Tracking Depressive Symptom Rates in America: Insights from COVID-19 Survey Data

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Abstract

Globally, depression is a leading cause of disability and is widely believed to have been exacerbated by the social, economic, and health-related stresses associated with the COVID-19 pandemic. Using data from the CDC's Household Pulse Survey, this study examines reported depression symptom rates among U.S. adults from May 2020 to August 2024. The survey's goal was to explore differences across demographic groups and geographic regions in order to better understand COVID-19's impact socially and economically on different populations. This analysis uses non-parametric statistical tests to identify if there are differences in depressive symptoms within each subgroup. Additionally, time-series plots were created to track trends over time, and heat maps were developed to highlight variations across states. Results showed that younger adults (ages 18–29), females, individuals with lower levels of education, and certain racial and ethnic groups consistently reported higher rates of depressive symptoms compared to national averages. Statistical testing confirmed that many of these differences between subgroups were significant. Further, this analysis compares its findings to previous literature to gain understanding on how the symptom patterns

observed differ or align from established trends. It should be carefully noted that the relationships identified in this analysis are observational and should not be interpreted as causal.

Keywords: age, education, ethnicity, mental health, pandemic, race, sex, state

1 Background and literature review

As one of the most prevalent mental disorders among American adults, depression affects approximately eight percent of the population. This condition can lead to significant impairments, often disrupting or restricting an individual's ability to perform daily activities such as maintaining employment, managing household responsibilities, or engaging in meaningful social interactions (National Institute of Mental Health, 2023). Further, deaths from suicide in the United States totaled over 49,000 in 2022 and suicide rates rose by thirty-seven percent from 2000 to 2018. These rates then fell by five percent between 2018 and 2020; however, by 2022, rates had climbed back to their previous peak (Depression and Bipolar Support Alliance, 2025). Additionally, in 2022, suicide was the second leading cause of death among individuals aged 10–14 and 25–34. Approximately forty-five percent of those who died by suicide had been previously diagnosed with a mental health condition (U.S. Centers for Disease Control and Prevention, 2024). Understanding the demographic distribution of these conditions is essential in identifying at-risk populations and tailoring more effective prevention and intervention strategies.

Mental health is a fundamental component of overall well-being and plays a crucial role in shaping both individual quality of life and broader societal health outcomes. According to Bose et al. (2018), one in five U.S. adults lives with a clinically significant mental health or substance use disorder, with children and adolescents facing increasingly severe mental health challenges. Taking a more holistic approach from a public health perspective can help shift focus away from individualized care and toward broader solutions. In the public health space, the emphasis is on preventing illness at the community and population level.

Public health researchers work to identify the underlying causes of diseases and disabilities and implement large-scale solutions to tackle these issues. For example, rather than simply treating a gunshot wound, public health professionals focus on understanding the root causes of gun violence and developing interventions aimed at preventing it, addressing the problem at its source rather than individual cases (Johns Hopkins Bloomberg School of Public Health, 2023). When mental health is viewed through a public health lens, the framework shifts toward interventions aimed at improving outcomes at scale.

This perspective has become especially urgent in the context of the COVID-19 pandemic, which dramatically intensified mental health challenges worldwide. In the first year of the COVID-19 pandemic, depression and anxiety rose twenty-five percent across the globe. In the first year of the pandemic, rates of depression and anxiety increased by twenty-five percent worldwide. According to a World Health Organization (2022) briefing, approximately ninety percent of countries acknowledged that the early stages of the pandemic could contribute to a rise in mental health conditions. These rises can be attributed to individuals increased fear of illness, death, condition of loved ones, grief, and financial stressors. Additionally, the unprecedented stress of social isolation and the constraints placed on peoples ability to work and see loved ones created further distress. The brief included estimates from a Global Burden of Disease study, showing that the pandemic has affected the mental health of young people and women at heightened rates. As the world continues to navigate the long-term impacts of the pandemic, addressing mental health must remain a global priority.

This analysis, seeks to examine mental health trends across different populations using survey data that categorizes individuals by age, sex, race/ethnicity, education level, and state. With this, there are three main research questions at hand: (1) How do these trends change over time? (2) Are there statistically significant differences in depression symptom rates between subgroups? (3) Do certain states show rates higher than other states or the national average? The subgroups analyzed include sex, age, race/ethnicity, and education level. This research explores potential explanations for these patterns across all demographic

and geographic populations. It aims to provide valuable insights to inform public mental health initiatives. Identifying populations that are more susceptible to depression and highlighting areas where targeted interventions are most needed can help guide the development of more effective and equitable mental health strategies.

Throughout the remainder of this study, Section 2 describes the dataset and provides further detail on the variables and structure of the data. Section 3 outlines the statistical methods and visualizations used to conduct the analysis. Section 4 presents the results and discusses their interpretation. Finally, Section 5 compares the results to previous works and considers their significance for future studies.

2 Description of data

Obtained from the Centers for Disease Control and Prevention's (CDC) website, the dataset used tracks weekly depressive symptom rates across multiple demographics. Originally designed to monitor the social and economic impacts of the COVID-19 pandemic, this dataset relies on self-reported survey responses to measure symptoms of depression rather than clinically diagnosed cases. Collected weekly, participants provided information on employment status, consumer spending, food security, housing, education disruptions, and various aspects of physical and mental well-being. However, for this analysis, only mental health and demographic data were used and available to the public. The reported rates of depressive symptoms were weighted to adjust for non-response and to match Census Bureau estimates of the population by age, sex, race and ethnicity, and educational attainment. All estimates shown meet the National Center for Health Statistics (NCHS) Data Presentation Standards for Proportions (Centers for Disease Control and Prevention, 2025). The data was ethically collected through self-reported symptom survey and made publicly available by the CDC.

To understand more about how the survey was conducted, the NCHS included questions to obtain information on the frequency of depressive symptoms. The questions were a

Table 1: Description of Variables

Variable Name	**Description**
Value	Percentage of adults reporting depressive symptoms
Education Level	Highest level of education attained.
Racial/Ethnic Group	Self-identified race/ethnicity.
Age Group	Grouped into 10-year intervals starting at 18 (e.g., 18-29, 50-59, etc.).
State	U.S. state of residence at the time of survey response.
State Depression Rate	Percentage of respondents in each state reporting symptoms.
National Depression Rate	Percentage of all respondents nationwide reporting symptoms.

modified version of the two-item Patient Health Questionnaire (PHQ-2) to include questions that could potentially indicate an individual with a depressive disorder. These questions include: (1) Over the last 7 days, how often have you been bothered by having little interest or pleasure in doing things? (2) Over the last 7 days, how often have you been bothered by feeling down, depressed, or hopeless? Each respondent was required to answer in the following statement:, "Would you say not at all, several days, more than half the days, or nearly every day? Select only one answer." For each scale, the answers were assigned a numerical value: not at all = 0, several days = 1, more than half the days = 2, and nearly every day = 3. Each respondent's answers were assigned numerical values based on this scale. The total score was then calculated by summing the responses to both questions. A combined score of three or higher on the PHQ-2 has been associated with a diagnosis of major depressive disorder. Moreover, starting July 21, 2021, the reference period for survey questions was updated from the "past 7 days" to the "past two weeks" (Centers for Disease Control and Prevention, 2025).

The primary outcome variable, referred to as the "value" in the dataset, represents the percentage of adults whose PHQ-2 scores met or exceeded the clinical threshold, indicating symptoms consistent with depression (Centers for Disease Control and Prevention, 2025). The survey data also provides insight into a range of demographic characteristics, including subgroup averages for age, sex, race/ethnicity, education level, and state, along with national-level estimates for comparison. For each time period, the "value" reflects the proportion

of participants experiencing depressive symptoms during the reference week. To ensure consistency, the date associated with each observation corresponds to the start of the reported week. Data were collected between May 5, 2020, and August 8, 2024, spanning approximately 72 weeks and comprising 5,230 total observations. A summary of key variables used in the analysis is provided in Table 1.

3 Methods

A comprehensive understanding of the dataset was established prior to addressing the exploratory questions at hand. Time-series variation in reported depressive symptom rates are evident in the visualizations created using Python's Matplotlib. These plots assist in identifying seasonal trends and assessing whether specific demographic subgroups exhibit higher or lower rates persistently. Additionally, the start date of each survey time period was used as the reference point for all visualizations. The data were divided by age, sex, education level, and race/ethnicity, with separate data frames created for each category to ensure clarity and precision in the figures. Moreover, the data frame representing the "National Estimate" over the seventy-two-week observation period to serve as a reference point. This national estimate line was overlaid onto each demographic-specific plot to facilitate direct visual comparisons. Seasonal fluctuations and demographic disparities in reported depressive symptoms were evident throughout the study period.

To assess whether there were statistically significant differences in reported depressive symptoms across demographic subgroups, both Welch's t-tests and Kruskal-Wallis test were conducted. Given the data covered several years, each weekly observation within a subgroup was treated as an independent over time. For the binary comparisons, such as between sexes, the Welch's t-test was applied to compare the mean symptom rates between male and female respondents. Welch's t-test is specifically useful to test for differences in means between two groups when variances may be unequal. The Kruskal-Wallis test was used

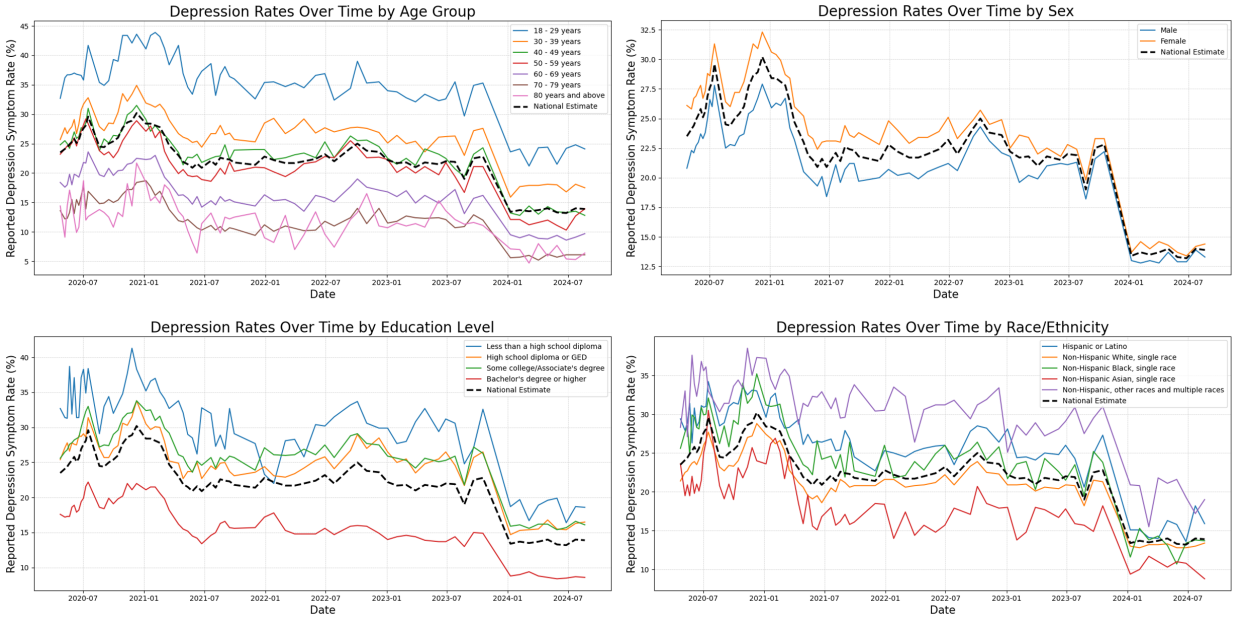

Figure 1: Symptom Rates Over Time by Subgroup

to identify differences in depressive symptom rates across three or more groups without assuming normality or equal variances. The Kruskal-Wallis test assesses whether at least one group differs significantly in its distribution of values compared to the others. An initial attempt to use a one-way ANOVA was rejected due to violations of the normality assumption, as indicated by the Shapiro-Wilk test ($p < 0.05$). As a result, the Kruskal-Wallis test was selected as a more appropriate alternative. When the Kruskal-Wallis test indicated statistically significant differences, follow-up pairwise comparisons were performed using Dunn's test with Bonferroni correction to determine which specific subgroups differed significantly.

Lastly, state-level changes in depressive symptom rates over time were examined using comparative heat maps. Three maps were generated: one displaying the average depressive symptom rate in each state over the full 72-week observation period, and two others capturing rates at key time points, April 23, 2020 (early pandemic), and April 26, 2023 (post-pandemic period). For each map, state-level data were extracted from the survey's "By State" subgroup, then merged with a U.S. state shape file and projected with con-

sistent scaling. For simplicity only the continental United States was displayed as Alaska, Hawaii, and the District of Columbia were excluded from the final figure. To support accurate visual comparison between the two time-point maps, a shared color scale was defined based on the combined minimum and maximum rates across all dates. Each map includes labeled state abbreviations and corresponding depression rates, with offset annotations used for small northeastern states to improve label placement. Together, these visualizations aim to provide a geographic view of depressive symptoms across the United States.

4 Results

Visual observation of depressive symptom rates revealed both consistent subgroup patterns and an abrupt overall downwards shift around October 2023. This drop is consistent among all subgroups and the national average, and can be see in every depiction in Figure 1. This change may reflect a shift in sample size, methodology, or data reporting practices, and should be considered when interpreting post-October trends. Despite this, subgroup averages continued to follow similar trends relative to one another after this observed change.

4.1 Depressive Symptom Rates by Age

Each demographic group was analyzed independently to identify specific patterns. This approach facilitated the identification of discrepancies between subgroups. Several meaningful patterns emerged from the analysis of age groups. Individuals aged 18–29 years reported the highest average levels of depressive symptoms at 35.1%, followed by the 30–39 year group at 26.7%. A gradual decrease was observed across older age categories, with 40–49 years averaging 23.4%, 50–59 years at 21.5%, and notably lower rates among those aged 60–69 years (16.7%), 70–79 years (12.2%), and 80 years and above (11.9%). All age groups followed similar patterns over time, with spikes and lows occurring around comparable time points. Ages 18–29 and 30–39 showed rates higher than the national estimate (22.7%), while

40–49 and 50–59 were approximately at the national average, and all age groups 60 and older reported rates notably below the national estimate. These distinctions remained relatively stable throughout the time series. Moreover, Dunn's test results confirmed that most pairwise differences between age groups were significant ($p < 0.01$), particularly between younger and older age groups, highlighting a consistent pattern of higher depressive symptom rates among younger individuals. However, no significant difference was found between the 70–79 and 80+ age groups ($p > 0.05$), indicating that symptom rates were comparable among the oldest individuals.

4.2 Depressive Symptom Rates by Sex

Additionally, when examining symptom rates by sex, females consistently reported higher levels of depressive symptoms than males ($p < 0.01$). On average, females had a symptom rate of 24.1%, compared to 21.2% for males, both relative to the national estimate of 22.7%. The formal hypotheses for this comparison were:

$$H_0 : \mu_{\text{female}} = \mu_{\text{male}} \quad \text{vs.} \quad H_a : \mu_{\text{female}} \neq \mu_{\text{male}}$$

While both groups followed similar patterns over time, with noticeable peaks and troughs, the difference in magnitude was most pronounced between September 2020 and August 2022, where the gap stayed around approximately five percentage points. After this period, the difference narrowed slightly, generally ranging between two and three percentage points. Despite this diminished gap, females consistently reported higher symptom rates throughout the observed period.

4.3 Depressive Symptom Rates by Education

Reported depressive symptom rates varied notably by education level, revealing a clear inverse relationship between educational attainment and symptom prevalence. Among all ed-

ucation levels, individuals with a Bachelor's degree (16.0%) consistently showed rates below the national estimate, often reporting rates five or more percentage points less. Additionally, this subgroup demonstrated the most consistent symptom rates, with notably less volatility than rates observed in other education levels. Further, all other education levels were above the national estimate. Those with a high school diploma (25.0%) and those with at least some college/Associate's degree (26.0%) showed similar symptom rates, both ranging from one to five percentage points above the national estimate. Individuals with less than a high school diploma (30.1%) exhibited the highest rates of depressive symptoms, approximately five to seven percentage points higher than the national average. Additionally, statistical test results confirmed that individuals with a Bachelor's degree reported significantly lower symptom rates compared to all other education groups ($p < 0.01$); however, no significant difference was found between those with a high school diploma and those with some college or an Associate's degree ($p > 0.05$).

4.4 Depressive Symptom Rates by Race/Ethnicity

Meaningful variation in reported depressive symptom rates was observed across racial and ethnic subgroups. Non-Hispanic Asian individuals (18.2%) reported the lowest average rate of depressive symptoms at approximately four to five percentage points below the national average. Conversely, individuals identifying as Non-Hispanic, other races or multiple races (30.4%) had the highest symptom rates, averaging around six to eight percentage points above the national estimate. Respondents who were Non-Hispanic Black (24.6%), Hispanic or Latino (26.2%), and Non-Hispanic White (21.4%) reported rates relatively close to the national average (22.7%), with White individuals consistently reporting the lowest rates among these three groups. Further, statistical testing confirmed that Non-Hispanic Asian individuals reported significantly lower symptom rates than all other racial and ethnic groups ($p < 0.01$), while Non-Hispanic individuals of other or multiple races had significantly higher rates than all other subgroups ($p < 0.01$). In contrast, there was no significant difference in

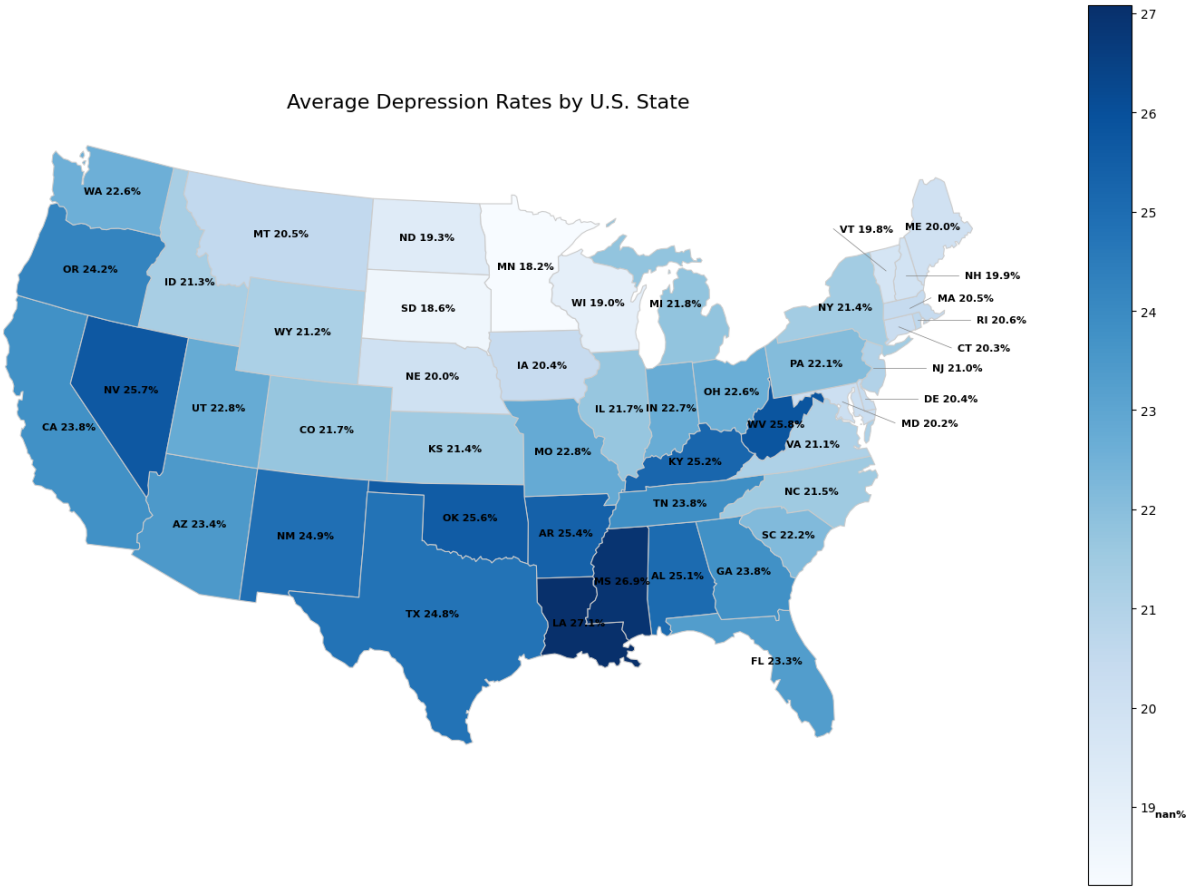

Figure 2: Average Depressive Symptom Rate by State (April 2020 - August 2024)

symptom rates between Hispanic or Latino and Non-Hispanic Black individuals ($p > 0.05$). Although levels of reported symptoms varied across subgroups, each racial and ethnic group followed similar date trends over the observed period.

4.5 Depressive Symptom Rates by State

When looking at symptoms reported at the state level, several notable differences emerge across regions. A map made of the continental United States highlights these regional variations. Although Alaska and Hawaii were not included in the final figure, their average symptom rates were 23.3% and 20.8%, respectively. Figure 2 demonstrates the averages over the entire observed time period. This includes combined effects from the COVID-19 pandemic as well as the post-pandemic period. Specific states stand out due to their con-

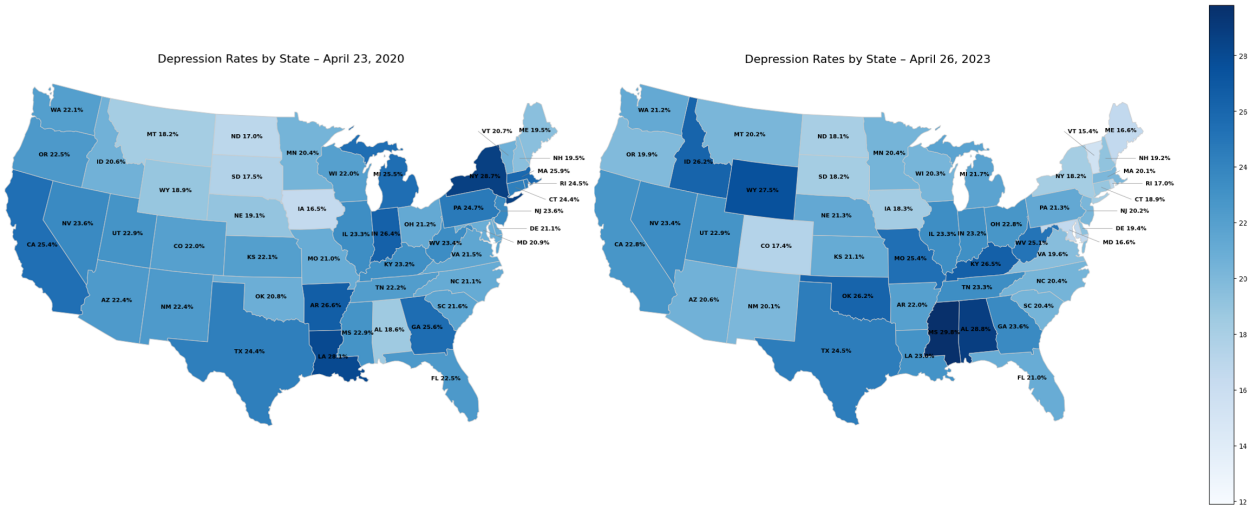

Figure 3: Pre and Post Pandemic Symptom Rates

sistently higher or lower rates compared to the rest of the country. As a point of reference, the demographic areas of the United States are easily distinguishable as North and South based on the heatmap of reported symptoms. States with higher reported symptoms include Louisiana (27.1%), Mississippi (26.9%), West Virginia (25.8%), and Nevada (25.7%). States in the Midwest had the lowest reported symptoms, including Minnesota (18.2%), South Dakota (18.6%), Wisconsin (19.0%), and North Dakota (19.3%). These findings help highlight the meaningful geographic disparities in reported symptoms across the United States.

In addition to overall averages, state-level depressive symptom rates were compared at two key time points, one during the early stages of the COVID-19 pandemic and another several years later. At the beginning of the pandemic, depressive symptom rates were substantially higher nationwide as seen in Figure 3. For example, on April 23, 2023, New York had the highest depressive symptom rate at 28.7%, followed by Louisiana (28.1%), and Indiana (26.4%). The least symptomatic state during this time-period was Iowa (16.5%). Almost three years later on April 26, 2023, the rates shifted notably. For example the states with the highest levels are Mississippi (29.8%), Alabama (28.8%), and Wyoming (27.5%). The state with the lowest reported symptoms was Vermont (15.4%), notably lower than the rest of the country and consistently low across multiple time periods. Overall, the comparison between

these two time periods illustrates a general decline in reported symptoms throughout the country.

5 Discussion

5.1 Age-Based Disparities in Reported Depressive Symptoms

When examining reported symptom rates by age, individuals aged 18–29 years stood out with significantly higher levels of depressive symptoms compared to all other age groups. This subgroup has been widely recognized in previous literature as one of the most vulnerable to mental health challenges, particularly in the wake of the COVID-19 pandemic. Major contributing factors include increased social media use, academic pressures, and economic stress, all of which disproportionately affect younger adults. Studies have linked these stressors to decreased academic and professional performance, higher rates of substance abuse, and elevated risks of suicidal thoughts. These findings highlight the critical need for targeted interventions, including expanded access to social support systems and counseling services in settings commonly accessed by this age group, such as colleges, early career programs, and community centers (Osorio and Hyde, 2021).

5.2 Sex-Based Disparities in Reported Depressive Symptoms

Notably, this study found that females reported higher rates of depressive symptoms than males, a finding consistent with a broad range of existing research. There are many suspected reasons for this, as the triggers for depression can be different between the two sexes. For females, hormonal fluctuations are strongly associated with increased vulnerability to depressive symptoms. Specific forms of depression-related conditions, such as premenstrual dysphoric disorder (PMDD), postpartum depression, and perimenopausal depression and anxiety, occur exclusively in females and are associated with fluctuations in ovarian hormone levels. Further, the sexes present symptoms differently, as females present internaliz-

ing symptoms while males present externalizing symptoms. Women tend to experience and express depression through emotional distress and withdrawal, whereas men are more likely to exhibit symptoms such as anger, risky behavior, or substance use. For instance, a study of fraternal twins found that females were more affected by issues in personal relationships, while males were more influenced by factors related to their careers and achievement of goals (Albert, 2015). While this analysis utilized data from the Household Pulse Survey, which effectively captures internalizing symptoms such as feelings of sadness, hopelessness, and loss of interest, it may underestimate the prevalence of depression among males, who may experience emotional distress in different, less easily recognized ways. For further research, additional questions that highlight feelings of aggression, recklessness, temper, or increased substance use may better encapsulate the entirety of depressive symptoms across the sexes.

The gap in symptoms between females and males was observed as more pronounced during the COVID-19 pandemic. This disparity can be explained by disproportionate social and caregiving responsibilities placed on women during this time of social isolation. The mandatory lockdown instated in March 2020, forced people to be in close and prolonged coexistence with family members. This may have led to increased domestic tension, as some reports indicate a rise in domestic violence during this period of lockdown. Further, the additional psychological strain of upkeeping caregiving roles, combined with the fear of a global pandemic, placed immense pressure on women. Likewise, women who continued to work during the pandemic faced the dual burden of providing both financial support and care, often without access to social support networks such as daycare, due to the stay-at-home provisions in place at the time. (Arilha et al., 2024). Although these are factors that can give context to the disparity at hand, they are presented to offer insight and not to imply a causal relationship between the pandemic and the depressive symptom gap.

5.3 Racial/Ethnic-Based Disparities in Reported Depressive Symptoms

From the survey data, Non-Hispanic White individuals reported fewer depressive symptoms than individuals of Hispanic or Latino and Non-Hispanic Black backgrounds. This observation contrasts with existing literature, which typically finds that White individuals experience higher rates of depressive symptoms compared to other subgroups. While this pattern is observed in other studies, Black and Hispanic individuals face a disproportionately greater risk of being undiagnosed with major depression, as diagnosis rates in these communities are generally lower than among their White counterparts. However, research suggests that increased availability of mental and behavioral health services in these communities is associated with higher diagnosis rates, indicating that improved access can help reduce under diagnosis (Blue Cross Blue Shield, 2025). Limited access to affordable mental health services may also contribute to higher self-reported symptom rates, as individuals experiencing barriers to treatment are less likely to have their symptoms managed or formally diagnosed. Because the Household Pulse Survey relies on self-reported symptoms rather than clinical diagnoses, it may offer a more accurate reflection of depression levels in undeserved communities. Given these findings, further research is needed to investigate the underlying factors contributing to these disparities and to assess how access to care influences the reporting, diagnosis, and persistence of depressive symptoms in these populations.

5.4 State-Level Disparities in Reported Depressive Symptoms

At the state level, the averaged results did not fully align with current statistical reporting. For instance, according to Haines (2023), the states with the highest depression rates include West Virginia (29%), Kentucky (27.6%), Vermont (26.6%), and Tennessee (26%). This study differed in methodology as it examined the share of adults in each state who reported poor mental health in at least 14 of the last 30 days, so rates may differ because of that. In

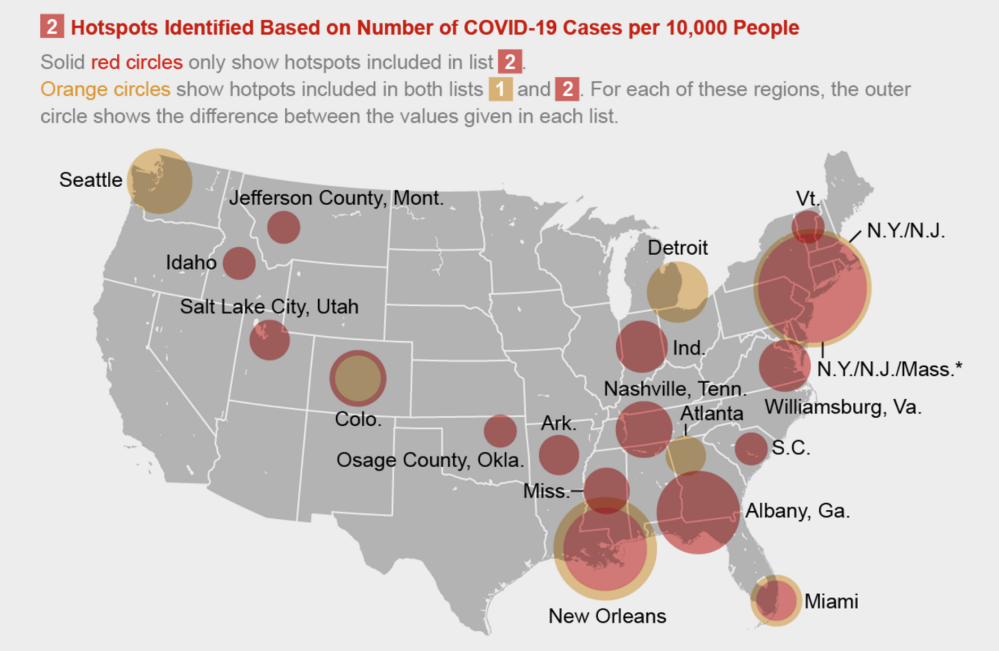

Figure 4: COVID-19 hot spots per 100,000 people as of March 29, 2020 (Kolak et al., 2020).

my study, only West Virginia was in the top four. Additionally, Haines (2023) lists Hawaii (11.4%), California (15.3%), Maryland (17.2%), and South Dakota (17.2%) as having the lowest depression rates, but only South Dakota overlapped in my analysis. These differences may be due to the structure of survey data and response rates. The number of individuals from each state may have not been sufficient to produce highly accurate state-level estimates, particularly when compared to the other demographic subgroups also used in this study.

With this in mind, when comparing state depression rates during and after COVID-19, a few states stand out in comparison to the overall national average map. For example, in April 2020, New York and Louisiana recorded the highest reported symptom rates, as shown in Figure 3. Interestingly, a map produced by the University of Chicago's Center for Spatial Data Science Kolak et al. (2020) highlights COVID-19 hot spots per 100,000 people as of March 29, 2020 (Figure 4). Both maps draw attention to two prominent areas, New York/New Jersey and New Orleans, Louisiana. In the wake of lockdown and a global pandemic, these stressors may have contributed to an increase in depressive symptoms and raise important questions about the need for further research into the causal effects of the

COVID-19 pandemic on mental health.

This research aims to identify trends in depressive symptoms among U.S. adults during and after the COVID-19 pandemic by utilizing t-tests, Kruskal-Wallis tests, Dunn's tests, and visual analyses. Results found that younger adults, females, individuals with less educational attainment, and racial and ethnic minorities consistently reported higher symptom rates. These findings could be a result of differences in access to care, social and economic stress, and generational patterns. Due to this analysis being an observational study, no causal relationships were found; however, it hopes to guide more targeted research in the future. Further research could incorporate survey questions that capture both internalizing and externalizing depressive symptoms, examine disparities between self-reported and clinically diagnosed depression in populations with limited access to care, and employ larger, more robust statistical models to track changes in depression rates over time. Additionally, the sudden drop in reported symptoms during October 2023 calls for further investigation, as to whether it reflects a real shift in trends or changes of survey methodology. Prioritizing continued research can support the development of a more equitable approach to treatment for mental health, ensuring that all individuals have access to the care that they need.

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Supplemental Materials

Additional materials for this analysis are provided in the Supplemental Materials section of the repository. All code and data used in this manuscript are available at this GitHub repository.

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