certain way based on a scale from 0 to 4 (0 = never, 1 = almost never, 2 = sometimes, 3 = often, 4 = very often). The scores are summed for a final score ranging from 0 (low perceived stress) to 40 (high perceived stress), where the clinical cut-

off for moderate perceived stress is  $\geq 14$  and for high perceived stress is  $\geq 27$  (8).

In the Texas A&M University conducted in the Spring 2020 semester, GAD-7 scores revealed that 72% of respondents were experiencing varying levels of anxiety during the pandemic with 33% categorized as mild (GAD-7 score range: 5-9), 24% as moderate (GAD-7 score range: 10-14), and 15% as severe (GAD-7 score range: 15-21) (6). A similar percentage of moderate and severe anxiety scores was observed among the participants in the 2020 Healthy Minds study, which utilized the GAD-7 to assess anxiety severity in undergraduate and graduate students across 28 U.S. universities but adopted an unconventional scoring approach by summing scores on a scale of 0-12 and dichotomizing scores. Scores of 11 or higher indicated moderately severe or severe anxiety, and 33% of the 15,995 participants in the study met this threshold. After adjusting for race/ethnicity, gender identity, and international student status, greater odds of having moderately severe to severe anxiety was significantly associated with COVID-19 concern ( $p < 0.001$ ), financial distress ( $p < 0.001$ ), and infection ( $p < 0.001$ ) (7).

In contrast, the study conducted at the undisclosed private university in South Florida did not identify a significant increase in mean GAD-7 scores for the late March/early April non-virtual schooling cohort ( $n = 98$ , score 6.68) compared to the late April/early May virtual schooling cohort ( $n = 165$ , score 7.20) ( $p > 0.05$ ). Anxiety scores in the latter cohort were significantly predicted by the level of COVID-19 worry ( $p < 0.001$ ), school/work interference ( $p = 0.011$ ), and having a pre-existing medical condition ( $p = 0.007$ ) (5). This deviation from the findings of surveys at Texas A&M University and the 2020 Healthy Minds studies may be attributed to the short duration difference between the recording of survey results from each cohort. A limitation in interpreting these studies is that they exclusively feature GAD-7 data collected during the pandemic and therefore lack a comparison to baseline anxiety severity scores pre-pandemic.

The study conducted by the undisclosed university in the Midwest reported a significant increase in anxiety severity scores based on GAD-7 surveys in both the Spring 2020 and Fall 2020 cohorts collectively compared to a cohort from the

same university in Fall 2016, pre-pandemic. The 2016 cohort included 414 participants of which 53% were first-year undergraduate students, and the 2020 cohorts included 600 participants of which 70% were first-year undergraduate students. The mean GAD-7 score among participants rose significantly from 6.53 in 2016 to 7.20 in 2020 ( $p = 0.021$ ); however, mean scores remained in the mild anxiety severity range. Analysis of the PSS-10 results from the same study indicated a significant increase in stress scores between the 2016 and 2020 cohorts, with mean scores of 20.34 in 2016 and 21.16 in 2020 ( $p = 0.007$ ). The mean scores remained in the moderate stress severity range. (8).

Additional investigations delved into stress and anxiety, complementing the existing discourse on depression. A month following the issuance of a stay-at-home order by an undisclosed major university system in Texas in April 2020, 195 students underwent interviews to assess the impact of the COVID-19 pandemic on their mental well-being. The mean PSS-10 score in the month leading up to the interviews among these students was 18.8, indicating moderate perceived stress. Moreover, when queried about changes in their own and their peers' stress and anxiety levels due to the pandemic, 138 students (71%) of students reported an increase (12).

In a very early stage of the COVID-19 pandemic, GAD-7 and PSS-10 surveys were distributed to undergraduate students at an undisclosed public research university in Kentucky to gauge overall student anxiety and stress levels, respectively. Among 1,412 respondents, GAD-7 scores indicated that 24% of students reported moderate anxiety while 21% reported severe anxiety. PSS-10 results revealed that 88% of students were experiencing moderate to severe stress levels (63% moderate, 25% severe), with only 12% reporting low stress levels (13). A summary of the primary GAD-7 and PSS-10 findings among all studies discussed is provided in **Table 2** and **Table 3 (Appendix)**.

Additional analysis revealed that the GAD-7 and PSS-10 scores were significantly impacted by the year of study across multiple reports. The study conducted at the undisclosed university in the Midwest displayed a significant disparity in perceived stress ( $p = 0.003$ ) and anxiety ( $p = 0.026$ ) based on GAD-7 and PSS-10 scores, respectively,

between first-year students and advanced students (sophomores through seniors), with the latter reporting higher levels for both. Further, when accounting only for first-year students within each cohort, there was no significant difference in anxiety ( $p = 0.832$ ) or perceived stress ( $p = 0.653$ ) (8). The study conducted at the undisclosed university in Kentucky also reported advanced students having significantly elevated levels of stress and anxiety compared to first-year students ( $p = 0.03$ ) (13). An interesting finding in the latter study was the risk of experiencing severe stress and anxiety diminishing as students' GPAs and family incomes increased. This overall trend of higher anxiety and stress in advanced students may be linked to the additional pressures and responsibilities they faced compared to first-year students: advanced students were juggling academic demands, extracurricular commitments, and part-time employment, which may have exacerbated feelings of stress and anxiety, especially when disrupted by the pandemic. In comparison, first-year students who were adjusting to college life and forming social networks found adapting to the changes brought about by the pandemic easier than advanced students. This is believed to be due to first-year students' lower academic workload and their less entrenched practices.

Sex differences were also reported across multiple studies. In the study conducted at the undisclosed University in the Midwest, female respondents had significantly higher GAD-7 and PSS-10 scores when compared to their male counterparts ( $p < 0.001$ ) (8). The study conducted at the undisclosed university system in Texas did not report such a pattern; however, a majority (57%,  $n = 111$ ) of the participants were female (12). This was also true for the undisclosed university in Kentucky study, where 73% ( $n = 1,031$ ) of the study participants were female. Interestingly in this investigation, specific demographics exhibited varying susceptibility to heightened stress and anxiety, with female students being 1.5x ( $p < 0.01$ ) and 1.7x ( $p < 0.001$ ) more likely to experience high stress and anxiety levels, respectively (13). This is in line with pre-pandemic trends, showing that females were at a significantly greater risk for most anxiety disorders than males (14), with the lifetime prevalence of generalized anxiety disorder (GAD)

reported to be 6.6% in females compared to 3.6% in males (15).

Overall, while anxiety and stress levels remained high during the pandemic or increased in the studies in which pre-pandemic data was available, the GAD-7 and PSS-10 scores indicate that college students across various geographic areas in the U.S. were on average, mildly anxious and moderately stressed. To rephrase, a functional effect of the changes in GAD-7 or PSS-10 scores was not reported. As seen with depression levels, the lack of pre-pandemic comparison groups among all studies hinders our understanding of whether the reported anxiety and stress severity levels are a result of the pandemic or had been progressively increasing prior to and during the pandemic. Furthermore, the reliance on self-reported survey data introduces the possibility of response bias, where participants may underreport or overreport their symptoms. Finally, the lack of information on potential confounding variables, such as socioeconomic status, access to mental health resources, and prior mental health history, may impact the validity and reliability of the findings and hinders the investigation of isolating stress and anxiety caused by COVID-19 from other life events. These limitations highlight avenues for future research to address these methodological gaps and enhance the understanding of anxiety and stress among college students during periods of crisis.

#### **4. Impact of the COVID-19 pandemic on suicidal ideation among U.S. college students**

In exploring the impact of the pandemic on suicide, 8% of the 195 respondents from the undisclosed major university system in Texas disclosed experiencing suicidal ideation in relation to COVID-19. Among these individuals, 5% described the thoughts as mild, while 3% categorized them as moderate (12). In the Texas A&M study, a staggering 18% of the 2,031 participants reported having suicidal ideation or thoughts related to self-harm (6). Notably, baseline levels of suicide ideation among college students are typically reported at 12% (16).

Contrary to the Texas A&M study, a comprehensive study aimed at evaluating the impact of the pandemic on suicidal ideation surveyed random samples of college students from

286 U.S. universities and discovered a statistically significant decrease in suicidal ideation, with the prevalence of suicidal ideation dropping from 13.4% in 2017-2018 to 13.2% in 2020-2021 ( $p < 0.001$ ) (16). This decline may be attributed to the proactive measures implemented by governments and universities, such as promoting mental health services and offering academic accommodations, including support via online instruction. In addition, the stay-at-home order may have fostered increased familial support and a reduction in everyday stressors.

Limitations of these findings include reliance on self-reporting which may be subject to social desirability or memory recall biases. In addition, the comparison to baseline levels of suicidal ideation should be interpreted with caution, as the methodologies and timeframes for data collection may differ between studies. Lastly, while the decline in suicidal ideation observed in the comprehensive study may suggest the effectiveness of proactive measures and societal changes during the pandemic, further research is needed to understand the underlying mechanisms and long-term impacts.

### **5. Shared negative effects of the COVID-19 pandemic among college students in Texas**

The introduction of the COVID-19 pandemic ushered in a cascade of negative effects for college students, encompassing outcomes that yielded unfavorable consequences and heightened stressors. These repercussions, consistently identified across multiple studies, span various domains including personal health, financial concerns, academic pursuits, sleep patterns, and dietary habits.

According to the study conducted at the large undisclosed university system in Texas, 54% of the 195 respondents articulated that COVID-19 had deleterious impacts on academic, health, and lifestyle-related facets. Of the 195 respondents, 91% of participants reported concerns about health, 89% reported difficulty concentrating, 86% reported disruptions in sleep patterns, 86% reported heightened social isolation, 82% reported apprehensions about academic performance, 70% reported disturbances in eating patterns, 67% reported alterations in living environments, 59% reported financial strains, 54% reported increased

class workloads, 44% reported feelings of depression, and 8% reported contemplation of suicidal thoughts (12).

These findings reveal that the pandemic's impact extends beyond the immediate threat of contracting COVID-19. College students faced a myriad of challenges, spanning from anxieties about the health of loved ones to disruptions in eating routines, all of which may have contributed to negative impacts on mental health during this period. By revealing the specific areas where students experienced the most pronounced stressors, this data enables a multifaceted understanding of the profound toll exacted on the mental well-being of the U.S. college student population.

While this analysis highlights the multitude of challenges faced by college students during the COVID-19 pandemic, the data are derived solely from self-reported survey responses, lacking subsequent follow-up reports to gauge the duration and longevity of the observed adverse effects. In addition, the study may be subject to temporal bias, as it captures students' experiences during a specific period and may not reflect changes over time. Social desirability bias may have influenced respondents' answers, in particular sensitive topics like mental health. Furthermore, the study's focus on a single university system in Texas limits the generalizability of the findings to other student populations with different characteristics. The reliance on a limited set of assessment tools may also overlook other relevant mental health challenges, and uncertainties regarding response rates and sample representativeness further add complexity to the interpretation of the results.

### **6. Insight into the use of mental health services and coping strategies implemented by U.S. college students during the COVID-19 pandemic**

Amid heightened stress and anxiety among college students during the pandemic, various coping strategies emerged, revealing a mix of effective and less constructive approaches. A Texas A&M survey with 2,031 participants indicated that 43% of students coped adequately, 41% were uncertain, 16% struggled, and 19% did not use a coping mechanism (6). Notably, "support from friends and family" was the primary coping strategy

for 67% of Texas A&M students, whereas the same strategy was utilized by only 34% of participants at the other undisclosed Texas university system (6, 12). The second most common coping mechanism utilized by 33% of the Texas A&M participants was "technologies," including websites, mobile apps, and sensors that monitor health data. 14% of participants exclusively used mobile apps, and 72% of these apps focused on mindfulness and meditation, such as Headspace (6).

At the large undisclosed university system in Texas, 138 of the 195 participants (71%) reported heightened stress and anxiety levels due to the pandemic. Of the 138 students, 76% of them self-managed stress, with 23% using negative strategies (e.g., ignoring COVID-19-related news, drinking, smoking, sleeping longer than needed) and 29% using positive strategies (e.g., meditation, breathing exercises, spiritual practices, routines, positive reframing). Most (70%) engaged in relaxing hobbies, while 14% planned activities for academics and personal matters (12). In comparison, a study at a private Florida university with 98 participants showed that unhealthy coping strategies such as substance use and alcohol use were significantly correlated with lower Centers for Disease Control and Prevention (CDC) guideline adherence to social distancing, with correlation values of  $r = -0.23$  ( $p < 0.01$ ) and  $r = -0.3$  ( $p < 0.024$ ), for substance and alcohol use, respectively (5).

Despite universities shifting to tele-counseling during the pandemic, a survey administered by an undisclosed research university in Kentucky with 1,412 respondents found that over 60% of undergraduates with moderate to severe symptoms never used on-campus or off-campus mental health services. However, as stress, anxiety, and/or depression severity increased among respondents during the pandemic, based on PSS-10, GAD-7, and PHQ-9 scores, respectively, service use odds rose significantly ( $p < 0.01$ ,  $p < 0.01$ ,  $p < 0.001$ , respectively) (13).

Similar underutilization was seen at the large university system in Texas, where 93% of the 138 respondents with higher stress and anxiety levels, as indicated by PSS-10 and GAD-7 scores, respectively, did not use school counseling services. While most non-users did not provide explanations for their choice, some reasons cited include: a lack of perceived severity (3%),

discomfort with unfamiliar individuals (0.8%), and reluctance to discuss mental health over the phone or feelings of mistrust (1.6%) (12).

This data highlights the various coping strategies as well as the suboptimal use of mental health resources among U.S. college students during the pandemic, emphasizing the need for increased awareness to boost consumption of available resources. A limitation of this analysis is that the reliance on voluntary participation and self-reported nature of the data may introduce sampling bias and affect the accuracy of reported coping behaviors and service usage. Furthermore, the generalizability of the findings may be limited, as factors such as campus culture and resources may vary across institutions. The cross-sectional design of the study also hinders the ability to establish causality between coping strategies and mental health outcomes.

## **7. Effective non-pharmacological interventions in the treatment of mental health disorders**

The brain's remarkable neuroplasticity lays a foundation for addressing the pathophysiology and treatment of mental illnesses (17). Whether through pharmacological interventions or intentional lifestyle adjustments, leveraging the brain's plasticity holds promise in mitigating symptoms of depression, stress, and anxiety.

Lifestyle medicine, emphasizing health-promoting behaviors such as regular exercise and mindfulness, offers accessible and effective treatment for MDD among college students (18). Lifestyle medicine provides an alternative to antidepressants for patients with treatment-resistant depression, lacks a stigma associated with other treatment modalities such as electroconvulsive therapy, and presents physiological and psychosocial benefits, merging positive effects of pharmacological treatments and therapy (19). Challenges include underuse, patient compliance, and the bidirectional relationship between severe depression and unhealthy behaviors (20).

The current literature on the association between mental health and lifestyle habits among college students highlights six lifestyle categories: substance use, sunlight exposure, sleep, diet, network use, and exercise (20-22). Substance use, irregular sleep, poor diet, excessive screen time,



and lack of exercise correlated with higher depressive symptoms and overall lower mental health. Irregular eating, especially skipping breakfast, resulted in higher likelihood of depression, regardless of the scale used to measure depression, across all studies (20-22). One study reported that zinc, magnesium, B vitamins, and healthy fats were positively correlated with reduced depression (21). An interesting finding was the direct positive correlation noted between screen time and depressive episodes in males only, whereas a negative correlation between less than six hours of sleep and greater depressive symptoms was reported in females only (20).

Among lifestyle modifications, exercise stands out as a substantial treatment option, demonstrating efficacy equal to antidepressants with sustained effects and multifaceted physiological and psychosocial benefits among college students (18, 19, 23). In a six-month follow-up report to randomized control trials conducted by Duke University, participants in the study's "exercise-only" group, displayed lower rates of depression (30%) relative to participants in "antidepressant-only" and "combination antidepressant-exercise" groups, who experienced depression rates of 52% and 55%, respectively (18). This study consisted of 156 patients with MDD. Health benefits of exercise in this study were partially attributed to a reduction in neuroinflammatory and oxidative stress biomarkers, which promotes neuroplasticity. As a result, participants experienced greater levels of self-esteem and self-efficacy. The type of exercise practiced is imperative. To feel the benefits, minimum recommendations for the college age group of adults include 3-5 weekly sessions of moderate-intensity aerobic or mind-body exercises for at least 4-16 weeks (7).

The complexity of mental health conditions and the multifactorial nature of treatment approaches make comprehensively assessing the efficacy and suitability of alternative interventions challenging. The absence of long-term follow-up data in some studies restricts the ability to evaluate the sustainability of these interventions over time. Further research is needed to identify optimal lifestyle modification protocols and address barriers to implementation for these accessible

and promising interventions in college student populations.

## **8. Conclusion**

The results of this review highlight the exacerbation of mental health challenges among U.S. college students during the COVID-19 pandemic. Survey data revealed a significant upswing in the prevalence of depression, anxiety, and stress, particularly noteworthy among female students. This trend is in part attributed to the overrepresentation of females, constituting more than 50% of the surveyed samples in many of the discussed studies. Advanced students (sophomores to seniors) reported significantly greater anxiety and stress levels than their first-year counterparts. This trend was observed with depression severity in one study, as PHQ-9 scores increased as students increased in year of study; however, the opposite was also seen in multiple studies where depression severity decreased as students increased in year of study. Importantly, although the prevalence of depression, anxiety, and stress increased in many college student populations, the average survey score severity ranges did not differ significantly.

The adverse effects of the pandemic extended across academic, health, and lifestyle domains, with an inability to concentrate and heightened concerns about academic performance reported by most survey respondents. These findings emphasize that the repercussions of the COVID-19 pandemic transcended the contraction of the virus, imposing multidimensional stressors on students striving to maintain their academic standing and mental well-being. Our review also identified diverse coping mechanisms, with "technologies" emerging as a surprisingly common positive strategy alongside "support from friends and family". Strikingly, a substantial underutilization of college mental health resources was reported, although resource utilization appeared to increase as depression, anxiety, and stress levels intensified. This shows the need for heightened promotion of available resources to ensure students are aware of the support systems in place to address the underutilization trend. Given the reluctance of a significant portion of college students to seek professional healthcare for declining mental health, our findings advocate for non-pharmacological treatments. Health-promoting

behaviors, such as regular exercise, proper sleep, and balanced nutrition emerged as accessible and effective alternatives. This finding emphasizes the importance of promoting non-pharmacological options among college students, offering proactive, easily implementable therapeutic resources that

integrate seamlessly into their daily lives and enhance awareness of accessible alternatives to traditional treatments.

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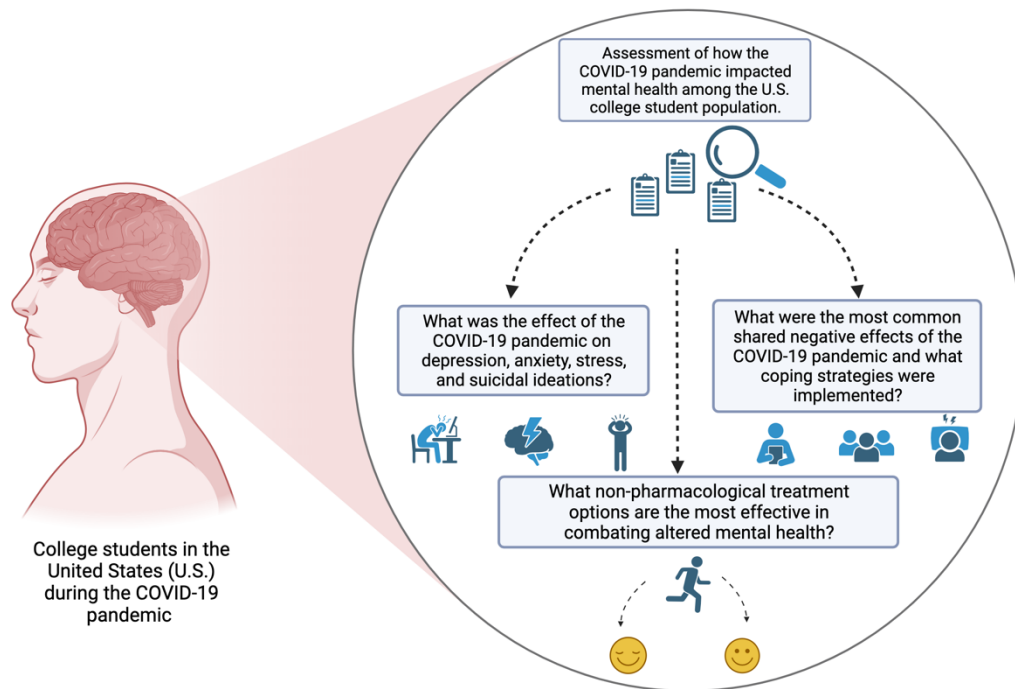
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## Appendix:



**Figure 1: Assessment of the effects of the COVID-19 pandemic on college students in the U.S.** In the present review, we assessed how the COVID-19 pandemic impacted mental health among the U.S. college student population. By analyzing PHQ-9, GAD-7, and PSS-10 survey responses across multiple studies in the U.S., we assessed depression, anxiety, and stress levels in this population. We also assessed levels of suicidal ideation before and during the pandemic. In addition, we assessed the shared negative effects of the pandemic, coping strategies implemented, and non-pharmacological therapeutics that may be effective at mitigating the stressors induced by the pandemic.

	Mild (%)	Moderate (%)	Moderately Severe - Severe (%)	Sample size pre- or early pandemic	Sample size during pandemic	Mean score pre- or early pandemic	Mean score during pandemic	P-value (comparison of means)	Study
PHQ-9 Data	33	25	23		1,994				Texas A&M (6)
			20		15,765				2020 Healthy Minds (7)
				194	194	5.6	9.6	< 0.05*	University of Southern Nevada, Las Vegas (UNLV) (1)
				414	600	7.70	8.43	< 0.05*	Undisclosed university in the Midwest (8)
			35 → 44	165	98	8.44	9.36	> 0.05	Undisclosed university in South Florida (5)

**Table 1: Summary of PHQ-9 Data.** For each study listed on the right, the percentage of respondents that stated mild (PHQ-9 score range 5-9), moderate (PHQ-9 score range 10-14), and moderately severe to severe (PHQ-9 score range 15-27) depression severity symptoms is reported. In the South Florida study, the arrow indicates the change in the percentage of respondents that reported at least moderate depression severity from early in the pandemic to later in the pandemic. Sample sizes of respondents are also

reported from pre- or early pandemic to during the pandemic, where applicable. The mean PHQ-9 scores from pre- or early pandemic to during the pandemic, where applicable, are also reported, along with p-values indicating whether the change in mean PHQ-9 scores was significant (\*p < 0.05).

	Mild (%)	Moderate (%)	Moderately Severe - Severe (%)	Sample size pre- or early pandemic	Sample size during pandemic	Mean score pre- or early pandemic	Mean score during pandemic	P-value (comparison of means)	Study
GAD-7 Data	33	24	15		2,031				Texas A&M (6)
			33		15,995				2020 Healthy Minds (7)
		28		98	165	6.68	7.20	> 0.05	Undisclosed university in South Florida (5)
				414	600	6.53	7.20	0.021*	Undisclosed university in the Midwest (8)
	32	24	21	1,412					Undisclosed university in Kentucky (13)

**Table 2: Summary of GAD-7 Data.** For each study listed on the right, the percentage of respondents that stated mild (GAD-7 score range 5-9), moderate (GAD-7 score range 10-14), and moderately severe to severe (GAD-7 score range 15-21) anxiety severity symptoms is reported. Sample sizes of respondents are also reported from pre- or early pandemic to during the pandemic, where applicable. The mean GAD-7 scores from pre- or early pandemic to during the pandemic, where applicable, are also reported, along with p-values indicating whether the change in mean GAD-7 scores was significant (\*p < 0

	Mild (%)	Moderate (%)	Moderately Severe - Severe (%)	Sample size pre- or early pandemic	Sample size during pandemic	Mean score pre- or early pandemic	Mean score during pandemic	P-value (comparison of means)	Study
PSS-10 Data				414	600	20.34	21.16	0.007*	Undisclosed university in the Midwest (8)
					195		18.8		Undisclosed university system in Texas (12)
	12	63	25	1,412					Undisclosed university in Kentucky (13)

**Table 3: Summary of PSS-10 Data.** For each study listed on the right, the percentage of respondents that stated mild (PSS-10 score range 0-13), moderate (PSS-10 score range 14-26), and moderately severe to severe (PSS-10 score range 27-40) stress severity symptoms is reported. Sample sizes of respondents are also reported from pre- or early pandemic to during the pandemic, where applicable. The mean PSS-10 scores from pre- or early pandemic to during the pandemic, where applicable, are also reported, along with p-values indicating whether the change in mean PSS-10 scores was significant (\*p < 0.05).