An investigation of COVID-19 related worry in a United States population sample

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Background: Although general anxiety has increased markedly since the onset of the COVID-19 pandemic, little has been reported about the demographic distribution of COVID-19 related worry, its relationship with psychological features, and its association with depression symptoms in the United States (US).
Methods: 2117 participants, selected to represent the age, gender, and race/ethnic distributions of the US population, completed an online survey. Analysis of variance and correlation analyses were used to assess relationships between the COVID-19 related worry score and demographic characteristics, past psychiatric diagnoses, personality dimensions, and current psychological symptoms. Logistic regression was used to evaluate the association between the COVID-19 worry score and depression symptoms.
Results: The COVID-19 worry score was markedly higher in younger (18-49 year-olds) than older participants, and moderately higher in men, those who were married or cohabiting, with post-college education, and/or living in large urban areas. The COVID-19 worry score also was markedly higher in those who reported having been diagnosed with a psychiatric disorder. The COVID-19 worry score correlated with neuroticism, current psychological symptoms, and COVID-19 risk and COVID-19 behavior scores. The COVID-19 worry score was associated with current depression symptoms (OR = 1.10, 95% CI = 1.09–1.11; p < 0.001) in univariable models and remained significant after adjustment for other correlates of depression, including COVID-19 risk.
Conclusions: In this US sample, the COVID-19 worry score was inversely related to age, strongly related to psychological symptoms, and independently associated with depression symptoms. These findings have implications for the community mental health response to the COVID-19 pandemic in the US.

1. Introduction

The COVID-19 pandemic has had a profound impact on public well-being, with millions of cases and deaths, severe economic hardships, and widespread social effects in the US and globally (Brenner, 2020; World Health Organization, 2021). There have been adverse effects on the mental health of survivors of the illness, individuals at high risk of exposure to infection, and the community at large (Fiorillo and Gorwood, 2020). Population-based surveys have found relatively high cross-sectional prevalence, and longitudinal increases in the prevalence of symptoms of depression and anxiety during the pandemic, in the US (Daly et al., 2021a; Daly and Robinson, 2021b; Ettman et al., 2020a; Holingue et al., 2020; Khubchandani et al., 2020; Twenge & Joiner, 2020a; Twenge & Joiner, 2020b) and other countries (Creese et al., 2020; Pieh et al., 2020; Ran et al., 2020; Fukase et al., 2021; Stocker et al., 2021).

Although a strong relationship between general anxiety and depression during the pandemic has been well-documented in several population-based studies, it also is important to describe the distribution of COVID-19 related worry in the population, and the relationship between this worry and depression during the pandemic. Several population-based surveys in Europe and Asia have described demographic and psychological correlates of COVID-19 related worries, such as concerns about becoming infected, infecting others, and income loss, and their association with depression in population-based surveys (Choi et al., 2020; Dawel et al., 2020; Hyland et al., 2020; Parlapani

et al., 2020; Garre-Olmo et al., 2021; Sebri et al., 2021).

However, relatively little has been reported about the demographic distribution of COVID-19 related worry, and the relationship of this worry with depression, in population-based samples in the US, especially after the early phase of the pandemic. Ettman et al. (2020b) found that low financial assets and COVID-19-related financial stressors were associated with depression in a survey conducted in late March – mid April 2020. Zheng et al. (2021) reported that COVID-19 related health and financial worries at baseline predicted depression at followup, in a survey of Canadian and US residents conducted from March to May 2020. Haliwa et al. (2021) found that financial concerns and effects of COVID-19 on daily life were associated with increase in depression from pre-pandemic (September–December 2019) to April–June 2020. In the Understanding America Study, conducted in March 2020, worries about financial adversities because of the pandemic, as well as concerns about becoming infected and dying from COVID-19, were associated with depression symptoms (Kämpfen et al., 2020). In addition, Dayton et al. (2021) found that depression scores were significantly related to COVID-19 related worries in participants surveyed in late March 2020.

Additional studies are needed to determine the distribution of COVID-19 related worry in the population; to evaluate the relationship between COVID-19 worry and other psychological symptoms; and to elucidate the association between COVID-19 worry and symptoms of depression during later phases of the pandemic in the US. This knowledge is important for identifying individuals in the community who may be most at risk for developing depression and other psychopathology during future phases of the pandemic in this country, and for planning and delivering the most effective treatment and prevention programs.

Therefore, in the current study, we addressed three research questions: 1) What is the demographic distribution of COVID-19 related worry in a US population-based sample surveyed in September 2020? 2) How is COVID-19 worry related to other psychological symptoms and traits? 3) How strongly is COVID-19 worry associated with symptoms of depression, and is this association independent of demographic characteristics and clinical features evaluated in the study?

2. Materials and methods

2.1. Participants

Potential participants were identified by the survey research firm, Qualtrics, from market research panels (www.qualtrics.com). Census-matched quota sampling was used to identify a study sample of about 2000 adult residents of the US, with approximately equal proportions of men and women; one-third in each of three age groups (ages 18–34; 35–55; and 55 and over); and a race/ethnicity distribution of 66% non-Latinx White; 12% non-Latinx Black; 12% Latinx; and 10% other.

Informed consent of participants was obtained after the nature of study procedures had been explained. The online consent form indicated that Johns Hopkins University was conducting the study to identify COVID-19 related concerns and to determine if these concerns change over time, and that participants would be asked about their feelings, thoughts, and behaviors. Participants were compensated $1.50 for completing the baseline survey. Study investigators were provided with de-identified responses. The investigation was carried out in accordance with the latest version of the Declaration of Helsinki. The study design was reviewed and approved by the Institutional Review Board of the Johns Hopkins Medical Institutions.

All surveys underwent data quality screening procedures including algorithmic and keystroke analysis for attention patterns, click-through behavior, duplicate responses, machine responses, and inattentiveness. Participants who failed an attention or speed check, along with any responses identified by the data-scrubbing algorithms, were excluded from the analysis.

2.2. Measures

2.2.1. COVID-19 related worry

COVID-19 related worry was assessed with a 12-item questionnaire (Coronavirus Worry Scale) (University of Miami. PhenXToolkit, 2020; Dayton et al., 2021) that asked about the current degree of worry or anxiousness experienced by the participant because of the COVID-19 coronavirus: 3 items about worries related to becoming infected or transmitting infection to others; 5 items about financial worries; and 4 items about worries affecting sleep, concentration, thought, and feeling. Each item was scored on a 5-point Likert scale (1 = Strongly disagree; 2 = Disagree; 3 = Neither agree nor disagree; 4 = Agree; 5 = Strongly agree). Possible scores on the instrument range from 5 to 60 (Appendix, Table A1).

2.2.2. COVID-19 related behaviors and risk

COVID-19 related behaviors were assessed with an 11-item questionnaire (Coronavirus Impact Scale; University of Miami. PhenXToolkit, 2020) that asked about the extent of changes the participant had made in usual lifestyle or daily activities because of COVID-19. The behaviors included handwashing, use of hand sanitizer, cleaning of home, disinfecting household surfaces, disinfecting or wiping down groceries, disinfecting or wiping down mail or packages, stocking up food and supplies, avoiding domestic travel, avoiding international travel, not ordering restaurant itake-out food, and wearing a mask while in public. The possible scores on this Likert-scaled instrument ranged from 0 to 33 (Samuels et al., 2021).

COVID-19 related risks were assessed with the COVID-19 Risk Scale, which includes 12 items that ask about situations experienced by the participant that may confer increased risk of exposure to COVID-19. The situations include working outside the home; working or volunteering in high-exposure risk environments; close physical contact with someone having COVID-19; living with others who work or go to school outside the home, who work or volunteer in high-risk environments, who have been in close physical contact with someone with COVID-19, or who have been ill with COVID-19; going to indoor places with other people around; physical distancing and mask-wearing by self and others when outside the home; and having a chronic health condition. Each item is rated 1 for Yes, or 0 for No, with total scores ranging from 0 to 12 (Samuels et al., 2021).

2.2.3. Reported psychiatric diagnoses and psychological symptom scores

Participants also were asked if a clinician had ever diagnosed them with depression, obsessive compulsive disorder (OCD), or any anxiety disorder.

Current (that is, within the past-month) depression and anxiety symptoms were assessed with the four-item PHQ-4, with two items assessing depression symptoms (depressed mood and anhedonia), and two items assessing general anxiety (nervousness; inability to control worry). Each item is rated 0–3, so that possible scores on the depression scale and the anxiety scale range from 0 to 6. A score of three or more on the depression scale is suggestive of depression (Kroenke et al., 2009).

Past-month contamination obsessions were assessed with five Likert-scaled questions from the contamination section of the Dimensional Yale-Brown Obsessive-Compulsive Scale (DY-BOCS) (Rosario-Campos et al., 2006). The questions asked about: time spent thinking about contamination and engaging in behaviors to reduce contamination; contamination-related avoidance; contamination-related distress; contamination-related disruption of daily routine; and ability to resist contamination-related thoughts and behaviors. The possible scores ranged from 0 to 20.

Past-month contamination phobias were assessed with 10 items from the Severity Measure for Specific Phobia—Adult instrument (Craske et al., 2013). Each item is rated on a 4-point Likert-scale, with response options ranging from never to all of the time. The possible scores range from 0 to 40.

Past-month obsessive-compulsive symptoms were assessed with the Obsessive-Compulsive Inventory – Revised (OCI-R), an 18-item screening instrument for obsessive-compulsive symptoms (Foa et al., 2002). The instrument includes three items each for washing, checking, obsessing, ordering, hoarding, and neutralizing symptoms. Each item is scored on a 5-point Likert-scale. The possible total score ranges from 0 to 72.

The Doubt Questionnaire, a 18-item instrument, was used to assess doubt/uncertainty. Each item is rated on a 5-point Likert scale, from strongly disagree to strongly agree. The possible total score ranges from 18 to 90 (Marton et al., 2019) (**Appendix, Table A2**).

2.2.4. Personality traits

Personality traits were assessed with the BFI-10, a 10-item instrument measuring general personality dimensions, with 2 items each for assessing neuroticism, extraversion, openness, agreeableness, and conscientiousness. Each item is rated on a 5-point Likert-scale. The score on each of the personality dimensions ranges from 2 to 10 (Rammstedt and John, 2007).

2.3. Statistical analysis

We compared COVID-19 worry scores across categorical demographic and diagnostic groups, using ANOVA. We used the Pearson r coefficient to estimate correlations between the COVID-19 worry score, on the one hand, and personality dimensions, psychological symptoms, and COVID-19 related behavior and risk, on the other. We used univariable logistic regression models to identify risk correlates of depression, and multivariable logistic regression models to estimate the magnitude of the association between COVID-19 related worry and depression, adjusting for other correlates of depression symptoms.

3. Results

3.1. Sample characteristics

A total of 2117 individuals completed the survey between September 17–30, 2020, about six months after the first reported COVID-19 related death in the US. The ages of participants ranged from 18 to 89 years (mean, 46 years), and 54% were women. Whites comprised 71% of the sample; African Americans, 12%, Asian-Americans 6%, and Latinx, 5%. Most (64%) of the participants lived in a large city or suburb of a large city, 13% in a small city, and 23% in a town, village, or rural area. More than 75% of the participants had attended college (**Table 1**).

3.2. Demographic and clinical correlates of the COVID-19 worry score

The COVID-19 worry score varied across most demographic characteristics. The COVID-19 worry score was highest in 18–49 year-olds, and then decreased progressively in older age groups. The COVID-19 worry score also was higher in men than women, participants who were married or cohabiting, those living in large cities, and those with post-college education (**Table 2**).

The COVID-19 worry score was higher in those who reported having received a clinical diagnosis of depression, obsessive-compulsive disorder, or other anxiety disorder (**Table 3**).

The COVID-19 worry score was positively correlated with neuroticism, and negatively correlated with agreeableness and conscientiousness personality scores. The COVID-19 worry score also was strongly positively correlated with scores on doubt, obsessive-compulsive symptoms, contamination obsessions, and contamination phobias, as well as general anxiety. Moreover, the COVID-19 worry score was positively correlated with COVID-19 risk and COVID-19 related behavior scores (**Table 4**).

Table 1

Demographic characteristics of the sample (N = 2117) US survey, September 17–30, 2020.

Characteristic	Number (%)
Sex	
Female	1137 (53.7)
Male	980 (46.3)
Age Group	
18-29	357 (16.9)
30-39	471 (22.2)
40-49	484 (22.9)
50-59	274 (12.9)
60-69	350 (16.5)
70-89	181 (8.5)
Race/ethnicity	
Asian-American	131 (6.2)
Black or African-American	255 (12.0)
Latinx	109 (5.1)
White	1494 (70.6)
Other or Multiple	128 (6.0)
Education, highest completed	
Not high school graduate	55 (2.6)
High school graduate or GED	466 (22.0)
Some college or college graduate	1094 (47.0)
Post-college	602 (28.4)
Marital status	
Never married	525 (24.8)
Separated or divorced	240 (11.3)
Widowed	77 (3.6)
Cohabiting	152 (7.2)
Married	1123 (53.0)
Residential area	
Large city	617 (29.1)
Suburb of large city	744 (35.1)
Small city	268 (12.7)
Town or village	164 (7.7)
Rural area	324 (15.3)

Table 2

COVID-19 worry score, by demographic characteristics.

Demographic characteristic	Mean (SD)	Test statistic
Age, in years		
18-29	38.3 (11.9)	
30-39	39.9 (11.8)	
40-49	41.1 (12.3)	
50-59	35.5 (12.0)	
60-69	30.4 (11.4)	
70-89	27.5 (9.1)	$F_{5;2111} = 65.7$[a]
Sex		
Men	37.8 (13.1)	
Women	35.8 (11.9)	$F_{1;2115} = 14.1$[a]
Ethnicity		
Asian-American	37.9 (10.8)	
African-American	36.8 (12.1)	
Latinx	39.3 (12.0)	
White	36.4 (12.8)	
Other or multiple	36.3 (12.7)	$F_{4;2112} = 1.7$
Education, highest completed		
Not high school graduate	36.9 (13.7)	
High school graduate	35.1 (12.2)	
Some college or college graduate	35.3 (12.1)	
Post-college	40.2 (12.7)	$F_{3;2113} = 22.7$[a]
Marital status		
Never married	36.0 (12.1)	
Separated or divorced	33.4 (11.8)	
Widowed	29.3 (10.4)	
Cohabiting	38.4 (13.2)	
Married	38.0 (12.6)	$F_{4;2112} = 15.7$[a]
Residential area		
Large city	40.7 (12.3)	
Suburb of large city	35.0 (12.4)	
Small city	34.4 (12.0)	
Town or village	34.3 (11.1)	
Rural area	36.1 (12.8)	$F_{4;2112} = 23.4$[a]

[a] $p < 0.001$.

Table 3
COVID-19 worry score, by reported history of psychiatric diagnosis.

Clinician diagnosis	Mean (SD)	Test statistic
Depression		
No (N = 1347)	34.3 (12.2)	
Yes (N = 770)	40.9 (12.1)	$F_{1;2115} = 143.0$[a]
Obsessive-compulsive disorder		
No (N = 1926)	36.0 (12.4)	
Yes (N = 191)	44.1 (11.1)	$F_{1;2115} = 76.2$[a]
Other anxiety disorder		
No (N = 1524)	35.0 (12.5)	
Yes (N = 593)	41.1 (11.7)	$F_{1;2115} = 107.1$[a]
Any of these disorders		
No (N = 1184)	35.0 (12.5)	
Yes (N = 933)	41.1 (11.7)	$F_{1;2115} = 180.7$[a]

[a] $p < 0.001$.

Table 4
Correlations between COVID-worry score, personality scores, other psychological scores, and COVID-19 behavior and COVID-19 risk scores.

	Pearson *r*
Personality scores	
Neuroticism	0.23[a]
Extraversion	0.03
Openness	0.01
Agreeableness	−0.13[a]
Conscientiousness	−0.22[a]
Other psychological scores	
Doubt	0.49[a]
Obsessive-compulsive symptoms	0.64[a]
Contamination obsessions	0.67[a]
Contamination phobias	0.67[a]
General anxiety score	0.57[a]
COVID-19 behavior and risk scores	
COVID-19 behavior	0.61[a]
COVID-19 risk	0.26[a]

[a] $p < 0.001$.

3.3. Demographic and clinical correlates of depression symptoms

A total of 712 (33.6%) of the participants had a current score of three or more on the depression scale of the PHQ-4 which is suggestive of depression (Kroenke et al., 2009). Many of the correlates of the COVID-19 worry score in study participants also were associated with current depression. The prevalence of depression was inversely related to age, greater in men than women, greater in Latino than other groups, and greater in those living in large urban areas. The prevalence of depression was lower in widowed than other marital groups, and lower in those who had attended college than those with more or less education. Moreover, the prevalence of current depression was substantially greater in those who reported having been diagnosed with depression, OCD, or an anxiety disorder. The odds of depression increased with neuroticism scores and were inversely related to extraversion, agreeableness, and conscientiousness scores. The odds of depression increased with other symptoms of psychological distress (doubt, obsessive-compulsive symptoms, contamination obsessions, and contamination phobias), as well as with COVID-19 related behavior and COVID-19 related risk scores (Table A3).

3.4. Association between the COVID-19 worry score and depression

The COVID-19 worry score was significantly associated with current depression. The odds of depression increased with the COVID-19 worry score (O.R. = 1.10 per unit increase in the COVID-19 worry score; 95% CI = 1.09–1.11; $p < 0.001$), unadjusted for any other variables. The magnitude of this relationship did not appreciably change, after including demographic characteristics, reported clinical diagnoses, personality scores, or COVID-19 behavior and COVID-19 risk scores in

the models. The magnitude of this relationship was most reduced, although still statistically significant, after adjusting for doubt and other symptoms of psychological distress. In these models, age, reported clinical diagnoses, neuroticism, conscientiousness, doubt, contamination phobias, and COVID-19 risk also were associated with depression, independent of age and COVID-19 worry score (Table 5).

The strength of the relationship between the COVID-19 worry score and depression was not appreciably different in participants who reported having been diagnosed with depression, OCD, and/or an anxiety disorder (O.R. = 1.08; 95% CI = 1.06–1.09; $p < 0.001$), and those who had not (O.R. = 1.11; 95% CI = 1.09–1.13; $p < 0.001$). Moreover, we stratified COVID-19 risk into low risk (score of 0–1), intermediate risk (2–3), high risk (4–5), and highest risk (6–10) scores. The magnitude of the association between COVID-19 worry score and depression was similar in participants in the low risk (O.R. = 1.11; 95% CI = 1.08–1.05; $p < 0.001$), intermediate risk (O.R. = 1.11; 95% CI = 1.09–1.13; $p < 0.001$), high risk (O.R. = 1.08; 95% CI = 1.06–1.10; $p < 0.001$), and highest risk (O.R. = 1.07; 95% CI = 1.05–1.10; $p < 0.001$) groups.

4. Discussion

There were three major findings from this US survey, conducted about 6 months into the COVID-19 pandemic. First, we found that the COVID-19 worry score differed according to several demographic characteristics. Mean COVID-19 worry scores were higher in younger participants (less than 50 years old), and decreased progressively at older ages. COVID-19 worry scores also were higher, on average, in men; those with post-college education; those who were currently married or cohabiting; and those living in large cities. The strong inverse relationship between age and the COVID-19 worry score may explain, in part, the relationships between the other demographic correlates and the COVID-19 worry score, since greater proportions of those in the other higher-risk demographic groups were in the 18–49 year old age group. An inverse relationship between age and COVID-19 related worry has been found in other population-based studies conducted in earlier phases of the pandemic in other countries (Sebri et al., 2021), although some studies found greater COVID-19 worry in older age groups, especially worry related to contracting COVID-19 (Fisher et al., 2021; Hyland et al., 2020; Parlapani et al., 2020). Moreover, we found a strong inverse relationship between age and depression in this sample during this phase of the pandemic. This is consistent with numerous studies in other population-based surveys conducted earlier in the pandemic, in the US (Khubchandani et al., 2021; Czeisler et al., 2020; Daly et al., 2021a; Turchioe et al., 2020; Kantor and Kantor, 2020; Twenge and Joiner, 2020b) and other countries (Iob et al., 2020; Dawel et al., 2020; Stocker et al., 2021; Hyland et al., 2020; Ran et al., 2020; Bressington et al., 2020; Fukase et al., 2021). It has been suggested that exposure to stressors over time may help individuals develop competencies and coping skills that promote resilience during crises, such as the current pandemic (Angevaare et al., 2020; Solomou and Constantinidou, 2020). Interestingly, a longitudinal US population-based panel survey (the Understanding America Study) found that individuals with high resilience levels were less likely to experience mental distress between March and August 2020, and adults age 50 years and above had significantly greater resilience than did 18–49 year olds (Riehm et al., 2021).

COVID-19 worry scores also were higher, on average, in men; those with post-college education; those who were currently married or cohabiting; and those living in large cities. The strong inverse relationship between age and the COVID-19 worry score may explain, in part, the relationships between the other demographic correlates and the COVID-19 worry score, since greater proportions of those in the other higher-risk demographic groups were in the 18–49 year old age group. We may also conjecture that men may be more likely than women to be involved in work outside the home, or in high-risk occupations; those with post-college education may be more informed as to high-risk

Table 5

Association between COVID-19 worry score, clinical features, and depression (PHQ-2 score >2) Multivariable logistic models.

	Model 1	Model 2	Model 3	Model 4	Model 5
	Odds ratio (95% CI)				
COVID-19 worry score	1.09 (1.08–1.10)[c]	1.08 (1.07–1.09)[c]	1.08 (1.07–1.10)[c]	1.01 (1.00–1.03)[a]	1.09 (1.07–1.10)[c]
Age, in years					
18–49	1.00 [Ref]	1.00 [Ref]	1.00 [Ref]	1.00 [Ref]	1.00 [Ref]
50–59	0.59 (0.43–0.81)[b]	0.63 (0.45–0.87)[b]	0.59 (0.42–0.83)[b]	0.97 (0.68–1.38)	0.63 (0.46–0.86)[b]
60–69	0.25 (0.17–0.37)[c]	0.33 (0.23–0.49)[c]	0.26 (0.18–0.39)[c]	0.41 (0.28–0.62)[c]	0.30 (0.20–0.43)[c]
70–89	0.11 (0.05–0.24)[c]	0.16 (0.07–0.35)[c]	0.13 (0.06–0.29)[c]	0.18 (0.08–0.41)[c]	0.14 (0.06–0.30)[c]
Sex					
Women	1.00 [Ref]				
Men	0.96 (0.76–1.20)				
Ethnicity					
Other	1.00 [Ref]				
Hispanic or Latinx	1.38 (0.88–2.15)				
Education					
Other	1.00 [Ref]				
Post-college	1.10 (0.85–1.42)				
Marital status					
Widowed	1.00 [Ref]				
Currently unmarried	0.86 (0.39–1.90)				
Married/cohabiting	0.70 (0.32–1.54)				
Area of residence					
Not large city	1.00 [Ref]				
Large city	1.09 (0.85–1.38)				
Depression diagnosis					
No		1.00 [Ref]			
Yes		2.70 (2.09–3.49)[c]			
OCD diagnosis					
No		1.00 [Ref]			
Yes		1.90 (1.31–2.75)[b]			
Anxiety disorder diagnosis					
No		1.00 [Ref]			
Yes		1.59 (1.22–2.08)[b]			
Personality scores					
Neuroticism			1.28 (1.20–1.36)[c]		
Extraversion			0.95 (0.89–1.01)		
Openness			1.03 (0.96–1.10)		
Agreeableness			0.94 (0.88–1.00)		
Conscientiousness			0.87 (0.81–0.93)[c]		
Doubt score				1.04 (1.03–1.05)[c]	
Obsessive-compulsive symptom score				1.01 (0.99–1.01)	
Contamination obsessions score				1.03 (0.99–1.07)	
Contamination phobia score				1.08 (1.07–1.10)[c]	
COVID behavior score					0.99 (0.98–1.01)
COVID risk score					1.15 (1.09–1.21)[c]

[Ref] is Reference group; [a] p < 0.05; [b] p < 0.01; [c] p < 0.001.

Note: Model 1 includes COVID-19 worry score, age, and other demographic variables; Model 2 includes COVID-19 worry score, age, and reported psychiatric diagnoses; Model 3 includes COVID-19 worry score, age, and personality scores; Model 4 includes COVID-19 worry score, age, and doubt, obsessive-compulsive, and contamination obsessions and phobias scores; Model 5 includes COVID-19 worry score, age, and COVID-19 behavior and risk scores.

environments and to the adverse health outcomes of infection; those who are married or cohabiting may be more concerned about potential exposure to outside infected contacts of the significant other; and residents of large cities may be more concerned about viral exposure, given greater population density in urban areas. Future studies are needed to assess these and other potential correlates of the COVID-19 worry score and their relationship to demographic characteristics. NOTE: See Dayton et al. (2021) on demographic correlates of COVID worry.

Second, we found that the COVID-19 worry score was substantially higher in those who reported having ever been diagnosed with a psychiatric disorder (depression, obsessive-compulsive disorder, or an anxiety disorder). This is not surprising, given that these disorders often co-occur in the community, and worry is often a prominent symptom of them (Gladstone and Parker, 2003; Kessler et al., 2012). We also found that the COVID-19 worry score was positively correlated with neuroticism and inversely related to agreeableness and conscientiousness. These personality features may promote adaptive coping strategies during stressful situations, such as the current pandemic (Sebri et al., 2021).

In addition, we found that the COVID-19 worry score was positively correlated with measures of obsessive-compulsive symptoms, including contamination obsessions and phobias. Contamination concerns may be particularly problematic during the COVID-19 pandemic, and there is evidence that safety behaviors like hand-washing may exacerbate obsessions and compulsions in OCD-affected individuals and possibly provoke these symptoms in others (Abba-Aji et al., 2020; Davide et al., 2020). Furthermore, we found that the COVID-19 worry score correlated with propensity to doubt, that is, subjective uncertainty about, and under-confidence in, one's perceptions and internal states (Lazarov et al., 2012), which is associated with increased impairment and poorer treatment response in OCD-affected individuals (Marton et al., 2019; Samuels et al., 2017). In prior analyses in the current sample, we found that doubt scores correlated with COVID-19 safety behaviors, contamination obsessions and compulsions, and other obsessive-compulsive symptoms (Samuels et al., 2021).

Third, consistent with the findings of population-based surveys in the US (Dayton et al., 2021) and other countries (Choi et al., 2020; Dawel et al., 2020; Hyland et al., 2020; Parlapani et al., 2020; Garre-Olmo

et al., 2021; Sebri et al., 2021), we found that the COVID-19 worry score was significantly associated with symptoms of depression during this pandemic phase. The magnitude of this relationship did not change appreciably, after adjustment for most of the other variables that were associated with depression in this sample. In particular, although the odds of depression were nearly two-to three-fold greater in those who reported having ever been diagnosed with a psychiatric disorder, including depression, the magnitude of the relationship between the COVID-19 worry score and depression was similar in those who had not been diagnosed with these disorders. Moreover, although COVID-19 risk was associated with depression, the magnitude of the association between the COVID-19 worry score and depression was similar across COVID-19 risk strata, even in those who were at low COVID-19 risk.

The magnitude of the relationships between the COVID-19 worry score and depression was substantially reduced, although still significant, after adjusting for obsessive-compulsive symptoms, especially contamination obsessions and contamination phobias. A possible explanation is that COVID-19 worry promotes the development of contamination symptoms, which then lead to depressive symptoms. Alternatively, contamination symptoms may be independently related to COVID-19 worry and depression.

Several potential limitations of the current study must be acknowledged. First, although the sample was selected to reflect the broad age, gender, and racial/ethnic distributions of US adults, participants in the survey may not be representative of the US population. We do not know if the survey panel recruited by Qualtics for this study is more or less representative than a panel recruited by other large social science survey platforms; however, several studies on the comparative validity of Qualtrics and MTurk have found that Qualtrics performs better than MTurk in providing study samples that reflect US population/census demographic distributions (Boas et al., 2020; Zack et al., 2019; Ogletree and Katz, 2021). Moreover, we do not know how many potential participants in the Qualtrics panel declined to participate before the study quota was filled, nor how study participants and non-participants differed on clinical features evaluated in the study. Nevertheless, the reported prevalence of depressive and anxiety symptoms in the study sample are similar to those found in a US national probability sample during mid-late September 2020 (Centers for Diseases Control, 2020).

Second, all information was collected by self-report survey questionnaires which assessed cross-sectional or retrospective time frames, and future prospective studies are needed to provide further insight into causal relationships between pandemic-related worry and depression. Third, like several other online surveys, in order to limit the time required by participants to complete the survey and ensure participation and completion of the survey by the targeted number of individuals, relatively brief instruments were used to collect information. We used the PHQ-4, which assesses only two symptoms of depression and two symptoms of generalized anxiety disorder (Kroenke et al., 2009); self-report instruments like the PHQ-9 and GAD-7 that assess a greater number of DSM-5 symptoms for these disorders should be considered for future research (Kroenke et al., 2001; Spitzer et al., 2006). In addition, only a limited number of factors could be assessed, and it would be useful to investigate additional potential correlates of COVID-19 related worry and depression, including other demographic characteristics (such as employment status, income, and household composition), vulnerabilities (such as history of trauma), personal resilience and coping style, and situational features (such as loneliness and number of social contacts) in future studies. Moreover, it will be important to evaluate the relationship between COVID-19 related worry and other conditions with reported high and/or increased prevalence during the pandemic, including post-traumatic stress, phobias, substance use, and suicide ideation (Newby et al., 2020; Salari et al., 2020; Wang et al., 2020; Xiong et al., 2020; Czeisler et al., 2020; Ettman et al., 2020a; Holingue et al., 2020).

Several other COVID-19 related worry and stress scales have been developed (Ahorsu et al., 2020; Arpaci et al., 2020; Khosravani et al.,

2021; Lee, 2020; Taylor et al., 2020). These instruments evaluate additional cognitive, behavioral, emotional, and physiological dimensions of COVID-19 related worry. How these dimensions relate to infection/transmission, financial, and other worries measured by the COVID-19 Worry Scale, how they are distributed in the population, and their relationships with psychological symptoms may help inform treatment approaches and prevention strategies during future phases of the pandemic.

5. Conclusions

The findings of the study have implications for the clinical and community mental health response to the COVID-19 pandemic. Given that prospective studies have found that anxiety and anxiety disorders appear to increase the risk of depression in the community (Kessler et al., 2008; Wittchen et al., 2000), clinicians must be aware that a variety of worries engendered by the pandemic may precipitate symptoms of depression, as well as other psychiatric disorders (Zvolensky et al., 2020). In addition, community strategies can be designed to identify, and target for intervention, those most at risk for COVID-19 related worry and its potential psychological impacts (Campion et al., 2020; Moreno et al., 2020). Public policies that reduce the risk of infection (such as vaccination programs), mitigate the financial impacts (such as temporary salary support and rental coverage), and respond to other worries related to the pandemic may help prevent the development and reduce the severity of depression and other psychological disorders.

Declaration of competing interest

The authors report no conflict of interest.

Table A1
COVID-19 Worry Scale Items [a]

I am very worried about getting the coronavirus.
I am very worried about my family/friends getting the coronavirus.
I am very worried about giving someone else the coronavirus.
I have a hard time sleeping because of the coronavirus.
I have had difficulty concentrating because of the coronavirus.
Thinking about the coronavirus makes me very anxious.
I am feeling overwhelmed by the coronavirus.
I am worried about money because of the coronavirus.
I am worried about having enough food because of the coronavirus.
I am worried about loss of income if I get sick from the coronavirus.
I am spending more money because of the coronavirus.
I am worried about medical bills if I get sick from the coronavirus.

1 = Strongly disagree; 2 = Disagree; 3 = Neither agree nor disagree; 4 = Agree; or 5 = Strongly agree.

[a] Each item is rated.

Table A2
Doubt Questionnaire

		Strongly Disagree				Strongly Agree
1.	I need to reassure myself that something I did was actually completed.	1	2	3	4	5
2.	I am uncertain of my own recollections of what happened during an event.	1	2	3	4	5
3.	I trust my own intuition.	5	4	3	2	1
4.	When faced with a dilemma, it is difficult to know my own opinion.	1	2	3	4	5
5.	I question whether I'm sure of my facts.	1	2	3	4	5

Table A2 (*continued*)

		Strongly Disagree				Strongly Agree
6.	I feel that I might have missed something because I didn't look carefully enough.	1	2	3	4	5
7.	When I do mental arithmetic, I doubt my answer.	1	2	3	4	5
8.	When I count items in a list, I feel like I might have missed one.	1	2	3	4	5
10.	Even when I'm pretty sure about a memory, I start to doubt whether it's really correct.	1	2	3	4	5
11.	I doubt my ability to remember accurately.	1	2	3	4	5
12.	I look at things a second time to be sure that I got an accurate look.	1	2	3	4	5
13.	It's easy for me to start doubting myself.	1	2	3	4	5
14.	It is difficult for me to skim through reading material because I doubt whether I really got the general idea.	1	2	3	4	5
15.	I have to read each individual word in a sentence.	1	2	3	4	5
16.	I second-guess my decisions.	1	2	3	4	5
17.	Even when I do something very carefully, I often feel that it is not quite done right.	1	2	3	4	5
18.	I usually have doubt about the simple everyday things I do.	1	2	3	4	5

Table A3

Association between demographic characteristics, clinical features, and depression (PHQ-2 score >2) Univariable logistic regression models

	Number (%) with depression (PHQ score>2)	Odds ratio (95% CI)
Demographic characteristics		
Age, in years		
18–49	592 (45.1)	1.00 [Ref]
50–59	75 (27.4)	0.46 (0.33–0.64)[c]
60–69	38 (10.9)	0.15 (0.10–0.22)[c]
70–89	7 (3.9)	0.05 (0.02–0.11)[c]
Sex		
Women	349 (30.7)	1.00 [Ref]
Men	363 (37.0)	1.33 (1.11–1.59)[b]
Ethnicity		
Non-Latinx	661 (32.9)	1.00 [Ref]
Latinx	51 (46.8)	1.79 (1.22–2.64)[b]
Education, highest		
College	273 (27.5)	1.00 [Ref]
High school	190 (36.5)	1.52 (1.21–1.90)[c]
Post-college	249 (41.4)	1.86 (1.50–2.31)[c]
Marital status		
Widowed	10 (13.0)	1.00 [Ref]
Never married, or separated/divorced	252 (32.9)	3.29 (1.67–6.51)[b]
Married or cohabiting	450 (35.3)	3.66 (1.86–7.17)[c]
Residential area		
Other	439 (29.3)	1.00 [Ref]
Large city	273 (44.2)	1.92 (1.58–2.33)[c]
Clinician diagnoses		
Depression		
No	273 (20.3)	1.00 [Ref]

Table A3 (*continued*)

	Number (%) with depression (PHQ score>2)	Odds ratio (95% CI)
Yes	439 (57.0)	5.22 (4.29–6.34)[c]
Obsessive-compulsive disorder		
No	584 (30.3)	1.00 [Ref]
Yes	128 (67.0)	4.67 (3.40–6.41)[c]
Other anxiety disorder		
No	371 (24.3)	1.00 [Ref]
Yes	341 (57.5)	4.21 (3.44–5.14)[c]
Personality scores		
Neuroticism		1.40 (1.33–1.47)[c]
Extraversion		0.92 (0.88–0.97)[b]
Openness		1.03 (0.97–1.09)
Agreeableness		0.80 (0.75–0.84)[c]
Conscientiousness		0.72 (0.68–0.77)[c]
Other psychological scores		
Doubt		1.08 (1.07–1.09)[c]
Obsessive-compulsive symptoms		1.06 (1.05–1.07)[c]
Contamination obsessions		1.25 (1.22–1.28)[c]
Contamination phobias		1.14 (1.13–1.15)[c]
COVID-19 behavior and risk scores		
COVID behavior		1.07 (1.06–1.08)[c]
COVID risk		1.34 (1.27–1.40)[c]

[Ref] is Reference group; [a] p < 0.05; [b] p < 0.01; [c] p < 0.001.

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