

Title: Mental Distress in the United States at the Beginning of the 2019 Coronavirus Disease (COVID-19) Pandemic

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Abstract:

Objectives. To assess the impact of the 2019 Novel Coronavirus (COVID-19) pandemic on mental distress in US adults.

Methods. Participants were 5,065 adults from the Understanding America Study, a probability-based Internet-panel representative of the US adult population. The main exposure was survey completion date (March 10-16, 2020). The outcome was mental distress measured via the Patient Health Questionnaire-4.

Results. Among states with 50 or more COVID-19 cases as of March 10, each additional day was significantly associated with an 11% increase in the odds of moving up a category of distress (OR=1.11 [95% CI 1.01-1.21]; p=.02). Perceptions about the likelihood of getting infected, death due to the virus, and steps taken to avoid infecting others were associated with increased mental distress in the model including all states. Individuals with higher consumption of alcohol or cannabis or with history of depressive symptoms were at significantly higher risk for mental distress.

Conclusions. These data suggest that as the COVID-19 pandemic continues, mental distress may continue to increase, and should be regularly monitored. Specific populations are at high risk for mental distress, particularly those with preexisting depressive symptoms.

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The United States has entered into a new historical phase with the rapid spread of the novel coronavirus SAR-CoV-2 (COVID-19 disease) and deaths due to COVID-19. Data from China suggest the mental health impacts of COVID-19 are severe¹. Thus far, there is little data on the mental health impact of the pandemic in the United States. This information is critical as there is a robust literature on how public health crises, such as SARS or natural disasters, can lead to mental health challenges, including symptoms of acute stress, loneliness, anxiety, and depression². Social distancing recommendations may further increase the likelihood of mental health symptoms, since isolation is known to have detrimental mental health effects³.

Early findings from China indicate the serious mental health impact of the COVID-19 pandemic. In one survey with 1,210 participants conducted in January and February 2020, 54% rated the psychological impact of the COVID-19 pandemic as moderate to severe, 29% reported moderate to severe anxiety symptoms, 17% reported moderate to severe depressive symptoms, and 8% reported moderate to severe stress levels¹. Another survey with 52,730 respondents in January and February 2020 reported that almost 35% of the sample experienced psychological distress⁴. This study also found regional differences in psychological distress, with respondents from Hubei province, the epicenter of the COVID-19 pandemic, reporting significantly higher distress. Moreover, people with preexisting mental disorders could be more heavily affected by the COVID-19 pandemic, including possible relapse or exacerbation of psychiatric conditions⁵.

There are marked mental health disparities in the US that are likely to be exacerbated by this pandemic. For example, serious mental distress is more common in women, in those uninsured, and is often comorbid with chronic somatic conditions⁶. Additionally, those in higher income brackets have lower rates of serious mental distress⁶. Existing research has linked economic

hardship with the incidence⁷ and progression⁸ of mental disorders. Difficulty with finances not only contributes to stress but also is a leading barrier to receiving mental health and substance use disorder treatment⁹. The COVID-19 pandemic has become intertwined with an economic crisis and has resulted in widespread job loss and economic downturn¹⁰. Information is needed to understand how shifting labor market outcomes, secondary to the COVID-19 pandemic, are potentially exacerbating mental health disparities across the US. Research from China has already demonstrated that college students whose families had less stable incomes were at increased risk of mental distress due to COVID-19¹¹.

The social isolation, financial hardship, and fear associated with COVID-19 could present a perfect storm for public mental health in the US. Data are needed to track the impact of the COVID-19 pandemic on mental health, including identifying those in greatest need, to serve as evidence-based information for the public and to marshal resources across local, state, and federal agencies. The current study addresses this need by examining predictors of mental distress in a nationally-representative household panel during a period of rapid spread of COVID-19 in the U.S.

Methods

Study Sample

Data for this project comes from the Understanding America Study (UAS), a probability-based Internet-panel recruited via postal mailings. Eligible participants were selected based on a random selection of addresses drawn from the post office delivery sequence files via a commercial vendor¹².

The initial panel intake survey includes an age screening; eligible individuals are all adults aged 18 and older in the contacted household. The UAS panel consists currently of 11 nationally-representative sample batches, rolled into the panel between 2014 and 2019. The current analysis uses early release (March 17, 2020) data from the UAS 230 wave which was fielded between March 10th and March 16th. This week of data collection paralleled the declaration of COVID-19 as a pandemic by the World Health Organization, of a national emergency by the President of the United States, and the beginning of school and work closures and social distancing recommendations.

All active respondents of the UAS were selected for participation, except Spanish speakers. As such, this survey was made available to 8,502 UAS participants. Of the 8502 invited participants, 5325 completed the survey and are counted as respondents (overall response rate of 63%). Of those who are not counted as respondents, 89 started the survey without completing and 3088 did not start the survey.

Survey weights for UAS account for probabilities of sample selection and alignment to Current Population Survey benchmarks, along socio-economic dimensions, gender (male/female), race and ethnicity (White/Black/Other/Hispanic), age (18-39/40-49/50/59/60+), education (High school or less/Some college/Bachelor or more), Census regions (Northeast/Midwest/South/West), and fraction of Native Americans. The reference population considered for the weights is the U.S. population of adults age 18 and older. More information about UAS can be found at <https://uasdata.usc.edu/index.php>, while specific information about

the UAS 230 survey is at <https://uasdata.usc.edu/page/COVID-19+Corona+Virus>. Survey weights were used in all analyses.

Measures

Mental Distress and Substance Use

The primary outcome measure of interest was the 4-item version of the Patient Health Questionnaire (PHQ-4), which has been validated in the general population¹³. This measure asks about the frequency of being bothered by feelings of nervousness, worry, depression, and loss of interest over the past 2 weeks. Response options include not at all (0), several days (1), more than half the days (2), and nearly every day (3). The total score is determined by adding the scores of each of the 4 items. Scores are categorized as normal (0-2), mild (3-5), moderate (6-8), or severe (9-12). A score of ≥ 3 for the first two items suggests anxiety, while a score of ≥ 3 on the last 2 items suggests depression¹⁴. In an earlier wave of data collection participants completed the 8-item version of the Center for Epidemiologic Studies-Depression Scale (CES-D 8)¹⁵. The number of symptoms a respondent previously endorsed as occurring “much of the time” in the past week was used as a measure of historical depressive symptoms. The most recent CES-D 8 was used for participants who had multiple CES-D 8 from prior waves (49% of sample had CES-D 8 from June 2019, 32% from June 2017, and 19% from May 2015).

COVID-19 Items

Respondents were asked to provide their best estimate of the chance (0-100%) that they would become infected with COVID-19 in the next 3 months and that they would die if infected. We

classified individuals as having a perception of 0%, 1-50%, or >50% for both of these questions. The category of 0% was used as the reference group because these variables were zero-inflated. Participants were also asked whether they had “taken any steps to stay away from other people to avoid infecting them.” Response options were yes, no, and unsure. The survey start date (between March 10th and March 16th) was used to assess whether calendar time was associated with mental distress.

Other Variables

Sociodemographic factors included: gender (female or male); age (years); race/ethnicity (white, American Indian or Alaska Native, Asian, Black or African-American, Hawaiian or Pacific Islander, Hispanic or Latino, or multiracial); education (high school degree or below, attended some college or received a two-year degree, Bachelor’s degree, or Graduate degree); marital status (married, never married, separated or divorced, or widowed); household income (less than 20k, 20-39k, 40-59k, 60-99k, or 100k and above); and currently have a job (yes or no). Lastly, participants were asked to estimate the number of days over the past week on which they consumed alcohol and cannabis.

High- and Low-Count States

We classified states according to whether or not they had a high or low count of confirmed cases of COVID-19 as of March 10th, 2020, the first day the UAS 230 survey was fielded. States were deemed “high-count” states if they had at least 50 individuals diagnosed with COVID-19. On this date, the mean number of cases per US state was 3.9, with a median of 0. Four states had 50 or more cases as of this date and were classified as “high-count”: Washington (WA) state (267

cases), New York (NY) (173 cases), California (CA) (144 cases), and Massachusetts (MA) (92 cases). The remainder of states had 17 or fewer confirmed cases and were termed “low-count”¹⁶.

Statistical analyses

Associations between PHQ-4 levels (normal, mild, moderate, severe), sociodemographic and COVID-19 related variables were evaluated using survey-weighted bivariate tests (chi-square or ANOVA). A multivariable ordinal logistic regression model was then used to examine the independent associations between these factors as explanatory variables and categorical PHQ-4 levels (normal, mild, moderate, severe) as the outcome. The assumption was made that the increase between each PHQ-4 level (i.e. normal to mild, mild to moderate, moderate to severe) was equivalent. An approximate likelihood-ratio test of the proportionality of odds demonstrated that this assumption was not violated ($\chi^2 = 40.26$; $p = .06$).

The independent variables of interest were date on which the survey was completed (i.e. calendar time), perceived likelihood of becoming infected with COVID-19 in the next three months, of dying if infected, and whether participants took any steps to avoid infecting others. The model further adjusted for demographic factors, substance use in the past week, and previous symptoms of depression (CES-D 8). The model was then stratified by individuals residing in high- or low-count states in order to examine whether this modified the association between calendar time (date completing the survey) and PHQ-4 score. Because only a small number of states were significantly affected by COVID-19 during the week of data collection, we expected individuals

in these high-count states to have greater increases in mental distress relative to individuals in low-count states.

The analysis was restricted to 5,065 individuals (95% of n=5,325 respondents) with complete information on all our analytic variables (Table 2). All analyses used the UAS survey weights, allowing these findings to generalize to the adult US population. The analyses were performed in R Studio (R Studio version 1.1.383; R version 3.6.1) using the survey package (version 3.37)^{17,18}.

Results

Sample description

A total of 5,065 adults, ages ≥ 18 years of age, were included in this analysis. After applying the weights, slightly less than half were male (49%), most were between 18-54 years of age (61%), white (64%), half had an income of $\geq \$60,000$, and a quarter did not have any college experience (24%). A summary of sample characteristics is provided in eTable 1.

PHQ-4 Scores

PHQ-4 scores indicated that the majority of the sample (73.0%) reported a normal level of mental distress, 16.3% reported mild, 6.2% reported moderate, and 4.5% reported severe mental distress. Of all participants, 14.7% met the criteria for anxiety and 9.5% those for depression. The frequency of individual PHQ-4 items were similar to 2019 PHQ-4 estimates of the US adult population (eTable 3)¹⁹.

Correlates of mental distress

Unadjusted Analyses

In unadjusted bivariate tests, increasing number of days since March 10, 2020 was significantly associated with increased PHQ-4 total scores (i.e. higher mental distress) ($p<.001$). Between March 10th and March 16th, the proportion of normal PHQ-4 levels decreased from 74% to 64% and, and the proportion of mild PHQ-4 levels increased from 13% to 24%. The proportion of individuals with moderate or severe distress remained relatively constant, fluctuating between 3-7% and 2-7%, respectively (eFigure 1).

Individuals living in high-count states had significantly higher proportions of mild (19% vs 15%), moderate (7% vs 6%), and severe (6% vs 4%) levels of distress overall (eTable 1) as well as over time (Figure 1) ($p<.05$). The proportion of participants meeting criteria for anxiety was 17% versus 14%, and for depression was 11% versus 9% in the high- and low-count states, respectively; this difference was not statistically significant. Individuals with higher perceived likelihood of becoming infected with COVID-19 or dying if they were to become infected were at elevated risk for higher mental distress ($p<.001$). Participants who reported taking steps towards not infecting others or being unsure regarding whether they were taking these steps, were more likely to report mental distress ($p<.001$). Greater number of days using cannabis in the past week was associated with increasing mental distress ($p<.001$), though alcohol was not. Prior CES-D 8 score was positively associated with current PHQ-4 score ($p<.001$). Younger age, being female, being separated or divorced, and never married were significantly associated with greater distress (all $p<.001$). Higher household income and currently having a job were protective against mental distress ($p<.001$).

Adjusted and Stratified Analyses

Among individuals living in high-count states (WA, NY, CA, MA), each additional day past March 10 was associated with an 11% increase in the odds of moving up to the next PHQ-4 level (i.e. moving from normal to mild symptoms, mild to moderate, or moderate to severe) (OR=1.11 [95% CI 1.01-1.21]; $p=.02$). This finding was significant when adjusting for demographics variables (age, gender, race/ethnicity, marital status, education, household income, currently having job), as well as use of cannabis and alcohol in the past week and historical CES-D 8 score. Among individuals living in low-count states, however, each additional day past March 10th was only associated with a 2% increase in the odds of moving up to the next PHQ-4 level, and this association was not statistically significant (OR=1.02 [95% CI 0.95-1.10]; $p=.50$). Higher perceived likelihood of infection (1-50% vs. 0% OR=1.89 [95% CI 1.23-2.91]; >50% vs. 0% OR=3.29 [95% CI 1.97-5.51]) as well as of dying if infected (1-50% vs. 0% OR=1.49 [95% CI 1.02-2.17]; >50% vs. 0% OR=1.83 [95% CI 1.06-3.16]) were significantly associated with higher mental distress among individuals residing in low-count states (Table 2). In a model including all states (eTable 4), each additional survey day past March 10 was associated with a 5% increase in the odds of moving up a PHQ-4 level, and this was not significantly significant (OR=1.05 [95% CI 0.99-1.11]; $p=.12$). Perceived likelihood of infection (1-50% OR=1.83 [95% CI 1.32-2.52]; >50% OR=2.77 [95% CI 1.82-4.21], both $p<.001$), dying if infected (>50% OR=1.64 [95% CI 1.06-2.54]; $p<.001$), and taking steps to avoid infecting others (OR=1.28 [95% CI 1.02-1.60]; $p=.03$) were all significantly associated with higher mental distress.

The strength of association and significance of other variables varied across these three models (high-count, low-count, overall), but generally, younger age, being separated or widowed, cannabis and alcohol consumption, and prior symptoms of depression were all significantly

associated with higher mental distress. Among the low-count states, American Indian or Alaska Native (OR= 0.08 [95% CI 0.01-0.54]), Asian (β = 0.37 [95% CI 0.15-0.94]), and Black or African-American (OR= 0.55 [95% CI 0.34-0.88]) individuals had significantly lower levels of mental distress, relative to white, non-Hispanic individuals.

Discussion

Data from this nationally-representative panel collected during the initial COVID-19 outbreak in the United States suggest mental distress is increasing. However, a significant increase in symptoms over 7 days, between March 10th and 16th, was only observed in states with a high count of COVID-19 cases (Washington, New York, California, and Massachusetts). Within these states, individuals responding to the survey at a later date had 10% higher odds (per day) of being in a higher response category, even after controlling for other factors that also increase the risk of mental distress. Importantly, while the overall distress level of this sample did not differ from a nationally representative sample prior to the pandemic¹⁹, these data suggest that as the pandemic continues, we may see increases in mental distress. Longitudinal data will be important to understand how the mental health of the population changes over the course of the pandemic. Increases in mental distress were also associated with an individual's perception of their personal risk of contracting or dying of COVID-19 in the next 3 months. Individuals who reported taking steps to avoid infecting others, which may reflect a greater awareness of COVID-19 (e.g. through news or social media exposure), also had higher levels of distress.

Certain sociodemographic and behavioral factors are consistently associated with the incidence and prevalence of mental disorders^{20–24}. The results of the current study are consistent with these

prior findings. Younger age, female gender, and not being married were risk factors, and higher income was protective in some of the models. Our findings emphasize the continued importance of these sociodemographic factors in predicting mental distress. Past week use of cannabis or alcohol, and historical symptoms of depression, were all associated with higher distress. This indicates that individuals with a pre-existing mental health disorder may be especially vulnerable to distress during this pandemic. We did not have current information on mental health diagnoses or whether individuals were receiving behavioral or pharmacologic treatments at the time of participation. These data will be important for understanding who, among those with a history of mental disorder, is at heightened risk for mental distress during and following the pandemic.

Among the low-count states, American Indian or Alaska Native, Asian, and Black or African-American individuals had lower levels of mental distress. This is consistent with a larger body of work demonstrating that, despite higher rates of poverty, poorer physical health, and greater discrimination and stressors, racial and ethnic minorities largely appear to have decreased risk of mental disorders^{25,26}. Though explanations for this ‘paradox’ are beyond the scope of this manuscript, we note the critical need for more research on this topic during this pandemic, especially given the rise in anti-Asian sentiment and the disproportionate impact of the pandemic on communities of color^{27,28}.

This study has both strengths and weaknesses. In terms of strengths, the data were timely, nationally-representative, and specific to the impacts of COVID-19. Furthermore, the outcome was measured using a psychometrically valid instrument¹³. We were also able to incorporate historical data on depressive symptoms, which was valuable for determining if those with pre-existing mental health conditions are particularly vulnerable. The greatest limitation was the cross-sectional design, hindering causal inference. It is possible that the association between

survey date and mental distress is confounded or that the person's mental distress during this data collection week influenced the date on which they chose to complete the survey. While we adjusted for demographic factors as well as prior depressive symptoms, the potential for bias remains. Lastly, the descriptive and analytic inferences made from this analysis are generalizable to the adult US population under the assumption that non-response is unrelated to any factors that are not included in the construction of the survey weights.

We are sensitive to the fact that, as of the writing of this paper, the US has had over 2 million confirmed cases of COVID-19, so our decision to use a threshold of 50 cases as criteria for labeling states as having a high- versus low-count may seem problematic. However, our decision to use 50 cases as the threshold was based on the number of cases in US states on the first day of data collection (March 10). Moving forward, analyses that use data collected at later points in the pandemic will have to classify states differently.

It is intuitive that a stressful experience, such as this pandemic, would increase mental distress, given the existing literature on how prior public health crises can negatively impact public mental health². Yet, the unprecedented scale and associated mortality of this pandemic, coupled with increases in social isolation and disruptions to life, speak to a potential crisis or 'perfect storm'²⁹. Together, these data reinforce the need for targeted prevention and intervention efforts among groups who are at greatest risk. Our findings also suggest reinforcing public health messages about minimizing substance use and ways to improve resiliency and reduce isolation during this time of great uncertainty. Policies and interventions, such as those that improve mental health education and access to behavioral health treatment via telehealth³⁰, online support³¹ (e.g., chat-based), or telephone support³² will be critical in mitigating the effect of the COVID-19 pandemic³³ on mental health. Previous research on the long-term effects of

pandemics and quarantining³⁴ suggests that the end of the crisis does not necessarily bring an end to deleterious mental health effects. Those affected may experience PTSD, depression, and anxiety months—or even years—afterwards³⁴. Any interventions created in response to the pandemic must include longer-term follow-up and must be accessible to those who have lost their health insurance and those who have few economic resources to pay for treatment³⁵.

The data presented in this paper are unique in that they capture the mental health of the U.S. population at an early and critical inflection point in the COVID-19 pandemic. In the US, the number of confirmed cases was still relatively low in most states and social distancing recommendations and school and work closures were just beginning. The status quo changed drastically from March 10th to March 16th, especially in states that were affected first. In the weeks that have followed, transmission increased exponentially, and the lives of most people in the U.S. have changed in dramatic ways. It is likely that mental health has changed in parallel. As more data are collected and analyzed, it will be critical to understand how the population's mental health is responding to these changes and which individuals and communities are at risk for poor mental health outcomes.

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Contributor Statement

Drs. Holingue, Kalb, and Thrul conceptualized and designed the study, carried out data analyses, drafted the initial manuscript, and revised the manuscript. Ms. Riehm assisted with data analyses and reviewing the manuscript. Drs. Bennett and Kapteyn designed and implemented the survey. Drs. Bennett, Kapteyn, Veldhuis, Johnson, Fallin, and Stuart assisted with interpreting results and reviewing the manuscript. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

Disclosure of Potential Conflicts of Interest

All authors have no potential conflicts of interest to disclose. The project described in this paper relies on data from survey(s) administered by the Understanding America Study, which is maintained by the Center for Economic and Social Research (CESR) at the University of Southern California. The content of this paper is solely the responsibility of the authors and does not necessarily represent the official views of USC or UAS. For any questions or more information about the UAS, contact Tania Gutsche, Project and Panel Manager, Center for Economic and Social Research, University of Southern California, at tgutsche@usc.edu.

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Human Participant Protection

Informed consent was sought from all participants. UAS panel procedures have been approved by the USC Institutional Review Board (IRB).

References

1. Wang C, Pan R, Wan X, et al. Immediate Psychological Responses and Associated Factors during the Initial Stage of the 2019 Coronavirus Disease (COVID-19) Epidemic among the General Population in China. *Int J Environ Res Public Health*. 2020;17(5):1729.
2. Huremović D. *Psychiatry of Pandemics: A Mental Health Response to Infection Outbreak*. Springer; 2019.
3. Leigh-Hunt N, Bagguley D, Bash K, et al. An overview of systematic reviews on the public health consequences of social isolation and loneliness. *Public Health*. 2017;152:157-171.
4. Qiu J, Shen B, Zhao M, Wang Z, Xie B, Xu Y. A nationwide survey of psychological distress among Chinese people in the COVID-19 epidemic: implications and policy recommendations. *Gen Psychiatry*. 2020;33(2).
5. Yao H, Chen J-H, Xu Y-F. Patients with mental health disorders in the COVID-19 epidemic. *The Lancet Psychiatry*. 2020;7(4):e21.
6. Weissman JS, Pratt LA, Miller EA, Parker JD. *Serious Psychological Distress Among Adults, United States, 2009-2013*. US Department of Health and Human Services, Centers for Disease Control and Prevention; 2015.
7. Kiely KM, Leach LS, Olesen SC, Butterworth P. How financial hardship is associated with the onset of mental health problems over time. *Soc Psychiatry Psychiatr Epidemiol*.

- 394 2015;50(6):909-918.
- 395 8. Wickrama KAS, Surjadi FF, Lorenz FO, Conger RD, O’Neal CW. Family economic
396 hardship and progression of poor mental health in middle-aged husbands and wives. *Fam*
397 *Relat.* 2012;61(2):297-312.
- 398 9. Mojtabai R, Chen L-Y, Kaufmann CN, Crum RM. Comparing barriers to mental health
399 treatment and substance use disorder treatment among individuals with comorbid major
400 depression and substance use disorders. *J Subst Abuse Treat.* 2014;46(2):268-273.
- 401 10. Simpson A. Coronavirus Recession Looms, Its Course “Unrecognizable.” *The New York*
402 *Times.* [https://www.nytimes.com/2020/03/21/business/economy/coronavirus-](https://www.nytimes.com/2020/03/21/business/economy/coronavirus-recession.html)
403 [recession.html](https://www.nytimes.com/2020/03/21/business/economy/coronavirus-recession.html). Published March 21, 2020.
- 404 11. Cao W, Fang Z, Hou G, et al. The psychological impact of the COVID-19 epidemic on
405 college students in China. *Psychiatry Res.* 2020:112934.
- 406 12. Alattar L, Messel M, Rogofsky D. An introduction to the understanding America study
407 Internet panel. *Soc Sec Bull.* 2018;78:13.
- 408 13. Löwe B, Wahl I, Rose M, et al. A 4-item measure of depression and anxiety: validation
409 and standardization of the Patient Health Questionnaire-4 (PHQ-4) in the general
410 population. *J Affect Disord.* 2010;122(1-2):86-95.
- 411 14. Kroenke K, Spitzer RL, Williams JBW, Löwe B. An ultra-brief screening scale for
412 anxiety and depression: the PHQ-4. *Psychosomatics.* 2009;50(6):613-621.
- 413 15. Bracke P, Levecque K, Van de Velde S. The psychometric properties of the CES-D 8

- 414 depression inventory and the estimation of cross-national differences in the true
415 prevalence of depression. *Univ Leuven*. 2008.
- 416 16. Johns Hopkins University. Coronavirus COVID-19 Global Cases.
417 <https://coronavirus.jhu.edu/map-faq.html>. Published 2020.
- 418 17. Lumley T. Analysis of complex survey samples. *J Stat Softw*. 2004;9(1):1-19.
- 419 18. RStudio Team. RStudio: Integrated Development for R. 2016.
- 420 19. National Cancer Institute. Health Information National Trends Survey - PHQ-4 Total
421 Score. <https://hints.cancer.gov/view-questions-topics/question-details.aspx?qid=1182>.
422 Published 2020.
- 423 20. Suokas K, Koivisto A-M, Hakulinen C, et al. Association of income with the incidence
424 rates of first psychiatric hospital admissions in Finland, 1996-2014. *JAMA psychiatry*.
425 2019.
- 426 21. Breslau J, Kendler KS, Su M, Gaxiola-Aguilar S, Kessler RC. Lifetime risk and
427 persistence of psychiatric disorders across ethnic groups in the United States. *Psychol*
428 *Med*. 2005;35(3):317-327.
- 429 22. Kessler RC, Berglund P, Demler O, Jin R, Merikangas KR, Walters EE. Lifetime
430 prevalence and age-of-onset distributions of DSM-IV disorders in the National
431 Comorbidity Survey Replication. *Arch Gen Psychiatry*. 2005;62(6):593-602.
432 doi:10.1001/archpsyc.62.6.593
- 433 23. Kessler RC, Chiu WT, Demler O, Walters EE. Prevalence, severity, and comorbidity of

- 434 12-month DSM-IV disorders in the National Comorbidity Survey Replication. *Arch Gen*
435 *Psychiatry*. 2005;62(6):617-627.
- 436 24. Regier DA, Farmer ME, Rae DS, et al. One-month prevalence of mental disorders in the
437 United States and sociodemographic characteristics: the Epidemiologic Catchment Area
438 study. *Acta Psychiatr Scand*. 1993;88(1):35-47.
- 439 25. Keyes CLM. The Black–White paradox in health: Flourishing in the face of social
440 inequality and discrimination. *J Pers*. 2009;77(6):1677-1706.
- 441 26. McGuire TG, Miranda J. New evidence regarding racial and ethnic disparities in mental
442 health: Policy implications. *Health Aff*. 2008;27(2):393-403.
- 443 27. Laurencin CT, McClinton A. The COVID-19 pandemic: a call to action to identify and
444 address racial and ethnic disparities. *J Racial Ethn Heal Disparities*. 2020:1-5.
- 445 28. Yancy CW. COVID-19 and African Americans. *Jama*. 2020.
- 446 29. Reger MA, Stanley IH, Joiner TE. Suicide mortality and coronavirus disease 2019—a
447 perfect storm? *JAMA psychiatry*. 2020.
- 448 30. Zhou X, Snoswell C, Harding L, et al. The Role of Telehealth in Reducing the Mental
449 Health Burden from COVID-19. *Telemed e-Health*. 2020;26(4).
450 doi:10.1089/tmj.2020.0068
- 451 31. Liu S, Yang L, Zhang C, et al. Online mental health services in China during the COVID-
452 19 outbreak. *The Lancet Psychiatry*. 2020;7(4):e17-e18.
- 453 32. Yang Y, Li W, Zhang Q, Zhang L, Cheung T, Xiang Y-T. Mental health services for older

adults in China during the COVID-19 outbreak. *The Lancet Psychiatry*. 2020;7(4):e19.

33. The Lancet Psychiatry. Send in the therapists? *The lancet Psychiatry*. 2020;7(4):291.

34. Brooks SK, Webster RK, Smith LE, et al. The psychological impact of quarantine and how to reduce it: rapid review of the evidence. *Lancet*. 2020.

35. Duan L, Zhu G. Psychological interventions for people affected by the COVID-19 epidemic. *The Lancet Psychiatry*. 2020;7(4):300-302.

Table 1. Mental Distress (PHQ-4 Levels) Over Calendar time, In High-Count and Low-Count States.

Survey Date	PHQ-4 Level	Frequency	
		High-count states	Low-count states
3/10/20	Normal	75.4%	73.2%
3/10/20	Mild	10.4%	13.3%
3/10/20	Moderate	8.1%	7.3%
3/10/20	Severe	6.0%	6.2%
3/11/20	Normal	69.5%	75.4%
3/11/20	Mild	19.1%	13.6%
3/11/20	Moderate	6.2%	6.0%
3/11/20	Severe	5.2%	5.0%
3/12/20	Normal	71.6%	76.2%
3/12/20	Mild	14.3%	14.8%
3/12/20	Moderate	9.9%	6.5%
3/12/20	Severe	4.1%	2.5%
3/13/20	Normal	64.4%	73.9%
3/13/20	Mild	22.8%	18.1%
3/13/20	Moderate	9.1%	6.2%
3/13/20	Severe	3.6%	1.8%
3/14/20	Normal	62.3%	80.3%
3/14/20	Mild	21.3%	15.1%
3/14/20	Moderate	4.9%	2.8%
3/14/20	Severe	11.4%	1.7%
3/15/20	Normal	69.3%	72.1%
3/15/20	Mild	22.8%	14.3%
3/15/20	Moderate	1.9%	6.0%
3/15/20	Severe	6.0%	7.6%
3/16/20	Normal	59.0%	65.6%
3/16/20	Mild	24.1%	24.3%
3/16/20	Moderate	8.6%	5.3%
3/16/20	Severe	8.3%	4.8%

High-count states are those with 50 or more confirmed COVID-19 cases as of March 10, 2020 (States WA, NY, CA, MA). Low-count state are all remaining US states, with fewer than 50 cases.

480 Table 2. Multivariable Ordinal Logistic Regression Model Estimating PHQ-4 Levels (normal;
 481 mild; moderate; severe), Stratified by High- and Low- Count States

	High COVID-19 Count States		Low COVID-19 Count States	
	OR	95% CI ^a	OR	95% CI ^a
Survey Date	1.11	(1.01 , 1.21)*	1.02	(0.95 , 1.1)
Perceived likelihood infection (ref: 0%)				
1-50%	1.40	(0.85 , 2.31)	1.89	(1.23 , 2.91)**
>50%	1.57	(0.74 , 3.3)	3.29	(1.97 , 5.51)***
Perceived likelihood death if infected (ref: 0%)				
1-50%	0.83	(0.53 , 1.29)	1.49	(1.02 , 2.17)*
>50%	1.65	(0.81 , 3.38)	1.83	(1.06 , 3.16)*
Age (years)	0.98	(0.97 , 0.99)***	0.98	(0.97 , 0.99)***
Gender (ref: Male)				
Female	1.42	(0.98 , 2.06)	1.43	(1.1 , 1.86)**
Race/Ethnicity (ref: non- Hispanic white)				
American Indian/Alaska Native	0.30	(0.01 , 7.77)	0.08	(0.01 , 0.54)*
Asian	0.99	(0.56 , 1.73)	0.37	(0.15 , 0.94)*
Black/African-American	0.73	(0.28 , 1.88)	0.55	(0.34 , 0.88)*

Hawaiian/Pacific Islander	0.17	(0.01 , 2.27)	0.30	(0.02 , 4.66)
Hispanic/Latino	1.02	(0.67 , 1.56)	0.79	(0.46 , 1.36)
Multiracial	1.01	(0.43 , 2.38)	0.80	(0.35 , 1.84)
Marital Status (ref: Married)				
Never married	1.04	(0.71 , 1.52)	1.30	(0.94 , 1.81)
Separated or divorced	1.33	(0.77 , 2.29)	1.56	(1.1 , 2.22)*
Widowed	0.34	(0.15 , 0.77)*	1.63	(0.99 , 2.7)
Education (ref: <=High school)				
Some college/two-year degree	1.20	(0.71 , 2.03)	0.91	(0.67 , 1.24)
Bachelor's	1.60	(0.87 , 2.93)	0.97	(0.66 , 1.41)
Graduate	2.00	(1 , 4.01)	1.02	(0.68 , 1.54)
Household Income (ref: <20k)				
20-39k	0.60	(0.33 , 1.07)	1.17	(0.76 , 1.81)
40-59k	0.76	(0.45 , 1.28)	0.86	(0.55 , 1.34)
60-99k	0.58	(0.33 , 1.02)	0.69	(0.43 , 1.1)
100k and more	0.69	(0.4 , 1.21)	0.82	(0.5 , 1.37)
Currently have job (ref: Yes)				
No	1.23	(0.84 , 1.82)	1.29	(0.96 , 1.74)
Num. days cannabis past week	1.12	(1.02 , 1.22)*	1.05	(0.98 , 1.13)
Num. days alcohol past week	1.01	(0.92 , 1.12)	1.07	(1.01 , 1.13)*

Historical depressive				
symptoms (CES-D 8)	1.40	(1.3 , 1.5)***	1.47	(1.38 , 1.56)***
Took Steps to Avoid Infecting				
Others (ref: No)				
Unsure	1.23	(0.43 , 3.55)	1.76	(0.82 , 3.79)
Yes	1.30	(0.91 , 1.87)	1.26	(0.96 , 1.67)

*p<.05; **p<.01; ***p<.001. ^aN=5,065 in total; N=1,940 in high-count states; N=3,125 in low-count states. High-count states are those with 50 or more confirmed COVID-19 cases as of March 10, 2020 (States WA, NY, CA, MA). Low-count state are all remaining US states, with fewer than 50 cases.

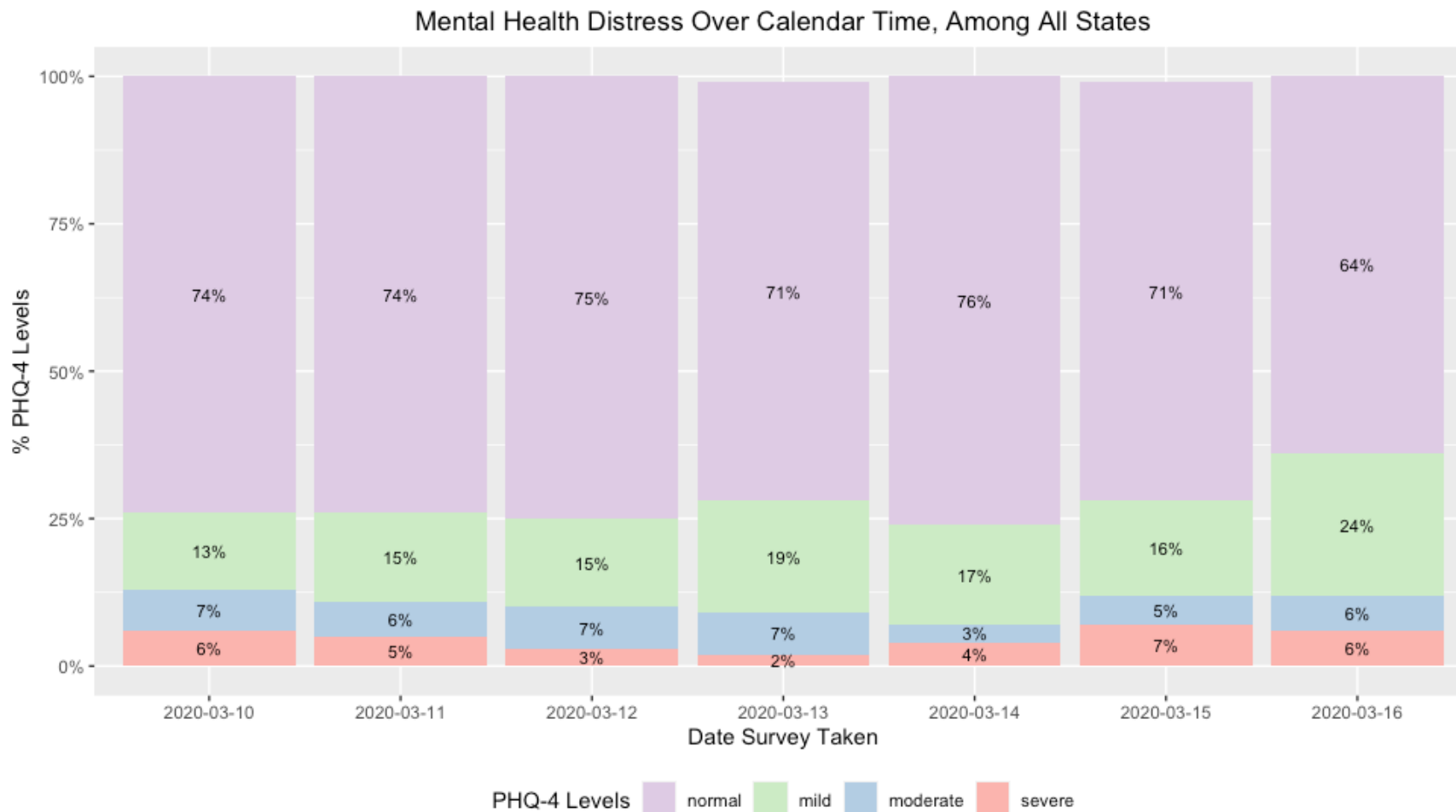
Supplemental Appendix

Mental Distress in the United States at the Beginning of the 2019 Coronavirus Disease (COVID-19) Pandemic

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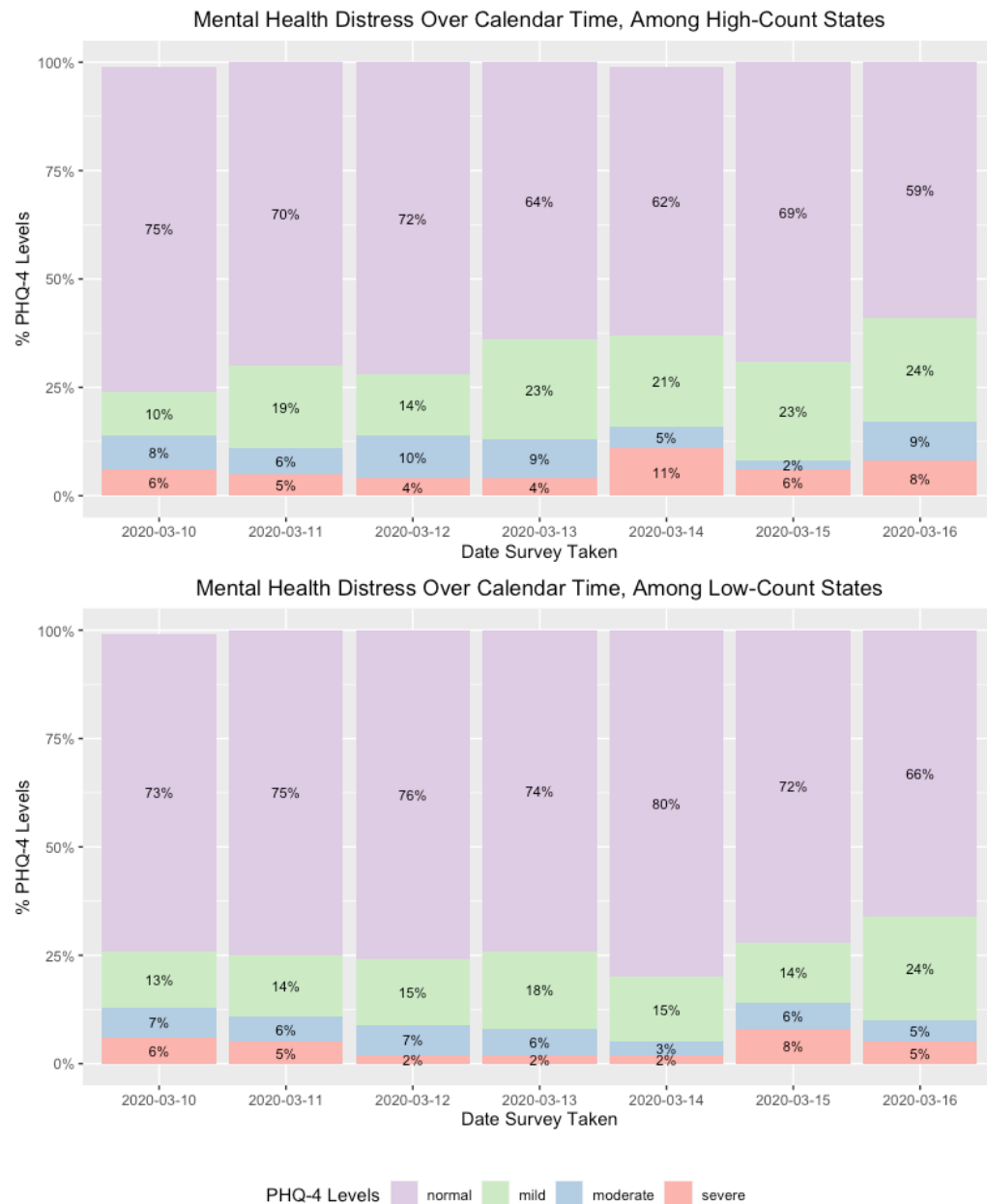
- eFigure 1. Mental Distress (PHQ-4 Levels) Over Calendar Time, Among All States (pg. 2)
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eFigure 1. Mental Distress (PHQ-4 Levels) Over Calendar Time, Among All States



eFigure 1. The primary outcome measure of interest was the 4-item version of the Patient Health Questionnaire (PHQ-4). This measure asks about the frequency of being bothered by feelings of nervousness, worry, depression, and loss of interest over the past 2 weeks. Response options include not at all (0), several days (1), more than half the days (2), and nearly every day (3). The total score is determined by adding the scores of each of the 4 items. Scores are categorized as normal (0-2), mild (3-5), moderate (6-8), or severe (9-12).¹

eFigure 2. Mental Distress (PHQ-4 Levels) Over Calendar time, In High-Count and Low-Count States.



eFigure 2. The primary outcome measure of interest was the 4-item version of the Patient Health Questionnaire (PHQ-4). This measure asks about the frequency of being bothered by feelings of nervousness, worry, depression, and loss of interest over the past 2 weeks. Response options include not at all (0), several days (1), more than half the days (2), and nearly every day (3). The total score is determined by adding the scores of each of the 4 items. Scores are categorized as normal (0-2), mild (3-5), moderate (6-8), or severe (9-12).¹ High-count states are those with 50 or more confirmed COVID-19 cases as of March 10, 2020 (States WA, NY, CA, MA). Low-count state are all remaining US states, with fewer than 50 cases.

eTable 1. Participant Characteristics among Total UAS Sample and Stratified by PHQ-4 Severity – mean (SE) or n (%)

	Total Sample (n=5,065)	PHQ-Severity				P-value ^a
		Normal (n=3,685)	Mild (n=863)	Moderate (n=316)	Severe (n=201)	
Days since March 10 - mean (SE) ^b	2.16 (0.03)	2.11 (0.04)	2.44 (0.09)	2.05 (0.12)	2.11 (0.19)	<0.001
Survey Date - %						
10-Mar-20 (n=401)	8.2	8.3	6.4	9.8	11.2	<0.05
11-Mar-20 (n=2,152)	42.9	43.4	39.2	41.7	48.5	
12-Mar-20 (n=817)	15.8	16.3	14.2	18.4	10.0	
13-Mar-20 (n=693)	12.7	12.4	15.1	14.3	6.5	
14-Mar-20 (n=362)	7.8	8.2	7.9	4.1	6.8	
15-Mar-20 (n=197)	3.6	3.5	3.6	2.9	5.8	
16-Mar-20 (n=443)	9.1	8.0	13.5	8.7	11.2	
Age - mean (SE)	48.46 (0.36)	50.47 (0.41)	44.88 (0.81)	40.18 (1.28)	40.31 (1.61)	<0.001
Gender - %						
Male	48.9	52.9	40.7	32.7	35.5	<0.001
Female	51.1	47.1	59.3	67.3	64.5	
Race/Ethnicity - %						
White	64.2	63.9	63.9	68.1	64.5	0.29
American Indian/Alaskan Native	<1%	<1%	<1%	<1%	<1%	
Asian	5.5	5.7	6.3	2.3	4.1	
Black/African-American	11.2	12.1	9.0	8.6	8.6	
Hawaiian/Pacific Islander	<1%	<1%	<1%	<1%	<1%	
Hispanic/Latino	15.9	15.2	18.4	15.8	18.5	
Multiracial	2.8	2.6	2.4	5.0	4.4	
State COVID-19 Count - %						
Low	76.3	77.8	72.2	72.4	70.3	<0.05
High	23.7	22.2	27.8	27.6	29.7	

^aP-value for Chi-square or ANOVA test of difference in participant characteristic by PHQ-4 level. ^bRange of 0-7 days.

eTable 1 (continued). Participant Characteristics among Total UAS Sample and Stratified by PHQ-4 Severity – mean (SE) or n (%)

	Total Sample (n=5,065)	PHQ-4 Severity				P-value ^a
		Normal (n=3,685)	Mild (n=863)	Moderate (n=316)	Severe (n=201)	
Education Categories - %						
High school or less	23.8	22.6	26.2	26.1	31.8	0.07
Some college/Two-year degree	42.4	42.7	39.5	44.2	46.0	
Bachelor's	18.6	18.7	18.7	19.4	14.8	
Graduate	15.2	16.0	15.7	10.3	7.4	
Marital Status - %						
Married	54.4	58.7	47.7	38.5	29.9	<0.001
Never Married	26.9	22.7	33.4	46.0	45.5	
Divorced/Separated	14.5	14.2	14.9	13.1	21.4	
Widowed	4.2	4.4	4.0	2.4	3.1	
Currently Have Job - %						
Yes	61.4	62.1	64.7	57.0	44.4	<0.001
No	38.6	37.9	35.3	43.0	55.6	
Household Income - %						
Less than 20k	15.6	13.3	17.1	23.9	34.8	<0.001
20-39k	18.4	17.2	19.6	23.2	27.0	
40-59k	16.1	16.0	18.1	14.3	13.2	
60-99k	24.9	26.9	21.7	18.8	12.3	
100k or more	25.0	26.6	23.4	19.8	12.7	

^aP-value for Chi-square or ANOVA test of difference in participant characteristic by PHQ-4 level. ^bRange of 0-7 days.

eTable 1 (continued). Participant Characteristics among Total UAS Sample and Stratified by PHQ-4 Severity – mean (SE) or n (%)

	Total Sample (n=5,065)	PHQ-4 Severity				P-value ^a
		Normal (n=3,685)	Mild (n=863)	Moderate (n=316)	Severe (n=201)	
Perceived likelihood infection - %						<0.001
0%	20.6	23.3	11.3	14.9	18.2	
1-50%	70.7	70.2	73.4	72.3	66.8	
>50%	8.7	6.5	15.3	12.8	15.0	
Perceived likelihood death if infected - %						<0.001
0%	23.4	25.3	17.5	18.0	20.0	
1-50%	70.4	69.5	73.7	76.5	64.9	
>50%	6.2	5.1	8.8	5.5	15.1	
Num. days alcohol past week - mean (SE)	1.20 (0.04)	1.19 (0.04)	1.23 (0.09)	1.29 (0.17)	1.16 (0.19)	0.96
Num. days cannabis past week – mean (SE)	0.54 (0.04)	0.42 (0.04)	0.65 (0.09)	1.15 (0.22)	1.20 (0.23)	<0.001
Took Steps to Avoid Infecting Others- %						
No	70.9	73.2	67.1	59.5	62.4	
Unsure	2.3	1.9	2.5	2.7	8.2	<0.001
Yes	26.8	24.9	30.4	37.8	29.4	
CES-D 8- mean (SE)	1.63 (2.10)	1.15 (0.04)	2.57 (0.11)	3.63 (0.22)	4.16 (0.26)	<0.001

^aP-value for Chi-square or ANOVA test of difference in participant characteristic by PHQ-4 level. ^bRange of 0-7 days.

eTable 2. PHQ-4 Item Frequencies in UAS 230 Sample (n=5,065) compared to Adult US Population Estimates from Health Information National Trends 2019 Survey²

PHQ-4 Survey Question: Over the past 2 weeks, how often have you been bothered by any of the following problems?

Sample	PHQ-4 Items	Nearly every day	More than half the days	Several days	Not at all
US Sample HINTS		0.05	0.06	0.21	0.68
UAS 230 Sample Overall	Feeling down, depressed or	0.04	0.05	0.18	0.73
UAS 230 Low-count States	hopeless	0.04	0.04	0.18	0.74
UAS 230 High-count States		0.05	0.06	0.20	0.69
US Sample HINTS		0.07	0.07	0.23	0.63
UAS 230 Sample Overall	Little interest or pleasure in	0.03	0.05	0.16	0.75
UAS 230 Low-count States	doing things	0.03	0.05	0.15	0.77
UAS 230 High-count States		0.04	0.05	0.20	0.71
US Sample HINTS		0.06	0.08	0.25	0.61
UAS 230 Sample Overall	Feeling nervous, anxious or	0.07	0.08	0.27	0.58
UAS 230 Low-count States	on edge	0.07	0.07	0.26	0.60
UAS 230 High-count States		0.08	0.09	0.30	0.52
US Sample HINTS		0.06	0.06	0.20	0.68
UAS 230 Sample Overall	Not being able to stop or	0.05	0.06	0.18	0.71
UAS 230 Low-count States	control worrying	0.05	0.06	0.18	0.72
UAS 230 High-count States		0.05	0.06	0.20	0.68

There were no significant differences between US Sample HINTS and the UAS 230 Overall Sample, or between the UAS 230 Low-count and High-count States for all PHQ-4 Items. High-count states are those with 50 or more confirmed COVID-19 cases as of March 10, 2020 (States WA, NY, CA, MA). Low-count state are all remaining US states, with fewer than 50 cases.

eTable 3. Multivariable Ordinal Logistic Regression Model Estimating PHQ-4 Levels (normal; mild; moderate; severe), Among Individuals Living in All States

	OR	95% CI ^a
Survey Date	1.05	(0.99 , 1.11)
Perceived likelihood infection (ref: 0%)		
1-50%	1.82	(1.32 , 2.52)***
>50%	2.77	(1.82 , 4.21) ***
Perceived likelihood death if infected (ref: 0%)		
1-50%	1.19	(0.89 , 1.58)
>50%	1.64	(1.06 , 2.54)*
Age (years)	0.98	(0.97 , 0.99)***
Gender (ref: Male)		
Female	1.50	(1.21 , 1.85)***
Race/Ethnicity (ref: non-Hispanic white)		
American Indian/Alaska Native	0.11	(0.02 , 0.49)**
Asian	0.64	(0.40 , 1.03)
Black/African-American	0.58	(0.38 , 0.88)*
Hawaiian/Pacific Islander	0.24	(0.03 , 1.76)
Hispanic/Latino	0.88	(0.65 , 1.20)
Multiracial	0.86	(0.48 , 1.56)
Marital Status (ref: Married)		
Never married	1.28	(0.99 , 1.65)
Separated or divorced	1.48	(1.11 , 1.97)**
Widowed	1.30	(0.83 , 2.03)
Education (ref: <=High school)		
Some college/two-year degree	0.99	(0.76 , 1.28)
Bachelor's	1.13	(0.82 , 1.54)
Graduate	1.16	(0.82 , 1.65)
Household Income (ref: <20k)		
20-39k	0.95	(0.67 , 1.35)
40-59k	0.82	(0.58 , 1.16)
60-99k	0.65	(0.45 , 0.94)*
100k and more	0.81	(0.56 , 1.19)
Currently have job (ref: Yes)		
No	1.26	(0.99 , 1.6)
Num. days cannabis past week	1.07	(1.02 , 1.14)*
Num. days alcohol past week	1.05	(1.00 , 1.11)*
Historical depressive symptoms (CES-D 8)	1.44	(1.38 , 1.51)***
Took Steps to Avoid Infecting Others (ref: No)		
Unsure	1.62	(0.84 , 3.11)
Yes	1.28	(1.02 , 1.6)*

*<0.05; **<0.01; ***<0.001. ^aN=5,065.

References

1. Kroenke K, Spitzer RL, Williams JBW, Löwe B. An ultra-brief screening scale for anxiety and depression: the PHQ-4. *Psychosomatics*. 2009;50(6):613-621.
2. National Cancer Institute. Health Information National Trends Survey - PHQ-4 Total Score. <https://hints.cancer.gov/view-questions-topics/question-details.aspx?qid=1182>. Published 2020.