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# Long-COVID and comorbid depression and anxiety two years into the COVID-19 pandemic☆,☆☆,☆☆☆

Sasha Rudenstine[a,*], Talia Schulder[a], Krish J. Bhatt[b], Kat McNeal[a], Catherine K. Ettman[c], Sandro Galea[c]

[a] Department of Psychology, City College of New York, 160 Convent Avenue NAC 8/122B, New York, NY 10031, United States
[b] Mailman School of Public Health, Columbia University, 722 W 168th St, New York, NY 10032, United States
[c] School of Public Health, Boston University, 715 Albany St, Boston, MA 02118, United States

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ABSTRACT

Long-COVID, or the persistence of COVID-19 symptoms for months after initial infection, has been shown to impact the lives of those affected. The current study sought to investigate the relationships between long-COVID, COVID-19 related stress, depression, anxiety, and comorbid depression and anxiety outcomes. Data were collected in Winter 2021-2022 from a population of adults enrolled in at least one course across multiple City University of New York (CUNY) campuses. Frequencies and chi-square tests were computed to assess for demographics and relationships to probable diagnoses of depression and anxiety, and binary logistic regressions were computed to assess for the odds of probable comorbid depression and anxiety based on demographics, stressors, and long-COVID. Women participants reported higher odds of probable depression outcomes, and stressor levels were significant correlates of probable anxiety outcomes. Women participants, 3.2 [1.5-6.9], as compared to men, lower-SES participants, 2.16 [1.1-4.2], as compared to higher-SES participants, participants with higher COVID-19 related stress levels, 4.8 [2.0-12.0], as compared to those with low levels, and participants with long-COVID, 3.7 [1.9-7.0], as compared to those without, all had higher odds of probable comorbid depression and anxiety. Findings highlight the importance of social location, stress, and long-COVID, in tandem, as correlates of psychological health during the shifting pandemic.

## 1. Introduction

The COVID-19 pandemic has caused widespread psychological harm to numerous populations (Abdalla et al., 2021; Breslau et al., 2021; Chen et al., 2020; Daly & Robinson, 2021; Ettman et al., 2020, 2020; Rudenstine et al., 2020, 2022a). The social isolation, interpersonal conflicts, and many economic and health-related stressors, brought on by COVID-19 and which became chronic for many, have contributed to significant increases in psychological distress (Abdalla et al., 2021; Daly & Robinson, 2021; Ettman et al., 2021, 2020; Fruehwirth et al., 2021; Lakhan et al., 2020; Loades et al., 2020; Magson et al., 2021; Pancani et al., 2021). In addition, the persistence of physical symptoms over a month after initial infection, "long-COVID," has been well documented (Leow et al., 2005; Moldofsky & Patcai, 2011; Sugiyama et al., 2022). Long-COVID symptoms include fatigue, changes in breathing patterns, cardiovascular risks, cognitive changes, and distortions in taste and smell for weeks and months after the onset of COVID-19 (Crook et al., 2021; Pavli et al., 2021; Raveendran et al., 2021).

Investigations into psychological distress during the pandemic have documented increased prevalence of depression and anxiety symptoms (Daly & Robinson, 2021; Ettman et al., 2020; Holingue et al., 2020; Rudenstine et al., 2020; Zhang et al., 2020). A 2022 review examined pandemic-related mental health sequalae and documented changes in distress post COVID-19 infection, with greater distress at acute stages of infection, and continued distress in individuals followed months after initial infection (Zürcher et al., 2022). Prior work investigating other understood chronic pain disorders have shown an important comorbidity with mood and anxiety disorders suggesting that a more thorough

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* Corresponding author.
*E-mail addresses:* mrudenstine@ccny.cuny.edu (S. Rudenstine), schulderta@gmail.com (T. Schulder).

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understanding of the interrelationship of long-COVID with psychological distress is an important step towards understanding this disease and its long-term population health impacts (Alciati et al., 2012; Gadalla, 2008; Thieme et al., 2004; Yalcin & Barrot, 2014). The interrelationships between long-COVID and COVID-19 related stressors are particularly important to investigate within lower-resource and ethno-racially diverse populations, given the disproportionate material and psychological consequences of the pandemic within these communities as compared to communities with greater resources (Mattos dos Santos, 2020; Zhang et al., 2020). Among those who report long-COVID studies have found a range of ongoing challenges that increase daily stressors, ranging from barriers to returning to work and difficulty maintaining daily activities (Anaya et al., 2021; Lemhöfer et al., 2021; Perrin et al., 2020; Tabacof et al., 2022).

To date, increases in distress documented during COVID-19 have been understood in relation to stressors (Ettman et al., 2021; Fruehwirth et al., 2021; Gibson et al., 2021, 2021; Mattos dos Santos, 2020; Nagata et al., 2022; Rudenstine et al., 2020, 2021, 2022a; Zhang et al., 2020). In particular studies have shown a differential psychological impact on those with fewer economic resources as well as for populations of color in general (Mattos dos Santos, 2020; Zhang et al., 2020). The disproportional effect of COVID-19 on these historically marginalized populations as related to both COVID-19 infection rates and daily stressors necessitates a greater understanding of the psychological health of these communities.

### 1.1. The current study

The current study sought to investigate the relationship between COVID-19 related stressors and long-COVID endorsements on the odds of experiencing three psychiatric outcomes: probable depression only, probable anxiety only, and probable comorbid depression and anxiety. Data were collected from December 2021-January 2022, during the Omicron surge, in New York City, among a predominantly low-socioeconomic status (SES) urban population of adults enrolled in at least one course at a public university.

## 2. Methods

### 2.1. Participants

The present sample consisted of 1488 adults age 18 or older who were enrolled in at least one course across CUNY campuses.

### 2.2. Procedure

Data were collected via self-report surveys conducted on Qualtrics. Links for Qualtrics surveys were sent out in an email blast to multiple CUNY campuses in December 2021. The data were collected until January 26, 2022. Inclusionary criteria (age 18 or older and enrolled in at least one university course) was stated on the home page of the survey and participants consented by clicking on the link and completing the survey. No financial compensation was given for completing the survey. The study was approved by the Institutional Review Board at CUNY.

### 2.3. Measures

#### 2.3.1. Demographic characteristics

Gender was measured with three categories: woman, man, or other (including nonbinary or other identities). Ethnoracial group membership was measured with five categories: Latinx, non-Latinx Asian, non-Latinx Black, non-Latinx Indigenous, and non-Latinx white. An SES index was computed using the following variables and scores: household income (scores of 1 indicating income ≥$65,000), household savings (scores of 1 indicating savings ≥$10,000), individual income (scores of 1 indicating income ≥$35,000), individual savings (scores of 1 indicating savings ≥$5,000), education (scores of 1 indicating college graduate or above), and health insurance (scores of 2 for private health insurance, scores of 1 for public health insurance, and scores of 0 for no health insurance). SES scores were then aggregated and split at the median. The present index has been used in previous research investigating mental health during COVID-19 (Rudenstine et al., 2021).

#### 2.3.2. COVID-19 stressor index

Fifteen stressors were used to assess for COVID-19 related stress: seeing friends in person less, seeing family in person less, death of someone close to you due to COVID-19, family or relationship problems, feeling alone, not being able to get food due to shortages, not being able to get supplies due to shortages, losing a job, a member of your household losing a job, having financial problems, having difficulty paying rent, being forced to leave campus, working remotely (away from the office), challenges finding childcare, and event cancellations. These stressors have been used in previous research examining the psychological impact of stress exposure during the pandemic (Abdalla et al., 2021; Ettman et al., 2020, 2021; Rudenstine et al., 2020, 2021, 2022a). A question read, "Have any of the following affected your life as a result of the coronavirus or COVID-19 outbreak?" and participants were prompted to check all stressors that applied. Each stressor endorsement was scored as 1, total scores were aggregated, and dichotomized, with scores ≥5 being high stress, and <5 being low stress, in accordance with previous COVID-19 research, and in order to aid interpretation of logistic regression odds ratio results (Ettman et al., 2020; Rudenstine et al., 2021). This established stressor scale was developed from previously used measures for disaster stress and psychological health (Boardman et al., 2001; Galea et al., 2008).

#### 2.3.3. Long-COVID

Long-COVID was assessed with a single item that stated "Do you continue to have persistent symptoms (such as fatigue, shortness of breath, and cognitive dysfunction) for at least 3 months from the onset of your initial COVID-19 diagnosis?" Responses were on a binary yes/no scale. Only respondents who had precedingly endorsed having been diagnosed with COVID-19 were shown this question. Therefore, any individuals who reported not having been diagnosed with COVID-19 or testing positive were no included in the long-COVID variable coding. Of participants who had COVID-19, 39.9% endorsed having long-COVID, and 60.1% endorsed not having long-COVID.

#### 2.3.4. Probable depression

The Patient Health Questionnaire-9 (PHQ-9) is a clinically validated tool used to assess depressive symptoms (Kroenke et al., 2001). It has 9 items each scored on a 4-point scale from 0 (not at all) to 4 (nearly every day). It has a documented sensitivity of 88.0% and has a clinically validated cutoff score of 10, with scores ≥10 indicating probable depression (Kroenke et al., 2001). The Cronbach's alpha for the PHQ-9 for the present sample was .91.

#### 2.3.5. Probable anxiety

The Generalized Anxiety Disorder-7 (GAD-7) is a clinically validated tool used to assess anxiety symptoms (Spitzer et al., 2006). It has 7 items each scored on a 4-point scale from 0 (not at all) to 4 (nearly every day). It has a documented sensitivity rate of 89.0% and has a clinically validated cutoff score of 10, with scores ≥10 indicating probable anxiety (Spitzer et al., 2006). The Cronbach's alpha for the GAD-7 for our sample was 0.93.

#### 2.3.6. Probable comorbid depression and anxiety

In order to assess for comorbid outcomes, a new variable was coded using binary probable depression and anxiety variables that were split at the validated cutoff scores of 10. This new variable was binary: probable comorbid depression and anxiety (1), and non-comorbid depression and anxiety (0). The non-comorbid category included participants with

either just probable depression or anxiety scores, or neither. This scoring was conducted in order to assess for the specific impact of the predictors on probable comorbid depression and anxiety, rather than on either diagnosis alone. This use of cutoff scores to assess for comorbidity has been previously used to assess for depression and anxiety comorbidities (Bante et al., 2021; Johansson et al., 2013; Palgi et al., 2020).

## 3. Data analysis

All analyses were conducted on SPSS. First, we assessed sample characteristics including demographics, stressors, presence of long-COVID, and probable comorbid depression and anxiety. Second, we computed chi-square tests to assess for significance between characteristics and probable depression and anxiety rates. Third, we computed binary logistic regressions to assess for the odds of probable depression with demographics, stress levels, and long-COVID as predictors. Fourth, this analysis was replicated with probable anxiety as outcome. Fifth, this analysis was replicated with comorbid depression and anxiety as outcome. All analyses controlled for each other diagnostic outcomes, as well as for probable post-traumatic stress, in order to assess for the particular relationships with outcomes of interest for each statistical test. Additionally, all analyses controlled for preceding diagnosis of chronic illness, through a single item that asked participants if they had a previous chronic illness (including cardiovascular, pulmonary, or other chronic illness). Logistic regressions were computed hierarchically, with each variable type entered step-wise in order to preclude smaller subsamples from limiting other subsample sizes. Data that were missing for more than half of a measure were excluded from analyses, if less than half were missing then missing cells were imputed with the mean of remaining completed cells.

## 4. Results

The mean age of the present sample was 26.7 (SD = 9.72). Table 1 displays the sample characteristic distributions of the present sample, as well as p-values for chi-square analyses. The majority of our sample were women (67.4%), 30.4% were men, and 2.2% endorsed having other nonbinary identities. The ethno-racial group membership breakdown of our sample was as follows: 34.5% Latinx, 25.0% non-Latinx Asian, 16.1% non-Latinx Black, 0.8% non-Latinx Indigenous, and 23.6% non-Latinx white. In terms of socioeconomic status (SES), 62.7% of our sample met the cutoff for high SES, and 37.3% met the cutoff for being low-SES (the SES index used is described below). Sixty two percent of our sample endorsed a high number of stressors, and 38.0% endorsed a low number of stressors. Roughly 48% of the sample met the cutoff for probable depression, 37.1% met the cutoff for probable anxiety, and 32.6% met the cutoff for probable comorbid depression and anxiety. All documented factors yielded significant chi-square results, demonstrating significant relationships between these factors and probable depression and anxiety rates. However, given the disparate cell distribution, particularly for ethno-racial group membership levels and gender levels, such significance could be due to inequitable cell size. Given the significance of these variables, they were all included in the subsequent logistic regression computation.

**Table 1**
Demographic characteristics.

| Variable | Total | | Probable comorbid depression and anxiety | | | | *p*-value |
|---|---|---|---|---|---|---|---|
| | | | No | | Yes | | |
| | *N* | % | *N* | % | *N* | % | |
| **Total** | 1488 | 100 | 491 | 32.6 | 1013 | 67.4 | |
| **Ethno-racial group** | | | | | | | .002 |
| Latinx | 509 | 34.5 | 328 | 64.8 | 178 | 35.2 | |
| Non-Latinx Asian | 369 | 25.0 | 235 | 64.2 | 131 | 35.8 | |
| Non-Latinx Black | 237 | 16.1 | 172 | 73.8 | 61 | 26.2 | |
| Non-Latinx Indigenous | 12 | 0.8 | 4 | 33.3 | 8 | 66.7 | |
| Non-Latinx white | 348 | 23.6 | 245 | 71.6 | 97 | 28.4 | |
| **Gender** | | | | | | | <.001 |
| Man | 457 | 30.4 | 341 | 75.6 | 110 | 24.4 | |
| Woman | 1011 | 67.4 | 638 | 64.0 | 359 | 36.0 | |
| Other (including nonbinary or other identities) | 33 | 2.2 | 15 | 45.5 | 18 | 54.5 | |
| **Socioeconomic status** | | | | | | | <.001 |
| Low | 833 | 37.3 | 508 | 61.4 | 319 | 38.6 | |
| High | 1401 | 62.7 | 505 | 74.6 | 172 | 25.4 | |
| **COVID-19 related stressors** | | | | | | | <.001 |
| Low | 850 | 38.0 | 357 | 85.6 | 60 | 14.4 | |
| High | 1384 | 62.0 | 656 | 60.3 | 431 | 39.7 | |
| **Long COVID-19** | | | | | | | <.001 |
| Yes | 210 | 39.9 | 81 | 50.0 | 81 | 50.0 | |
| No | 316 | 60.1 | 182 | 77.4 | 53 | 22.6 | |

Table 2 displays the results for the computed logistic regressions. Only gender was significantly associated with higher odds of probable depression for women, 3.6 [1.6-8.2]. The finding for other transgender and nonbinary individuals was also significant, however, significance may be due to the small number of participants within this subsample and inequitable cell distributions. As for probable anxiety, only stressors were a significant predictor, 3.1 [1.1-8.6]. As shown the following variables were associated with significantly higher odds of probable comorbid depression and anxiety: gender, only for women participants, 3.2 [1.5-6.9], as compared to men, being low-SES, 2.16 [1.1-4.2], as compared to those who are high-SES, having a high COVID-19 stress level, 4.8 [2.0-12.0], as compared to participants who have low COVID-19 stress levels, and having long-COVID, 3.7 [1.9-7.0], as compared to those who do not.

## 5. Discussion

Using a sample of university students attending the largest public university in the US this study had two key findings. First, we found that (i) female gender was significant for probable depression and probable comorbid depression anxiety, (ii) pandemic-related stress exposure was associated with an increased risk of probable anxiety and comorbid outcomes, and (iii) low-SES was significantly associated with increased probability of comorbid depression and anxiety. Previously established correlates of psychological health in the context of COVID-19 include female gender, low-SES, and greater COVID-19 stress exposure (Abdalla et al., 2021; Ettman et al., 2021; Fruehwirth et al., 2021; Mattos dos Santos, 2020; Nagata et al., 2022; Peck, 2021; Rudenstine et al., 2020, 2021). Second, long-COVID was only a significant correlate of probable comorbid depression and anxiety. This demonstration that long-COVID, a variable unique to the COVID-19 pandemic, is associated with increased risk of comorbid mood-anxiety symptoms points to further ways in which psychological distress has increased during the COVID-19 pandemic (Ettman et al., 2021; Fruehwirth et al., 2021; Gibson et al., 2021; Nagata et al., 2022; Rudenstine et al., 2020).

The pandemic has disproportionately affected the psychological well-being of women (Almeida et al., 2020; Peck, 2021; Power, 2020). The burden of caretaking, greater strains on work-life-family balance due to remote working and school closures may have contributed to the greater effect of the pandemic on women's vs men's mental health (Power, 2020; *UN Secretary-General's Policy Brief*, n.d.). Previous investigations have demonstrated the increased toll faced by women who are pregnant, or those experiencing domestic violence during the pandemic (Almeida et al., 2020; Hessami et al., 2022; Power, 2020; *UN Secretary-General's Policy Brief*, n.d.). Research has also demonstrated increases in depression for women in the context of large-scale crises, and the present findings support the additionally significant risk of probable comorbid depression and anxiety for women during the pandemic (Akerkar & Fordham, 2017; Goldmann & Galea, 2014; Shooshtari et al., 2018).

The role of socioeconomic status as an important correlate of mood

**Table 2**
Odds of probable comorbid depression and anxiety by sociodemographics, stress, and long-COVID-19.

| Variable | Probable comorbid depression and anxiety | | | | | Probable depression | | | | | Probable anxiety | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *β* | SE | *p*-value | OR | 95% CI (LL-UL) | *β* | SE | *p*-value | OR | 95% CI (LL-UL) | *β* | SE | *p*-value | OR | 95% CI (LL-UL) |
| **Ethno-racial group membership** | | | | | | | | | | | | | | | |
| Non-Latinx White (Ref.) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Non-Latinx Black | 0.20 | 0.54 | .710 | 1.2 | 0.4-3.5 | 0.10 | 0.61 | .875 | 1.1 | 0.3-3.7 | -0.06 | 0.69 | .933 | 0.9 | 0.3-3.4 |
| Non-Latinx Asian | .095 | 0.55 | .862 | 1.1 | 0.4-3.3 | -0.03 | 0.62 | .956 | 1.0 | 0.3-3.3 | 0.01 | 0.64 | .993 | 1.0 | 0.3-3.5 |
| Latinx | -0.03 | 0.46 | .956 | 1.0 | 0.4-2.4 | 0.48 | 0.51 | .352 | 1.6 | 0.6-4.4 | -0.51 | 0.54 | .351 | 0.6 | 0.2-1.7 |
| Non-Latinx Indigenous | 1.95 | 2.25 | .385 | 7.0 | 0.1-578.9 | 0.68 | 3.08 | .851 | 1.8 | 0.0-741.1 | 0.62 | 3.07 | .840 | 1.9 | 0.0-758.6 |
| **Gender** | | | | | | | | | | | | | | | |
| Man (Ref.) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Woman | 1.17 | 0.39 | .003 | 3.2 | 1.5-6.9 | 1.28 | 0.42 | .002 | 3.6 | 1.6-8.2 | 0.13 | 0.46 | .775 | 1.1 | 0.5-2.8 |
| Other (including nonbinary or other identities) | 1.37 | 0.91 | .133 | 3.9 | 0.7-23.7 | 2.4 | 1.11 | .034 | 10.6 | 1.2-93.7 | -0.72 | 1.03 | .485 | 0.5 | 0.1-3.7 |
| **Age** (continuous) | -.003 | .017 | .865 | 1.0 | 1.0-1.0 | -0.01 | 0.02 | .599 | 1.0 | 1.0-1.0 | -0.02 | 0.02 | .366 | 1.0 | 0.9-1.0 |
| **Socio-economic status** | | | | | | | | | | | | | | | |
| Low | 0.77 | 0.34 | .023 | 2.16 | 1.1-4.2 | 0.14 | 0.38 | .702 | 1.2 | 0.6-2.4 | 0.53 | 0.39 | .173 | 1.7 | 0.8-3.6 |
| High (Ref.) | - | - | - | - | - | - | - | - | - | - | - | - | | - | - |
| **Total stress level** | | | | | | | | | | | | | | | |
| Low (<5 stressors) (Ref.) | - | - | - | - | - | - | - | - | - | - | - | - | | - | - |
| High (5+ stressors) | 1.58 | 0.46 | <.001 | 4.8 | 2.0-12.0 | 0.69 | 0.43 | .107 | 2.0 | 0.9-4.6 | 1.15 | 0.52 | .026 | 3.1 | 1.1-8.6 |
| **Long COVID-19** | | | | | | | | | | | | | | | |
| No (Ref.) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Yes | 1.3 | 0.33 | <.001 | 3.7 | 1.9-7.0 | .0.27 | 0.40 | .511 | 1.3 | 0.6-2.9 | 0.58 | 0.42 | .167 | 1.8 | 0.8-4.0 |

Note: $N = 1488$. Fifteen total stressors were assessed: seeing friends in person less, seeing family in person less, death of someone close to you due to COVID-19, family or relationship problems, feeling alone, not being able to get food due to shortages, not being able to get supplies due to shortages, losing a job, a member of your household losing a job, having financial problems, having difficulty paying rent, being forced to leave campus, working remotely (away from the office), challenges finding childcare, and event cancellations. These stressors have been used in previous research examining the psychological impact of stress exposure during the pandemic. Low stress indicated 1–4 stressors, and high stress ≥5 stressors. Socioeconomic status was measured using a computed index of the following factors: educational attainment, household income, household savings, individual income, individual savings, and health insurance. Total scores were dichotomized into high vs. low at a median score of 4.

and anxiety disorders concords with prior research (Ettman et al., 2021; Rudenstine et al., 2020, 2021; Zhang et al., 2020). The pandemic's effects on the economy, employment, housing and food insecurity, and academic trajectories, has caused greater disruptions for those with less access to wealth and educational attainment (Ando & Furuichi, 2021; Borio, 2020; Fairlie et al., 2020; Rudenstine et al., 2021; Sherbuk et al., 2020). Relatedly, the observation that COVID-19 related stressors are correlates of psychopathology throughout the ongoing pandemic is consistent with published work (Abdalla et al., 2021; Rudenstine et al., 2020, 2021, 2022b).

To the best of our knowledge there have been few studies to date investigating the role of long-COVID in ongoing psychological health. Preliminary investigations have identified a relationship between long-COVID and depression (Renaud-Charest et al., 2021). Importantly, our study, which found that long-COVID is associated with probable comorbid depression-anxiety and not with either probable diagnosis alone, suggests that among our sample population, the psychological sequalae of long-COVID was more pervasive than a singular diagnostic disorder. Previous work from our study has documented high rates of probable anxiety and probable depression among our sample as compared to national averages during COVID-19 (Ettman et al. 2020) with COVID-19 stressors being the strongest correlates of this distress. This study suggests that the experience of long-COVID has no significant relation to probable depression or anxiety alone, while it does for probable comorbid depression anxiety.

There are a couple of explanations for why long-COVID is specifically associated with increased comorbid depression-anxiety. First, such a relationship may be related to the particular impacts of long-COVID on everyday life. The ways in which long-COVID is associated with one's capacity to work, to engage in any form of exertion, its increase on fatigue, and other health risks associated with long-COVID, may relate to unique forms of stress that exacerbate both depression and anxiety, thus being associated with cooccurring and comorbid outcomes (Crook et al., 2021; Mendelson et al., 2020; Raveendran et al., 2021). Second, there is literature on relationships between chronic health conditions and comorbid depression and anxiety outcomes that identify associations between the impacts of symptoms, such as those stated above, and comorbid outcomes, which potentially occurring bidirectionally, with both medical and psychological comorbidities further exacerbating disease and distress (Scott et al., 2007; Zareifopoulos et al., 2019).

Our finding that experiencing long-COVID is associated with one's risk for probable comorbid depression and anxiety is consistent with and expands upon these initial studies. That long-COVID is a psychologically correlated variable is consistent with preliminary investigations into its medical and functional impacts (Crook et al., 2021; Pavli et al., 2021; Raveendran et al., 2021). The persistence of debilitating symptoms such as fatigue, pulmonary and cardiovascular abnormalities, among others, have been connected to fear and sadness regarding the uncertainty around how such symptoms will be mitigated. These responses to persistent symptoms are exacerbated by the lack of known or cohesively recommended treatments, as of yet, for long-COVID (Desforges et al., 2021; Jiang & McCoy, 2020). Additionally, such unknowns regarding these symptoms may further exacerbate individual experiences of confusion, and misunderstanding, within a healthcare system that has yet to establish a thorough understanding of long-COVID and to form treatment norms. The functional consequence of persistent COVID-19 symptoms also can be understood to decrease one's capacity for continued work, exercise, or to engage in activities that one enjoys and that require cognitive and physical exertion, potentially causing, or being exacerbated by, feelings of anhedonia and decreased outlets for anxiety (Anaya et al., 2021; Lemhöfer et al., 2021; Perrin et al., 2020; Tabacof et al., 2022). Additionally, research has documented decreases in post-COVID-19 symptoms for years post-infection which demonstrate the need for further research that understands such reductions in symptoms in relation to psychological health and mental health sequalae (Fernández-de-Las-Peñas et al., 2022). Research must account for the everchanging nature of physical and psychological health during COVID-19 and the complex interactions that can occur between these

factors.

The present findings have multiple limitations. First, due to the cross-sectional nature of the study, causality could not be inferred. Second, the sample was majority women and lower-SES, limiting the generalizability of our findings. Third, our reliance on self-report measures excludes the possibility for clinically determined diagnoses and rather relies on probable diagnostic outcomes. Nevertheless, the screening tools used for probable depression and probable anxiety are highly regarded and are well-established for assessing mental health outcomes (Bante et al., 2021; Johansson et al., 2013; Kroenke et al., 2001; Palgi et al., 2020; Spitzer et al., 2006). Fourth, unincluded variables that are notable factors in psychological health during disaster contexts and during COVID-19 such as immigration status, sexual orientation, geographical data at neighborhood levels, was not examined and would be important to investigate in future studies. Relatedly, additional research may include measures of previous diagnosis of depression and anxiety before COVID-19 infection, in order to better deduce relationships between preceding psychological distress and long-COVID, as well as more comprehensive assessments of long-COVID symptoms and their severity.

Despite the presence of these limitations, this is the first study of which we are aware to address the role played by long-COVID in shaping mental health outcomes. The current findings highlight the importance of understanding the various correlates of distress that affect individuals during the shifting pandemic. Social location, stress, and medical experiences together relate to psychiatric symptoms and should be accounted for in attempts to foster psychological wellbeing during a pandemic.

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## CRediT authorship contribution statement

**Sasha Rudenstine:** Conceptualization, Methodology, Investigation, Writing – original draft. **Talia Schulder:** Methodology, Formal analysis, Investigation, Writing – original draft. **Krish J. Bhatt:** Investigation, Writing – original draft. **Kat McNeal:** Investigation, Writing – original draft. **Catherine K. Ettman:** Conceptualization, Writing – review & editing. **Sandro Galea:** Conceptualization, Writing – review & editing.

## Declaration of Competing Interest

The authors have no conflicts of interest to report.
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