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RESEARCH ARTICLE

# Evolution of Depression and Anxiety During the COVID-19 Pandemic and Across Demographic Groups in a Large Sample of U.S. Adults

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**Introduction:** This study aimed to document the trends of feelings of depression and anxiety over the course of the COVID-19 pandemic within and across age, gender, education, and employment groups.

**Methods:** Using a large, national, serial cross-sectional sample of adults in the U.S. collected through the COVID-19 Trends and Impact Survey conducted in partnership with Facebook, we examined trends in feelings of depression and anxiety from April 2020 through June 2022 (N=21,359,165).

**Results:** Over time, differences in feelings of anxiety and depression widened for educational attainment, stayed consistent between employment groups, and narrowed for female versus male and age groups. The odds of frequent feelings of anxiety or depression were significantly lower in the studied final quarter (April−June 2022) than in the studied first quarter (October−December 2020) for the overall population ($p<0.001$). In April−June 2022, younger persons reported 6−7 times the odds (AOR for depression=6.07; 95% CI=5.72, 6.43 and AOR for anxiety=6.69; 95% CI=6.33, 7.07), nonbinary persons reported 5 times the odds (AOR for depression=5.35, 95% CI=4.89, 5.86 and AOR for anxiety=5.35, 95% CI=4.9, 5.85), persons with a high school degree reported 2 times the odds (AOR for depression=2.07, 95% CI=1.92, 2.22 and AOR for anxiety=1.68, 95% CI=1.57, 1.8), and persons who were not employed reported 1.3−1.5 times the odds (AOR for depression=1.46, 95% CI=1.42, 1.51 and AOR for anxiety=1.34, 95% CI=1.3, 1.38) of frequent feelings depression and anxiety, respectively, than counterparts who were older, were male, had graduate degrees, or were employed.

**Conclusions:** The risk factors most highly associated with poor mental health 2 years into the pandemic were young age, nonbinary gender, and low educational attainment.



## INTRODUCTION

The prevalences of depression and anxiety during the coronavirus disease 19 (COVID-19) pandemic have been notably high, with estimates suggesting a three- to four-fold increase in depression and anxiety among U.S. adults relative to the estimates before the pandemic.[1,2] Depression and anxiety each and together can reduce quality of

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life, contribute to the burden of comorbid illness, impair functionality, and lead to direct and indirect costs to individuals and society.[3,4] Societal costs of depression and anxiety include workplace costs of lost productivity and increased utilization of the medical system.[4,5] Anxiety, which is marked, for example, by persistently feeling nervous, worried, or on edge,[6] may lead to dissatisfaction with family life and lower overall well-being.[5] Depression, which is marked, for example, by feeling down, depressed, or hopeless,[7] has been estimated to cost over $326 billion annually in the U.S.[8] Costs include suicide-related costs, workplace costs of absenteeism and presenteeism (i.e., underperformance when at work), and medical treatment costs.[8] Depression and anxiety are linked to a host of poor physical health outcomes, including cardiovascular events, suicide, and early death.[9]

SES and certain demographic characteristics have been associated with depression and anxiety. For example, studies conducted before the COVID-19 pandemic showed that the female gender was associated with a pooled average of 2 times the prevalence of depression relative to the male gender.[10] Although less studied, persons who identify as nonbinary gender have also reported even greater levels of depression, anxiety, and other mental disorders.[11] Before the COVID-19 pandemic, the prevalence of depression and anxiety had an inverse-U curve across age groups; that is, younger persons and older persons had the lowest levels of poor mental health, with mental illness peaking around mid-life.[12] During the COVID-19 pandemic, younger age has been identified as a risk factor for depression and anxiety, with teens and younger adults reporting poorer mental health than older persons of all ages.[13] Before the COVID-19 pandemic, more education was generally associated with better mental health,[14] although the relationships have been mixed during the COVID-19 pandemic.[15] Unemployment is consistently associated with poor mental health,[16] with much literature showing the deleterious impacts of sudden job loss after large-scale events such as economic crises. Although several studies have documented the relative burden of anxiety or depression at different points of the pandemic, few studies have documented the evolution of poor mental health and whether risk factors have changed during the COVID-19 pandemic through 2022. Notably, Czeisler et al. documented increased symptoms of anxiety and depression in 5,470 U.S. adults surveyed between June 24 and 30, 2020.[13] Using the Understanding America Study, Daly and Robinson documented increased symptoms of anxiety in March and April 2020.[17] Using the larger U.S. Census Bureau Household Pulse Survey (HPS), Cai et al. documented increased symptoms of depression and anxiety between April 2020 and July 2020.[1] Also using the HPS, Vahratian et al. found an increase in poor mental health between August 2020 and February 2021, with the largest increase reported in young persons (aged 18−29 years) and persons without a high school degree.[18] Jai et al., also using the HPS, showed trends in anxiety and depression from August 2020 through June 2021 by state; however, they did not disaggregate trends by demographic categories or explore their associations with mental health over time.[19]

Although the HPS has tracked depression and anxiety in U.S. adults across some demographic characteristics,[20] to our knowledge, no paper has studied rigorously how the trends in depression and anxiety evolved during the COVID-19 pandemic using a large national sample and advanced statistical analysis to understand changes in mental health within and across groups over time through June 2022. This study used a large sample of U. S. adults to estimate the trends in depression and anxiety over the course of the COVID-19 pandemic through June 2022 among different social and demographic groups. We aimed to do the following:

1. Document trends in observed, self-reported feelings of depression and anxiety in adults over the course of the COVID-19 pandemic through June 2022.
2. Document these trends over time across age, gender, education, and employment groups.
3. Estimate the evolution of the statistical association between age, gender, education, and employment and feelings of depression and anxiety over the course of the COVID-19 pandemic.

This study adds to the literature on the evolution of mental health over the pandemic, the elevated burden of poor mental health over time, and the disparities between groups using large-sample, statistical analyses to control for other observed factors and additional demographic covariates beyond existing published data[20] documenting the mental health of U.S. adults.

## METHODS

### Study Sample

The COVID-19 Trends and Impact Surveys (CTIS) was an ongoing, serial cross-sectional, daily survey conducted by Carnegie Mellon University in partnership with Facebook and other academic collaborators, with data collected for 810 days in the U.S. from April 6, 2020 through June 25, 2022.[21] Facebook randomly sampled active users and featured the invitation to participate at the top of a user's Facebook feed. The sampling frame included Facebook users who were (1) aged ≥18 years, (2) active on the platform within the last month, and (3) living within the U.S. territory. A respondent deemed

eligible under these criteria was invited to participate every 1−6 months, depending on the subregional population density at which the sample was stratified. Facebook invited a new sample of eligible users to take the survey each day during the data collection period. Facebook users were eligible to see their first invitation within 7 days of being sampled. If a sampled user did not log onto Facebook within those 7 days, they did not see an invitation, resulting in them being labeled as a no contact. After a sampled Facebook user saw their first invitation, they saw the same invitation each time they opened Facebook for up to 3 days unless they already took the survey or dismissed the invitation using the X in the top right corner of the invitation. If a user clicked on the link to complete the survey, they were taken to a Qualtrics survey administered by the Delphi Group at Carnegie Mellon University outside the Facebook platform. Data were accessed by academic or nonprofit researchers upon request. Survey weights were constructed in a 2-step process to account for nonresponse and to align the sample more closely with the U.S. population. First, Facebook provided inverse probabilities of responding to the survey for each participant using deidentified respondent identifications, incorporating participant gender, age, and geographic information and other proprietary information on their Facebook profiles known to be associated with nonresponse.[22] After applying the inverse probability weights, the sample more closely represented the entire Facebook user population.[23] Second, the weights were adjusted more closely to align the Facebook user population with the U.S. age and gender distribution using U.S. census−based administrative subnational benchmarks.[23] More details on the CTIS survey instrument, sampling design, and weighting methodology can be found in the CTIS Methodology Report[21] and in previously published work.[23,24] In this study, we present results from 2 samples because of the later addition of several key variables of interest. Our larger sample includes all participants surveyed from April 2020 through June 2022 (N=21,359,165), which was used for the descriptive analysis. A subset of that sample, collected from October 2020 to June 2022 ($n$=11,097,424), was used for statistical analyses to allow for adjustment for all variables of interest in the full model. The CTIS study was reviewed and approved by the IRB of both the University of Maryland and Carnegie Mellon University.

## Measures

The 2 main outcomes analyzed were binary variables representing the presence of frequent feelings of depression and anxiety on the basis of modified questions from the Center for Epidemiologic Studies Depression Scale (CES-D[25]) and the General Anxiety Disorder (GAD)-7,[6] respectively. The CES-D and the GAD-7 are commonly used instruments to screen for depression and anxiety, respectively, to help providers flag patients who should be screened for formal diagnosis. Participants were asked, *over the last five days, how often have you… felt depressed or felt nervous, anxious, or on edge?* Responses included *none of the time, some of the time, most of the time*, or *all the time. Frequent feelings of depression* and *frequent feelings of anxiety* were defined by a CTIS response of *most of the time* or *all of the time*, as used in other publications.[26] In March 2021, the wording was revised to ask participants how often they felt depressed or anxious *over the last seven days* instead of *over the last five days*,[27] motivating the dichotomization of the variables instead of using a continuous measure.

Data regarding age and gender were collected from April 2020 through June 2022. Employment and education were added to the CTIS survey starting in October 2020. *Age* was defined as a categorical variable grouped as 18−24 years, 25−34 years, 35−44 years, 45−54 years, 55−64 years, and ≥65 years. Gender was self-reported by participants with the following options: male, female, nonbinary, prefer to self-describe, and prefer not to answer. For the purpose of this analysis, we used the following gender categories: male, female, nonbinary, and other/prefer not to answer (in which we grouped responses of prefer to self-describe and prefer not to answer together). *Education* was defined as a categorical variable: less than high school, high school, some college, college/professional degree, and graduate degree. Employment was coded as a binary variable as employed or not employed on the basis of participant responses to the survey question: *In the past 4 weeks, did you do any kind of work for pay?* Details on time and county-level variables can be found in the Appendix (available online).

## Statistical Analysis

First, we described the characteristics of participants in the analytic survey sample (Table 1) and the full survey sample (Appendix Table 1, available online) by quarter. Second, we graphed the unadjusted weighted prevalence of frequent feelings of depression and anxiety at the population level from April 2020 through June 2022 using rolling daily averages (Figure 1). Because this figure did not adjust for any covariates, we were able to present the full sample. We reported the weighted prevalence of frequent feelings of depression and anxiety by quarter (Appendix Table 2, available online) and by quarter across demographic groups (Appendix Tables 3 and 4, available online). Unadjusted estimates of the weighted prevalence of frequent feelings of depression and anxiety

**Table 1.** Characteristics of Sample From October 2020–June 2022

| Characteristics | Q3 (*n*=2,974,261) October–December 2020 (%) | Q4 (*n*=3,050,742) January–March 2021 (%) | Q5 (*n*=1,501,002) April–June 2021 (%) | Q6 (*n*=1,118,614) July–September 2021 (%) | Q7 (*n*=965,866) October–December 2021 (%) | Q8 (*n*=875,527) January–March 2022 (%) | Q9 (*n*=611,412) April–June 2022 (%) | Total (*n*=11,097,424) October 2020–June 2022 (%) |
|---|---|---|---|---|---|---|---|---|
| Age, years | | | | | | | | |
| 18–24 | 11.0% | 10.0% | 9.9% | 9.9% | 9.8% | 10.0% | 10.0% | 10% |
| 25–34 | 17.0% | 16.0% | 16.0% | 16.0% | 15.0% | 16.0% | 15.0% | 16% |
| 35–44 | 17.0% | 16.0% | 16.0% | 16.0% | 16.0% | 17.0% | 17.0% | 16% |
| 45–54 | 17.0% | 17.0% | 17.0% | 17.0% | 17.0% | 17.0% | 17.0% | 17% |
| 55–64 | 17.0% | 17.0% | 17.0% | 17.0% | 17.0% | 18.0% | 18.0% | 17% |
| ≥65 | 20.0% | 21.0% | 21.0% | 21.0% | 21.0% | 22.0% | 22.0% | 21.0% |
| Missing | 1.5% | 2.7% | 3.4% | 3.5% | 3.6% | 0.2% | 0.2% | 2.2% |
| Gender | | | | | | | | |
| Male | 45.0% | 44.0% | 43.0% | 43.0% | 43.0% | 44.0% | 44.0% | 44% |
| Female | 51.0% | 51.0% | 50.0% | 50.0% | 50.0% | 52.0% | 52.0% | 51% |
| Nonbinary | 0.8% | 0.8% | 1.0% | 1.2% | 1.2% | 1.3% | 1.4% | 1.0% |
| Other/prefer not to answer | 1.9% | 2.1% | 2.5% | 2.9% | 3.0% | 2.7% | 3.0% | 2.5% |
| Missing | 1.4% | 2.4% | 3.0% | 3.3% | 3.4% | 0.2% | 0.2% | 2.0% |
| Education | | | | | | | | |
| Graduate | 7.1% | 14.0% | 14.0% | 13.0% | 13.0% | 14.0% | 15.0% | 12% |
| Less than high school | 3.5% | 4.0% | 4.0% | 4.1% | 4.1% | 4.4% | 4.0% | 4.0% |
| High school | 17.0% | 18.0% | 17.0% | 18.0% | 18.0% | 19.0% | 19.0% | 18% |
| Some college | 25.0% | 25.0% | 24.0% | 24.0% | 25.0% | 25.0% | 25.0% | 25% |
| College/professional degree | 44.0% | 36.0% | 36.0% | 35.0% | 35.0% | 36.0% | 37.0% | 38% |
| Missing | 2.6% | 3.7% | 4.7% | 5.2% | 5.0% | 0.6% | 0.6% | 3.2% |
| Employed | | | | | | | | |
| Yes | 57.0% | 54.0% | 54.0% | 55.0% | 56.0% | 54.0% | 55.0% | 55.0% |
| No | 40.0% | 42.0% | 41.0% | 39.0% | 38.0% | 40.0% | 39.0% | 40.0% |
| Missing | 2.6% | 3.7% | 4.7% | 5.6% | 6.0% | 5.5% | 5.8% | 4.50% |

Q, quarter.

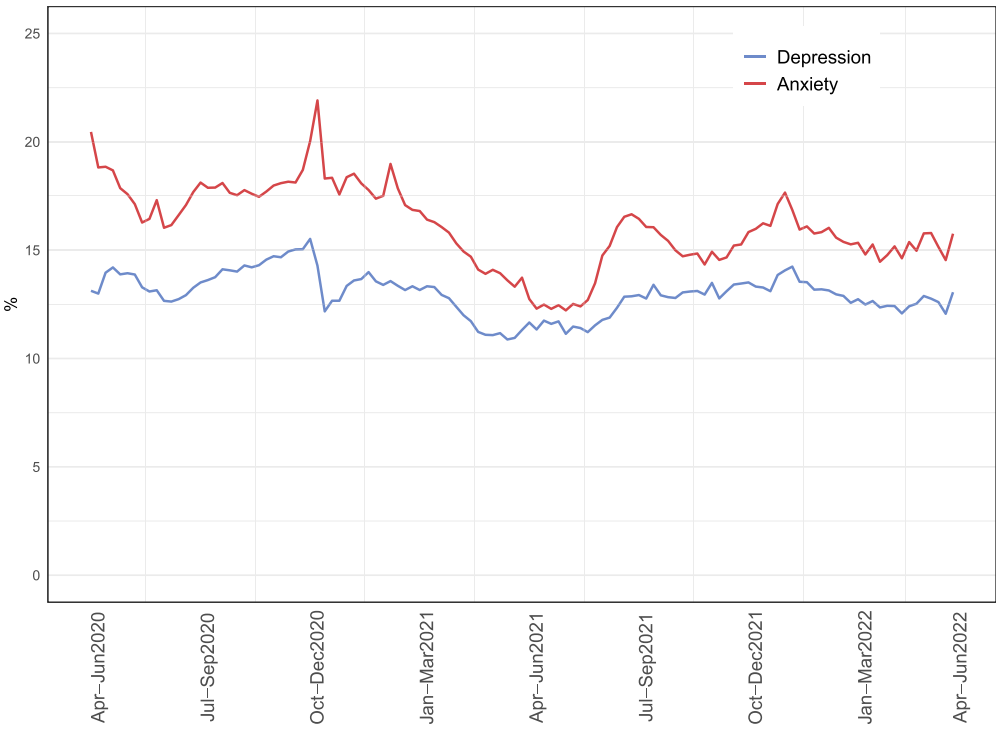


**Figure 1.** Average weekly prevalence of frequent feelings of depression and anxiety over time for U.S. Facebook users (%) (N=21,359,165)

*Note:* Data were collected from CTIS on Facebook users aged ≥18 years (N=21,359,165). Surveys were administered daily and aggregated up to the weekly average. *Frequent feelings of depression* and *anxiety* were defined by a response of *most of the time* or *all of the time* to the question, *over the last five days, how often have you. . . felt depressed or felt nervous, anxious, or on edge,* respectively.

Apr, April; CTIS, COVID-19 Trends and Impact Survey; Dec, December; Jun, June; Jul, July; Mar, March; Oct, October; Sept, September.

by age, gender, education, and employment group are presented (Appendix Figures 1 and 2, available online). Third, we estimated and graphed the weighted predicted probability of frequent feelings of depression and anxiety from October 2020 through June 2022 using rolling quarter averages (Figures 2 and 3). The model used to estimate the predicted probability included demographic variables (i.e., age, gender, education, and employment) and county-level variables (i.e., poverty rate, proportion of White residents in the county, COVID-19 spread, and urbanicity). Fourth, we estimated the weighted odds of reporting frequent feelings of depression and anxiety by demographic characteristics in each quarter from October 2020 to June 2022 (Tables 2 and 3), adjusting for demographic and county-level variables. Fifth, we estimated the interaction of time (by quarter) and demographic factors on frequent feelings of depression and anxiety (Appendix Tables 5 and 6, available online) using the full model to inform our understanding of whether changes in the association between demographic characteristics and mental health were significantly different over time. We created 4 separate models, with an interaction between quarters and 1 demographic characteristic in each to assess the relationship between each variable and outcome with time. We report *p*-values to test for significance in change of associations between covariables and mental health between the beginning and end of the study (Quarter 9 relative to Quarter 3). All statistical analyses were performed in R (Version 4.2.1), using the R survey package (Version 4.0) to account for the survey design.

## RESULTS

Table 1 shows the demographic characteristics of the pooled sample over time from October 2020 through June 2022. Across quarters, approximately half of the sample was female (ranging from 50% to 51%). The plurality of respondents had a college degree or more (ranging from 44% in October 2020 to 38% in June 2022); one fifth of the sample was aged ≥65 years (ranging from 20% to 21%), and employment ranged from 55% to 57% during the time period studied.

Figure 1 shows the weighted prevalence of frequent feelings of depression and anxiety over time for U.S. adults by

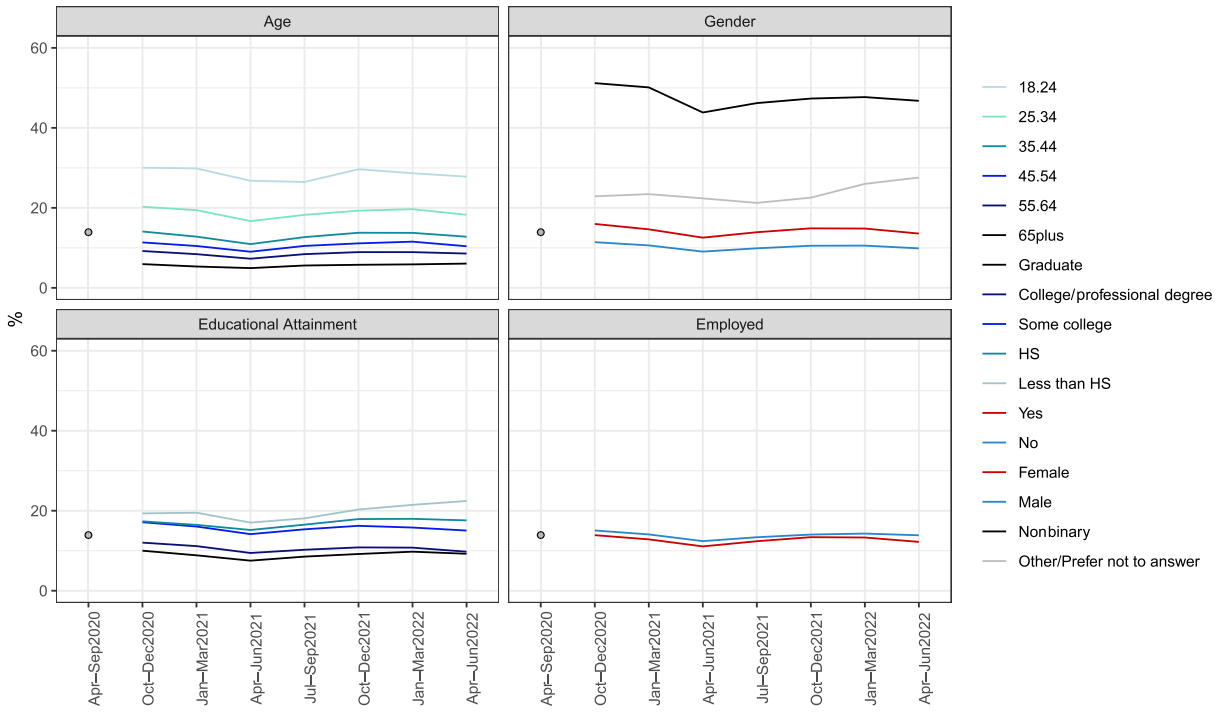


**Figure 2.** Predicted probability of frequent feelings of depression over time by age, gender, educational attainment, and employment ($n$=11,097,424)

*Note:* Data were collected from CTIS on Facebook users aged ≥18 years. Surveys were administered daily and aggregated up to the quarterly average. *Frequent feelings of depression* and *anxiety* were defined by a response of *most of the time* or *all of the time* to the question, *over the last five days, how often have you… felt depressed or felt nervous, anxious, or on edge*, respectively. Full model adjusted for individual demographic variables and county-level variables. Predicted probabilities from the model are available from October 2020 through June 2022 owing to education level and employment being added to the survey questionnaire in October 2020. The circle on the graph represents the average weighted prevalence of frequent feelings of depression in April–September 2020 adjusted for available covariates.

Apr, April; CTIS, COVID-19 Trends and Impact Survey; Dec, December; HS, high school; Jun, June; Jul, July; Mar, March; Oct, October; Sept, September.

weekly rolling average. Feelings of anxiety were consistently higher than feelings of depression at all time points.

The predicted probabilities of frequent feelings of depression and anxiety over time by age, gender, education, and employment, controlling for demographic and area-level factors, are reported in Figures 2 and 3, respectively. Predicted probabilities of frequent feelings of depression and anxiety were highest for all groups in October–December 2020. Younger age groups, persons who were not employed, and nonbinary-gendered persons had consistently higher predicted probabilities of frequent feelings of depression and anxiety across all reported periods of the pandemic. Although the predicted probabilities of frequent feelings of depression and anxiety were generally decreasing across groups in April–June 2022 relative to the probabilities earlier, they increased over time for persons with less than a high school degree.

Tables 2 and 3 show the adjusted odds of frequent feelings of depression (Table 2) and anxiety (Table 3) over time, respectively. The relative odds of frequent feelings of depression and anxiety decreased slightly for persons aged 18–24 years relative to the odds for persons aged ≥65 years between October–December 2020 and April–June 2022. Adults aged 18–24 years reported 7.0 (95% CI=6.9, 7.3) times the odds of frequent feelings of depression and 7.8 (95% CI=6.7, 8.0) times the odds of frequent feelings of anxiety as persons aged ≥65 years in October–December 2020. Adults aged 18–24 years reported 6.1 (95% CI=5.7, 6.4) times the odds of frequent feelings of depression and 6.7 (95% CI=6.3, 7.1) times the odds of anxiety in April–June 2022 relative to adults aged ≥65 years. The relative odds of frequent feelings of depression and anxiety got higher for persons who were not employed than for employed persons between 2020 and 2022. The odds of frequent feelings of depression and anxiety were 1.5 for females and 5.1 for nonbinary persons relative to the odds for males in 2020 and 1.4 for females and 5.4 for nonbinary persons in 2022. Persons with less than a high school degree had

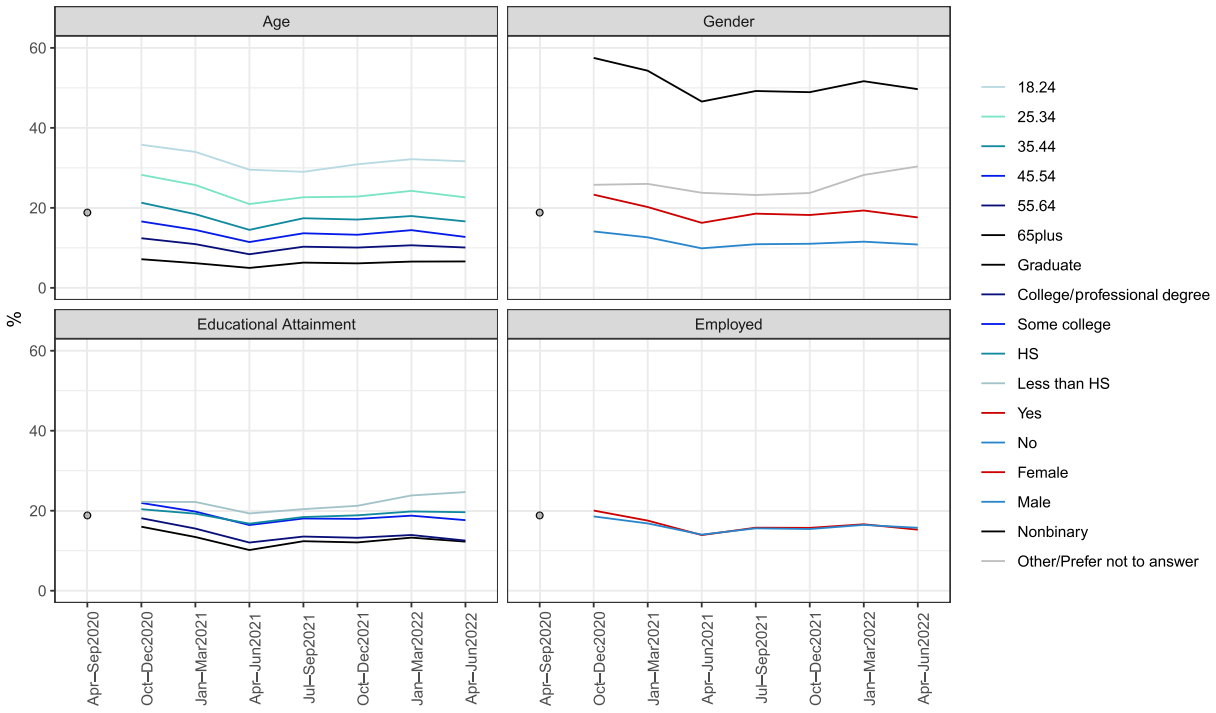


**Figure 3.** Predicted probability of frequent feelings of anxiety over time by age, gender, educational attainment, and employment (*n*=11,097,424)

*Note:* Data were collected from CTIS on Facebook users aged ≥18 years. Surveys were administered daily and aggregated up to the quarterly average. *Frequent feelings of depression* and *anxiety* were defined by a response of *most of the time* or *all of the time* to the question, *over the last five days, how often have you… felt depressed or felt nervous, anxious, or on edge,* respectively. Full model adjusted for individual demographic variables and county-level variables. Predicted probabilities from the model are available from October 2020 through June 2022 owing to education level and employment being added to the survey questionnaire starting October 2020. The circle on the graph represents the average weighted prevalence of frequent feelings of depression in April–September 2020 adjusted for available covariates.

Apr, April; CTIS, COVID-19 Trends and Impact Survey; Dec, December; HS, high school; Jun, June; Jul, July; Mar, March; Oct, October; Sept, September.

1.4 (95% CI=1.4, 1.5) and 1.0 (95% CI=1.0, 1.1) times the odds of frequent feelings of depression and anxiety in 2020 and 2.1 (95% CI=1.9, 2.2) and 1.7 (95% CI=1.7, 1.8) times the odds of frequent feelings of depression and anxiety in 2022.

## DISCUSSION

Using data from a large sample of social media users, we found the following. First, frequent feelings of depression and anxiety were high throughout the course of the pandemic, peaking between October and December 2020, with feelings of anxiety reported consistently higher than feelings of depression at all times. Second, the prevalence of frequent feelings of depression and anxiety differed significantly across demographic characteristics; risk factors for more frequent feelings of depression and anxiety in adjusted models were younger age, identifying as female or nonbinary gender, having lower education, and not being employed. The largest gaps in mental health were across age groups; most strikingly, adults aged 18–24 years had 6 times the odds of depression and 6.7 times the odds of frequent feelings of anxiety as adults aged ≥65 years in April–June 2022. Finally, differences in frequent feelings of depression and anxiety among groups widened over time for educational attainment and narrowed over time for certain gender and age groups. Young persons, nonmale persons, and persons with lower education were particularly at risk for frequent feelings of depression and anxiety >2 years after the start of the COVID-19 pandemic.

Differences in poor mental health were largest across age groups. Our findings that younger persons were more likely to report feelings of depression and anxiety are consistent with those of many studies conducted during the pandemic[28] and are higher than estimates from before the pandemic.[29,30] Before COVID-19, in 2019, young adults aged 18–25 years had 1.14 times the prevalence of depression as adults aged ≥50 years,[29] and

**Table 2.** Adjusted Odds (95% CI) of Frequent Feelings of Depression Over Time by Characteristics

| Characteristics | Q3 October–December 2020 | Q4 January–March 2021 | Q5 April–June 2021 | Q6 July–September 2021 | Q7 October–December 2021 | Q8 January–March 2022 | Q9 April–June 2022 |
|---|---|---|---|---|---|---|---|
| Age, years | | | | | | | |
| 18–24 | 7.01 (6.93, 7.27) | 7.73 (7.57, 7.90) | 7.01 (6.78, 7.26) | 6.11 (5.86, 6.38) | 6.76 (6.47, 7.06) | 6.44 (6.20, 6.75) | 6.07 (5.72, 6.43) |
| 25–34 | 5.12 (5.03, 5.23) | 5.46 (5.36, 5.56) | 4.96 (4.82, 5.11) | 4.73 (4.58, 4.88) | 4.78 (4.63, 4.954) | 4.71 (4.54, 4.89) | 4.33 (4.14, 4.54) |
| 35–44 | 3.62 (3.55, 3.70) | 3.651 (3.58, 3.72) | 3.35 (3.25, 3.50) | 3.37 (3.26, 3.48) | 3.49 (3.38, 3.62) | 3.33 (3.21, 3.46) | 3.11 (2.97, 3.25) |
| 45–54 | 2.67 (2.62, 2.73) | 2.75 (2.70, 2.80) | 2.60 (2.49 2.64) | 2.59 (2.51, 2.68) | 2.63 (2.54, 2.72) | 2.66 (2.57, 2.75) | 2.38 (2.28, 2.49) |
| 55–64 | 1.85 (1.81, 1.88) | 1.88 (1.85, 1.91) | 1.74 (1.70, 1.79) | 1.78 (1.73, 1.83) | 1.82 (1.764, 1.877) | 1.78 (1.72, 1.84) | 1.71 (1.64, 1.78) |
| ≥65 | ref | | | | | | |
| Gender | | | | | | | |
| Female | 1.46 (1.45, 1.48) | 1.44 (1.422, 1.454) | 1.42 (1.39, 1.44) | 1.44 (1.41, 1.47) | 1.46 (1.43, 1.50) | 1.43 (1.40, 1.47) | 1.40 (1.36, 1.44) |
| Nonbinary | 5.14 (4.90, 5.40) | 5.21 (5.00, 5.44) | 4.70 (4.42, 5.00) | 5.03 (4.69, 5.40) | 4.93 (4.57, 5.31) | 5.01 (4.61, 5.44) | 5.35 (4.89, 5.86) |
| Other/prefer not to answer | 2.03 (1.95, 2.11) | 2.23 (2.16, 2.31) | 2.52 (2.40, 2.65) | 2.16 (2.05, 2.28) | 2.20 (2.08, 2.33) | 2.63 (2.47, 2.81) | 2.95 (2.74, 3.18) |
| Male | ref | | | | | | |
| Education | | | | | | | |
| Less than high school | 1.43 (1.38, 1.48) | 1.61 (1.56, 1.65) | 1.71 (1.63, 1.78) | 1.76 (1.67, 1.85) | 1.75 (1.66, 1.85) | 1.81 (1.71, 1.92) | 2.07 (1.92, 2.22) |
| High school | 1.37 (1.34, 1.40) | 1.46 (1.44, 1.49) | 1.60 (1.55, 1.65) | 1.62 (1.57, 1.67) | 1.62 (1.57, 1.68) | 1.56 (1.50, 1.62) | 1.64 (1.57, 1.72) |
| Some college | 1.43 (1.41, 1.46) | 1.52 (1.49, 1.54) | 1.60 (1.56, 1.64) | 1.61 (1.56, 1.66) | 1.57 (1.53, 1.63) | 1.47 (1.42, 1.52) | 1.57 (1.50, 1.63) |
| College/professional degree | 1.09 (1.07, 1.12) | 1.12 (1.10, 1.14) | 1.13 (1.10, 1.16) | 1.114 (1.083, 1.146) | 1.10 (1.07, 1.14) | 1.05 (1.02, 1.09) | 1.05 (1.01, 1.09) |
| Graduate | ref | | | | | | |
| Not employed | 1.43 (1.41, 1.45) | 1.46 (1.44, 1.48) | 1.47 (1.44, 1.49) | 1.42 (1.40, 1.45) | 1.39 (1.35, 1.42) | 1.38 (1.35, 1.41) | 1.46 (1.42, 1.51) |

Q, quarter.

adults aged 18–29 years had 1.7 times the prevalence of anxiety as adults aged ≥65 years.[30] One year into the pandemic, we reported 7.01 times the odds of feelings of depression and 8.2 times the odds of feelings of anxiety (April–June 2021), which is consistent with other estimates from the onset of the pandemic; Czeisler et al. reported that persons aged 18–24 years had 7.7 higher fold probability of reporting either depression and anxiety than adults aged ≥65 years in June 2020.[13] In the years leading up to COVID-19, Weinberger et al. documented the rising trend in depression and among gender, education, and age groups in the U.S. from 2005 to 2015.[31] Our study shows that the gap in poor mental health across age groups stayed highly elevated through June 2022. Young people remain at risk for feelings of depression and anxiety and may continue to be at risk for recurrence of poor mental health as they age across the life course.[32]

Differences in mental health have long been shown between female and male groups across the life course, with gaps emerging around age 12 years.[32] Before the COVID-19 pandemic, pooled global estimates reported that women had 2.0 times the odds of depression[10] and 2.1 times the odds of anxiety as men.[33] Depression and anxiety increased for all gender groups during the COVID-19 pandemic, but gaps in poor mental health between females and males remained relatively stable over the course of the COVID-19 pandemic and were largely consistent with gaps that existed before the pandemic, which were also relatively stable.[31] To our knowledge, our study is one of the few to report on mental health across multiple gender categories during the COVID-19 pandemic. Second to the differences in depression between younger and older persons, the largest gaps were found between nonbinary persons and males, with nonbinary persons reporting >5 times

**Table 3.** Adjusted Odds (95% CI) of Frequent Feelings of Anxiety Over Time by Characteristics

| Characteristics | Q3 October–December 2020 | Q4 January–March 2021 | Q5 April–June 2021 | Q6 July–September 2021 | Q7 October–December 2021 | Q8 January–March 2022 | Q9 April–June 2022 |
|---|---|---|---|---|---|---|---|
| Age, years | | | | | | | |
| 18–24 | 7.83 (7.65, 8.00) | 8.09 (7.93, 8.26) | 8.17 (7.91, 8.45) | 6.32 (6.07, 6.58) | 6.91 (6.62, 7.22) | 6.84 (6.54, 7.15) | 6.69 (6.33, 7.07) |
| 25–34 | 5.95 (5.85, 6.06) | 6.16 (6.06, 6.26) | 6.08 (5.92, 6.26) | 5.01 (4.86, 5.16) | 5.31 (5.14, 5.48) | 5.22 (5.05, 5.4) | 4.91 (4.71, 5.12) |
| 35–44 | 4.37 (4.3, 4.45) | 4.31 (4.24, 4.38) | 4.2 (4.09, 4.32) | 3.83 (3.72, 3.95) | 3.95 (3.82, 4.08) | 3.81 (3.68, 3.94) | 3.59 (3.44, 3.74) |
| 45–54 | 3.11 (3.05, 3.16) | 3.13 (3.08, 3.18) | 3.09 (3.01, 3.18) | 2.83 (2.75, 2.92) | 2.88 (2.79, 2.97) | 2.9 (2.81, 3) | 2.59 (2.48, 2.69) |
| 55–64 | 2.03 (2, 2.07) | 2.08 (2.05, 2.11) | 1.97 (1.92, 2.02) | 1.9 (1.85, 1.96) | 1.93 (1.88, 1.99) | 1.89 (1.83, 1.95) | 1.83 (1.76, 1.9) |
| ≥65 | ref | | | | | | |
| Gender | | | | | | | |
| Female | 1.86 (1.84, 1.88) | 1.76 (1.74, 1.78) | 1.76 (1.73, 1.79) | 1.83 (1.8, 1.87) | 1.77 (1.73, 1.81) | 1.8 (1.76, 1.84) | 1.73 (1.69, 1.78) |
| Nonbinary | 5.32 (5.08, 5.57) | 5.18 (4.96, 5.4) | 4.81 (4.53, 5.11) | 5.23 (4.89, 5.6) | 5.04 (4.68, 5.42) | 5.32 (4.92, 5.76) | 5.35 (4.9, 5.85) |
| Other/prefer not to answer | 1.9 (1.83, 1.97) | 2.11 (2.04, 2.18) | 2.47 (2.35, 2.59) | 2.15 (2.04, 2.26) | 2.2 (2.08, 2.32) | 2.65 (2.49, 2.81) | 3.03 (2.82, 3.25) |
| Male | ref | | | | | | |
| Education | | | | | | | |
| Less than high school | 1.03 (1, 1.06) | 1.24 (1.21, 1.27) | 1.46 (1.4, 1.52) | 1.35 (1.29, 1.42) | 1.37 (1.3, 1.45) | 1.46 (1.38, 1.54) | 1.68 (1.57, 1.8) |
| High school | 1.01 (0.99, 1.03) | 1.17 (1.15, 1.19) | 1.33 (1.3, 1.37) | 1.25 (1.22, 1.29) | 1.3 (1.26, 1.34) | 1.25 (1.21, 1.29) | 1.35 (1.3, 1.41) |
| Some college | 1.17 (1.15, 1.19) | 1.28 (1.26, 1.3) | 1.4 (1.37, 1.43) | 1.31 (1.28, 1.35) | 1.33 (1.3, 1.37) | 1.29 (1.25, 1.32) | 1.36 (1.31, 1.41) |
| College/professional degree | 1.03 (1.01, 1.05) | 1.04 (1.03, 1.06) | 1.07 (1.05, 1.09) | 1.01 (0.99, 1.04) | 1.02 (0.99, 1.05) | 0.99 (0.96, 1.02) | 0.99 (0.96, 1.03) |
| Graduate | ref | | | | | | |
| Not employed | 1.23 (1.22, 1.24) | 1.28 (1.27, 1.29) | 1.33 (1.31, 1.36) | 1.29 (1.27, 1.31) | 1.31 (1.28, 1.34) | 1.28 (1.26, 1.31) | 1.34 (1.3, 1.38) |

Q, quarter.

higher odds of poor mental health in spring 2022. In a study of Canadian adults from August 2020 to March 2021, gender-diverse persons reported 2.1 times the odds of depression and 1.7 times the odds of anxiety as females.[34] Our findings that the odds of feelings of depression and anxiety increased over time for nonbinary persons suggest that mental health disparities may be growing for this group.

Although there appears to be a more consistent relationship between education and physical health,[35] the relationship between education and mental health remains less clear.[36] For example, the benefits of education may not be linear; that is, the health benefits of education may be related to completed degrees rather than to the total number of years of schooling,[37] and the benefits, if any, may grow over the life course.[38] In 2008–2012, U.S. adults who had finished some college reported the highest levels of major depressive disorder, whereas adults who had less than a high school degree had the highest levels of generalized anxiety disorder than all other educational attainment groups.[39] In April–May 2020, Cai et al. found that adults with less than a high school degree had 1.3 times the prevalence of having a positive screen for depression or anxiety in April–May 2020 and 1.2 times the prevalence in July 2020 relative to persons with a college degree or more.[1] Our findings showed that the gaps in feelings of depression and anxiety grew over time between educational groups. Most notably, the prevalences of frequent feelings of depression and anxiety were higher for persons without a high school degree in April–June 2022 than in October–December 2020, whereas the prevalence of the same outcomes was lower for persons with some college or above by April–June 2022.

Employment is generally associated with better mental health; in addition, depression and anxiety generally

trend in the same direction. That there were moments during the pandemic when being employed was associated with higher levels of feelings of anxiety may speak to the unique fears of catching and spreading the coronavirus. Reviews conducted before the COVID-19 pandemic showed that stressors such as job loss were associated with poor mental health outcomes, particularly among persons with fewer economic resources.[40] Within the U.S., Cseizler estimated that 30.1% of persons who were employed reported symptoms of depression or anxiety relative to 32% of unemployed persons in June 2020.[13] In our study, employed persons reported higher feelings of anxiety but lower feelings of depression at the start of the pandemic relative to persons who were not employed. However, once models controlled for other variables such as age, not being employed was associated with higher odds of feelings of depression and anxiety, suggesting that some of the trends in overall prevalence may be driven by age and other factors associated with employment.

### Limitations

This paper has 5 main limitations. First, the CTIS is a sample of U.S. Facebook users and is not representative of all U.S. adults. However, 69% of U.S. adults say that they had ever used Facebook,[41] and the relationship between the use of social media and mental health could go in either direction.[42] In addition, we used complex survey weights provided by the survey hosts to align our sample more closely with the U.S. population in terms of key sociodemographic characteristics.[23] Even after weighting, there might be a potential bias when inferring population point estimates. However, survey biases are unlikely to change rapidly across time, space, or subgroups. Therefore, CTIS is considered an appropriate data source to accurately track temporal and geographic trends, even if the daily point estimates have some bias.[23] In addition, subgroup analyses over time can be quite fine grained, given the CTIS sample size—in contrast to using much smaller representative samples, where they could lack statistical power. Second, the CTIS was an anonymous, daily survey and did not link participant respondents across time. Therefore, we were unable to comment on longitudinal relationships at the individual level; however, the distribution of sample characteristics remained relatively stable across time for our primary analyses, suggesting that the demographic makeup of the sample did not differ across time. Third, this study measures self-reported symptoms of anxiety and depression; a true diagnosis of anxiety or depression would need to be made by a provider using DSM-IV criteria. However, the CTIS study used screening stems from 2 respected and highly used mental health screening instruments that have been validated in different populations to screen for symptoms aligned with provider diagnosis: the question screening for frequent feelings of anxiety was adapted from the GAD,[6] and the question for frequent feelings of depression was adapted from the CES-D,[25] which was based on symptoms of depression as seen in clinical cases and commonly used for screening depression in the U.S.[43,44] Fourth, although this survey identifies multiple self-identified genders beyond male and female gender to also include nonbinary gender, which few large-scale surveys have done, this survey does not capture transgender status. Persons identifying as transmen or transwomen may have a mental health trajectory different from that of the groups examined specifically in our study; however, given that few studies have captured nonbinary status during the COVID-19 pandemic, we hope that the inclusion of a nonbinary category is a step toward more diverse gender inclusion in our understanding of trends in mental health across populations during the COVID-19 pandemic. Fifth, the percentage of teens using Facebook has declined over time,[45] and the remaining young Facebook users may not represent the U.S. population of teens. However, this study focuses on adults aged ≥18 years, who are more likely to use Facebook than younger persons,[46] and we use 2-stage survey weights incorporating age, gender, and state of residence, which aligns the sample more closely with the U.S. population.

## CONCLUSIONS

Notwithstanding these limitations, we found that feelings of depression and anxiety were high over the COVID-19 pandemic, with a peak in October−November 2020, and that risk factors stayed relatively stable over time, with the greatest risk for poor mental health being younger age and nonbinary gender. Poor mental health has large costs to society, and a recent report by the White House Council on Economic Advisors calls to reduce the burden of mental health in the U.S.[47] To reduce the burden of poor mental health in the U.S., it will be critical to understand how mental health evolved over time and what groups presently are reporting the greatest burden of mental illness. These findings, along with the literature on mental health before the COVID-19 pandemic, suggest that pre-existing gaps in mental health (such as between men and women) stayed relatively stable throughout the COVID-19 pandemic but that other gaps widened over the pandemic, including the mental health of nonbinary persons and the mental health of persons with less education. These findings show that young people are suffering, which confers

with[48] and adds evidence to the literature on the burden of mental illness among younger persons, who may need strategies to address poor mental health over the life course. Although the gap in mental health between younger and older people grew slightly smaller over the course of the pandemic, the gap remained high, suggesting that the burden of anxiety and depression remains high among young people. Finally, the finding that nonbinary persons saw elevated levels of poor mental health over time merits further investigation. Given partisan attempts to reduce protections against discrimination of nonbinary persons, it is possible that the mental health of this group remains in peril and may be worsening because of stressors imposed by the COVID-19 pandemic and by political forces that have emerged in the last 2 years. Armed with this evidence, policymakers, practitioners, and parents may wish to be proactive in screening for mental health issues and in considering treatment and management programs to ensure that poor mental health is addressed and reduced. In addition, these findings suggest that although depression and anxiety were high for all age groups during the pandemic, younger persons suffered disproportionately, suggesting an additional burden that the pandemic imposed during a sensitive life period. Given the effects of poor mental health across the life course, policymakers may wish to consider the mental health of youth for future large-scale events and may wish to prioritize screening and treatment of poor mental health for all people and for groups with elevated risk as the world emerges from the pandemic.

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## SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.focus.2023.100140.

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