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Research Article

Generalized Anxiety Disorder Prevalence and Disparities Among U.S. Adults: The Roles Played by Job Loss, Food Insecurity, and Vaccinations During the COVID-19 Pandemic

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Abstract

Objectives: The purposes of this study are to examine (i) to what extent job loss and food insecurity accounted for racial disparities in generalized anxiety disorder (GAD) risk among adults in the United States during the coronavirus disease 2019 (COVID-19) pandemic; and (ii) to what extent the COVID-19 vaccination mitigated such risk, especially among older adults.

Methods: First, we analyzed data from the U.S. Household Pulse Survey to report on the relative prevalence of GAD with respect to demographic characteristics, economic hardships, and COVID-19 vaccine status. We then adopted a series of logistic regression models to estimate the probabilities of having GAD by sequentially adding these possible explanatory factors.

Results: Findings demonstrated higher prevalence rates of GAD among Hispanic and non-Hispanic Black Americans than non-Hispanic White Americans, which can primarily be attributed to the fact that non-Hispanic White Americans were less vulnerable to job loss and food insecurity. Older adults were less susceptible to GAD than their middle-aged and young adult counterparts. Compared to unvaccinated older adults, the odds of having GAD were substantially reduced for older adults who were partially vaccinated, and even more significantly declined for fully vaccinated older adults.

Discussion: Racial and ethnic disparities in GAD were largely due to disproportionate experiences of job loss and food insecurity across different racial and ethnic groups during the pandemic. Social distancing measures partially explain the different prevalence of GAD between older adults and their counterparts. Rapid deployment of the COVID-19 vaccines played an effective role in suppressing GAD, especially among older adults.

Keywords: COVID-19 vaccine, Disaster mitigation and response, Job and food insecurities, Racial and ethnic disparity, Stress process theory

Key Points

- Racial and ethnic disparities in generalized anxiety disorder (GAD) were largely due to disproportionate experiences of job loss and food insecurity across different racial and ethnic groups during the coronavirus disease 2019 (COVID-19) pandemic.
- Older adults were less susceptible to GAD than middle-aged and young adults during the pandemic.
- The risk of having GAD was mitigated by the COVID-19 vaccine inoculations, especially among older adults.

During natural disasters, racial and ethnic minority groups in the United States tend to be more vulnerable to experiencing poor mental health conditions (Ma et al., 2021, 2024a; Norris & Alegria, 2005). Coronavirus disease 2019 (COVID-19) caused enormous morbidity and mortality across the United States and disproportionately affected racial and ethnic minority populations and older persons (Szilagyi et al., 2021). During the initial stage of the COVID-19 pandemic in the United States, Hispanic Americans and Black Americans were more likely than White Americans to suffer from generalized anxiety disorder (GAD) (Czeisler et al., 2020). However, whether such disparities continued to persist a year after the outbreak began has not yet been addressed since the United States experienced peaks of COVID-19 daily cases and mortality in early 2021 (CDC, 2024a).

In addition to Black Americans and Hispanic Americans, other racial minority groups were also vulnerable to the impacts of the pandemic (Akee & Reber, 2021). For example, American Indians and Alaska Natives (AIAN), died of COVID-19 at much higher rates than White Americans during the initial stage of the pandemic (Akee & Reber, 2021). As of June 2020, the age-adjusted mortality rate for AIAN in Montana was seven times that of non-Hispanic WhiteAmericans (White Americans). Meanwhile, COVID-19 victims in AIAN communities were much younger than their White American counterparts—more than 40% of AIAN who died of COVID-19 were younger than 65, in contrast to about 11% of White Americans. When COVID-19 vaccinations were available, older adult AIAN who lived in remote locations often had no transportation to reach the clinics and hospitals where they are administered,

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which contributed to increased morbidity in the older adult AIAN population (Healy & Blue, 2021). Although recent literature suggests that fear of COVID-19-related death facilitated the development of GAD (Menzies & Menzies, 2020), whether there was a disparity in GAD between other racial minority groups (including AIAN) and White Americans during the pandemic is not clear. Stress process theory (SPT) is the primary theoretical framework used to derive hypotheses about metal health disparities and social and environmental factors (Pearlin, 1989; Pearlin et al., 1981; Turner, 2013). SPT posits that stressful life events (stressors) and adverse living conditions challenge individuals' coping skills, threaten to overwhelm them mentally, and increase their risk of mental illness. Conversely, resources such as social supports and coping skills can mitigate negative mental health outcomes (Zarit et al., 2007). As a result, SPT has been used to study contextual factors that contribute to mental health disorders, especially among those who have experienced stressful life events (Breslau et al., 2008; Kiecolt et al., 2008; Louie & Wheaton, 2019; Mouzon, 2013, 2014; Williams et al., 2016).

Copious documentation illustrates that, for many disaster survivors, life is further disrupted by stressful outcomes caused by disasters, such as property/material losses (Ma & Smith, 2020; Norris et al., 2010), family member/relative/friend losses (Galea et al., 2005; Norris et al., 2010), job losses (Ma, 2018), and home displacement (Ma & Culhane, 2024). Consequently, survivors who were exposed to these disaster-related stressors were particularly susceptible to severe mental illness (Ma et al., 2021), post-traumatic stress disorder (Galea et al., 2005; Ma et al., 2024a), major depressive disorder (Galea et al., 2005; Ma et al., 2022), and increased alcohol use (Ma & Smith, 2017). Primarily due to social inequity, life stressors are causally linked to individuals' social-structural characteristics; these include demographic characteristics (race/ethnicity), socioeconomic status (SES), and social roles (e.g., work/employment status) (Ma et al., 2024b). SPT posits that individuals with lower SES are exposed to higher levels of stress, which puts them at greater risk of experiencing mental health problems. There is also evidence that, among disaster survivors, those in racial and ethnic minority groups are more likely to experience disaster-related stressors (e.g., losses to life and property, home displacement, and job loss), causing these socially vulnerable groups to be more susceptible to mental health problems (Galea et al., 2005; Ma et al., 2021, 2024a; Norris et al., 2010).

At the beginning of the COVID-19 pandemic, racial and ethnic minority groups were more likely to experience disaster-related stressors than White Americans. In February 2020, prior to the COVID-19 pandemic, the U.S. unemployment rate was 3.9%; by June 2020, a time when approximately 60,000 new daily cases of COVID-19 were being reported nationwide, it had almost tripled, reaching 11.1% (Saenz & Sparks, 2020). However, people of color were more likely to experience this stressful event. For example, by June 2020, the employment rate for Black Americans and Hispanic Americans had decreased by 12% from February 2020, in contrast to a 7.5% decrease among White Americans (Saenz & Sparks, 2020). Prior publications also show that Black Americans and Hispanic Americans were more likely to experience food insecurity, another disaster-related stressor, during the pandemic (Morales et al., 2021; Nagata et al., 2021). For example, in April 2020, about half of Black and Hispanic households in the United States were food insecure, compared to 30% of White American households (Morales et al., 2021). Both increased job losses and food insecurity during the pandemic are known to be associated with poorer mental health outcomes (Lee & Singh, 2022).

Nevertheless, existing literature also suggests that Black Americans had similar or better mental health relative to White Americans despite experiencing various forms of continuing social inequity (Williams et al., 2016). The tendency for Black Americans to report similar or better mental health outcomes has been an enduring paradox for the past three decades (Breslau et al., 2008; Kiecolt et al., 2008; Mouzon, 2013, 2014). In a recent study drawing on the SPT framework, Louie and Wheaton (2019) found that after adjusting for stress exposure and self-esteem, there was no association between race and mental health disorders among American adolescents. Specifically, the authors found that, although Black Americans experience higher rates of stress exposure than White Americans, this was offset by higher rates of self-esteem among Black Americans, which led them to find no association between race and mental health disorders. However, the extent to which pandemic-related stressors account for possible racial and ethnic disparities in GAD has, to our knowledge, not been investigated.

In addition, SPT suggests that personal coping resources frequently serve a stress-modifying role (Louie & Wheaton, 2019). SPT emphasizes the role of social resources (i.e., social support) to help prevent or mitigate the effect of stressors on mental health outcomes. Existing literature suggests that perceived social support is associated with a decreased likelihood of lifetime suicide attempts among the general population. For firefighters, perceived social support has been found to moderate the relationship between occupational stressors and suicidal ideation (Carpenter et al., 2015).

The role of received social support on mental health conditions among disaster survivors themselves is less well understood. During the initial stages of the pandemic, it is well documented that the fear of COVID-19 infection contributed to an increase in anxiety levels across the U.S. population (Fitzpatrick et al., 2020). In this regard, the rapid development of effective vaccines was a unique feature of the pandemic in the United States (Dooling et al., 2021). Although it cannot purely be classified as a social support, receiving the vaccination can be viewed as a personal coping resource which, according to SPT, may positively influence mental health outcomes.

On December 11, 2020, the U.S. Food and Administration (FDA, 2020) "issued the first emergency use authorization (EUA) for a vaccine for the prevention of coronavirus disease 2019 (COVID-19) … in individuals 16 years of age and older." Given that older adults (65 years and above) were at higher risks of both severe illness and death due to COVID-19, the Advisory Committee on Immunization Practices at the CDC recommended that this age group being prioritized for COVID-19 vaccination (Dooling et al., 2021; Whiteman et al., 2021). As of March 2021, nearly 69% of older adults had received at least one vaccine dose and 42% were fully vaccinated (The White House, Office of the Press Secretary, 2021). However, the extent to which receiving the COVID-19 vaccination can mitigate the risk of GAD, especially among older adults, remains unknown.

In summary, the major objectives of this study are to address the following three research questions:

1. Have some racial and ethnic minority groups continued to be disproportionately susceptible to GAD a year after the outbreak of the COVID-19 pandemic?
2. If so, to what extent can such disparities be accounted for by the pandemic-related economic hardships suffered by these groups?
3. Have COVID-19 vaccination statuses helped alleviate GAD in the United States, especially among older adults?

Method

This study used Household Pulse Survey (HPS) data collected by the U.S. Census from March 17 to 29, 2021 (U.S. Census, 2021). We analyzed the prevalence of GAD reported by respondents (N = 63,775) in relation to their demographic characteristics, pandemic-related economic hardship (stressors), and COVID-19 vaccination status (VS).

Sampling Frame

To examine how the COVID-19 pandemic affected adult and household populations across the country, the HPS first utilized the Census Bureau's Master Address File (MAF) because it's an ideal sampling frame that contains the physical address of 144,136,000 housing units (HU) across all 50 states and the District of Columbia. Second, the U.S. Census obtained email addresses, landline phone and mobile telephone numbers from commercial sources and other administrative sources and linked them to the physical addresses of approximately 140,000,000 HU in the MAF. Third, they identified and assigned unique phone numbers and email addresses to the housing units in the MAF to constitute the HPS sampling frame (U.S. Census, 2024).

Sampling, Weights, and Data Collection

The U.S. Census Bureau adopted a systematic sampling scheme to select 1,040,111 eligible HUs across 50 states and the District of Columbia and received a response rate of about 7%. To ensure the selected sample represents both the U.S. household and adult populations, the Census Bureau generated the final HPS household and person weights by applying (i) nonresponse adjustment, (ii) occupied HU ratio adjustment, (iii) person adjustment, and (iv) iterative raking ratio to the U.S. population estimates. Sampled households were contacted by both email and phone. To deploy the HPS quickly and securely during the pandemic, the U.S. Census conducted the HPS online using Qualtrics as the data collection platform, and respondents were able to answer the online questionnaire in approximately 20 min (U.S. Census, 2024). Through a formal, online consent process, all participants were aware that any information they provided was confidential and might be used by the U.S. Census Bureau for statistical purposes. Finally, when the survey was complete, the U.S. Census de-identified the data and published it on their website for public use (U.S. Census, 2021).

Outcome Variable

The dichotomous variable, GAD, is constructed in terms of the summed score (0–6 points) of responses to the GAD-2 survey questions in the HPS. This GAD-2 scale (Kroenke et al., 2007) has been widely used as a screening tool in clinical settings, with high sensitivity (86%) and specificity (83%) for diagnosing GAD (Plummer et al., 2016). A recent systematic review and diagnostic meta-analysis (Plummer et al., 2016) suggests "the cutoff score of 3 appears to provide the highest sensitivity/specificity balance for the GAD-2 identifying GAD." Accordingly, we designate a respondent as having GAD at the time of the survey if their summed score was greater than or equal to 3. To understand the extent to which these items are correlated, we further calculated Cronbach's alpha and yielded a score of 0.90, suggesting a high level of internal consistency.

Demographic Variables

This study includes three demographic characteristics: race and ethnicity, gender, and older adult status. Five mutually exclusive racial and ethnic groups are defined according to NIH's general guidance on Race and National Origin (2024) as non-Hispanic White Americans (thereafter White Americans), non-Hispanic Black Americans (thereafter Black Americans), non-Hispanic Asian Americans (thereafter Asian Americans), other non-Hispanic Americans (including Native Americans and multiple races) (thereafter Other Races), and Hispanic Americans (thereafter Hispanic Americans). Gender is a dichotomous variable indicating whether a respondent is male or female. Older adult is a dichotomous variable that indicates whether a respondent is at least 65 years old or not.

Economic Hardships Variables

The first hardship variable, job loss, is a dichotomous variable (1 = "yes" or 0 = "no") representing the respondent's answer to the question "have you, or has anyone in your household experienced a loss of employment income since March 13, 2020?" The second hardship variable, food insecurity, is an ordinal variable consisting of four possible descriptions of food insufficiency in the respondent's household during the last 7 days, as detailed in Table 1.

Vaccination Status

This ordinal variable, VS, is constructed in two steps: first, the respondent was asked, "have you received a COVID-19 vaccine?" If they responded "no," we set VS = 0 to indicate that they had not received a vaccine. If they responded "yes," then they were asked "did you receive all required doses?" If they responded "no," we set VS = 1 to indicate that they received one dose but were not *fully* vaccinated. If they responded "yes," we set VS = 2 to indicate that they received all required doses or were *fully* vaccinated. This study utilizes the (CDC, 2021, 2023, 2024b; Fast et al., 2022) definition of "fully vaccinated."

Statistical Analyses

First, we reported the summary statistics of sample and population characteristics, including the raw percentages of sample characteristics, and the weighted percentages of these characteristics of the study population as of March 2021 (see Table 1). Then, we constructed weighted two-way cross tabulations to examine the prevalence of GAD contingent upon a respondent's demographic, economic hardship, and VS variables (see Table 2). Finally, we employed a series of weighted logistic regression models to estimate the probabilities of having GAD in terms of sequentially nested sets of covariates (see Table 3).

The first research question is addressed in Model 1 (*Demographics*), which includes all three demographic variables. This allowed us to determine which demographic

Table 1. Sample and Population Characteristics, the Household Pulse Survey (*N* = 63,775), March 17–29, 2021

Variables	Frequency	%[a]	%[b]
General anxiety disorder			
No	47,531	67.59	69.91
Yes	16,244	32.41	30.09
Total	63,775	100	100
Race and ethnicity			
Non-Hispanic White American	48,854	76.60	65.40
Non-Hispanic Black American	4,215	6.61	10.30
Non-Hispanic Asian American	2,981	4.67	5.09
Other non-Hispanic American	2,086	3.27	3.49
Hispanic American	5,639	8.84	15.73
Total	63,775	100	100
Gender			
Male	26,046	40.84	47.99
Female	37,729	59.16	52.01
Total	63,775	100	100
Older adult (65 years and above)			
No	43,105	67.59	77.00
Yes	20,670	32.41	23.00
Total	63,775	100	100
Lost job			
No	41,178	64.57	56.03
Yes	22,489	35.26	43.77
Missing	108	0.17	1.95
Total	63,775	100	100
Food insecurity			
Enough to eat	48,662	76.30	67.93
Not always enough to eat	11,845	18.57	23.10
Sometimes not enough to eat	2,464	3.86	6.77
Often not enough to eat	674	1.60	1.88
Missing	130	0.20	3.17
Total	63,775	100	100
Vaccination status			
Not received	25,343	57.33	51.45
One dose but not fully vaccinated	1,782	2.79	2.34
Two doses or fully vaccinated	36,565	39.74	46.09
Missing	85	0.13	1.25
Total	63,775	100	100

Notes: [a]Raw percentage of the sample.
[b]Weighted population percentage.

Table 2. Weighted Two-Way Cross Tabulations of GAD on Demographic Characteristics, Economic Hardships During the Pandemic, and the Status of the COVID-19 Vaccination Among U.S. Adult Respondents to the Household Pulse Survey (*N* = 63,775), March 17–29, 2021

Variables	GAD (%)[a]			χ^{2b}
	No	Yes	Total	
Race and ethnicity				$\chi^2(4)$ 200.88***[c]
Non-Hispanic White American	71.41	28.59	100	
Non-Hispanic Black American	67.80	32.20	100	
Non-Hispanic Asian American	72.76	27.24	100	
Other non-Hispanic American	65.03	34.97	100	
Hispanic American	65.23	34.77	100	
Gender				$\chi^2(1)$ 391.19***
Male	73.65	26.35	100	
Female	66.46	33.54	100	
Older adult (65 years and older)				$\chi^2(1)$ 1,314.54***
No	66.31	33.69	100	
Yes	81.96	18.04	100	
Lost job				$\chi^2(1)$ 2,437.04***
No	77.86	22.14	100	
Yes	59.79	40.21	100	
Food insecurity				$\chi^2(3)$ 5,996.32***
Enough to eat	79.10	20.90	100	
Not always enough to eat	54.54	45.46	100	
Sometimes not enough to eat	41.59	58.41	100	
Often not enough to eat	29.07	70.93	100	
Status of vaccination				$\chi^2(3)$ 811.42***
Not received	64.88	35.12	100	
One dose but not fully vaccinated	74.61	25.39	100	
Two doses or fully vaccinated	75.27	24.73	100	

Notes: COVID-19 = coronavirus disease 2019; GAD = generalized anxiety disorder.
[a]Weighted percentage.
[b]Pearson chi-square statistics with (*k*) degrees of freedom.
[c]***$p < .01$, **$p < .05$, $p < .1$.

groups are most likely to suffer from GAD while controlling for competing risks present in other demographic characteristics. Specifically, we used White Americans as the reference group in this and the following weighted logistic regression to report the odds ratios of having GAD for other racial and ethnic groups. The second research question is addressed in Model 2 (*Lost Job*) and Model 3 (*Food Insecurity*) by successively adding the lost-job variable and food-insecurity variable. In this manner, we identified the extent to which these pandemic-related experiences might further influence the susceptibility of various demographic groups to GAD. The third research question is addressed in two parts. First, to identify possible mitigation effects of COVID-19 vaccinations on GAD levels for all adults, we added the VS variable in Model 4 (*Vaccination Status*). Finally, to identify possible distinctions in such effects between older adults (those aged 65+) and nonolder adults (those aged 18–64), we added an interaction term between the older adult and VS variables in Model 5 (*Interaction*). To visualize interaction effects, we also computed the associated predictive margins for Model 5 (see Supplementary Table S1) and plotted the probabilities of having GAD for six selected scenarios in Figure 1.

Finally, the fraction of missing data in our sample of 63,775 respondents was so small for each variable with missing value (none were above 0.21%) that we chose to employ

Table 3. Estimating the Probabilities of Having GAD by Nested Logistic Regression Models Among U.S. Adult Respondents to the Household Pulse Survey (*N* = 63,469), March 17–29, 2021

Variables	(Model 1)	(Model 2)	(Model 3)	(Model 4)	(Model 5)
	Demographics	Lost job	Food insecurity	Vaccination status	Interaction
	OR	OR	OR	OR	OR
Race and ethnicity (Ref: non-Hispanic White American)					
Non-Hispanic Black American	1.10 (0.95, 1.26)	1.03 (0.89, 1.18)	0.80*** (0.68, 0.94)	0.80*** (0.68, 0.93)	0.80*** (0.68, 0.94)
Non-Hispanic Asian American	0.87 (0.73, 1.06)	0.86 (0.71, 1.03)	0.79** (0.65, 0.97)	0.80** (0.65, 0.98)	0.80** (0.65, 0.98)
Other non-Hispanic American	1.21** (1.01, 1.46)	1.12 (0.93, 1.35)	0.94 (0.77, 1.14)	0.94 (0.77, 1.14)	0.93 (0.77, 1.13)
Hispanic American	1.20*** (1.06, 1.37)	1.06 (0.93, 1.22)	0.80*** (0.69, 0.92)	0.80*** (0.69, 0.92)	0.80*** (0.69, 0.91)
Gender (Ref: Male)					
Female	1.44*** (1.33, 1.56)	1.46*** (1.34, 1.58)	1.48*** (1.36, 1.61)	1.49*** (1.37, 1.62)	1.49*** (1.37, 1.62)
Older adult (Ref: No)					
Yes	0.43*** (0.39, 0.48)	0.50*** (0.45, 0.55)	0.51*** (0.46, 0.56)	0.54*** (0.48, 0.60)	0.70*** (0.56, 0.87)
Lost job (Ref: No)					
Yes		2.16*** (2.00, 2.34)	1.70*** (1.56, 1.85)	1.69*** (1.55, 1.84)	1.69*** (1.55, 1.84)
Food insufficiency (Ref: Enough to eat)					
Not always enough to eat			2.88*** (2.61, 3.17)	2.84*** (2.58, 3.13)	2.83*** (2.57, 3.12)
Sometimes not enough to eat			4.50*** (3.77, 5.38)	4.41*** (3.69, 5.28)	4.40*** (3.68, 5.26)
Often not enough to eat			8.20*** (5.82, 11.56)	7.97*** (5.65, 11.24)	7.86*** (5.57, 11.07)
Status of COVID-19 vaccination (Ref: Not received)					
One dose but not fully vaccinated				0.84 (0.66, 1.07)	0.94 (0.71, 1.23)
Two doses or fully vaccinated				0.87*** (0.80, 0.95)	0.91** (0.83, 1.00)
Interaction term: older adult # COVID-19 vaccination					
Old adult with one dose (not fully vaccinated)					0.57* (0.33, 1.01)
Old adult with two doses (fully vaccinated)					0.69*** (0.54, 0.89)
Constant	0.40*** (0.37, 0.43)	0.28*** (0.25, 0.30)	0.21*** (0.20, 0.23)	0.23*** (0.21, 0.25)	0.22*** (0.20, 0.24)
Observations	63,469	63,469	63,469	63,469	63,469

Notes: COVID-19 = coronavirus disease 2019; GAD = generalized anxiety disorder; OR = odds ratio; Ref = reference. Values in parentheses represent 95% confidence intervals.
***$p < .01$; ** $p < .05$; * $p < .1$.

listwise deletion for missing data, yielding a final sample size of *N* = 63,469. We also checked its robustness with a multiple imputation (MI = 10) analysis that yielded consistent results (see Supplementary Table S2). All statistical analyses were conducted using STATA 17MP.

Results

As presented in Table 1, about 30% of the study population suffered from GAD during the survey period. Among them, 23% of older adults reported experiencing GAD; more than 51% never received any dose of COVID-19 vaccination; only about 2% were partially vaccinated; and about 46% were fully vaccinated.

As shown in Table 2, GAD prevalence rates across demographic groups, as well as across levels of economic hardships and VS, are all significantly different ($p < .01$). Hispanic Americans and Other Races have the highest prevalence of GAD, at about 35% for each group; this is followed by Black Americans at 32%. Prevalence is much lower among older adults than their counterparts (18% vs 34%). GAD is much more prevalent among those who lost jobs during the pandemic than those who did not (40% vs 22%). The prevalence of GAD among those with the highest food insecurity, "often not enough to eat" (71%), is three times higher than for those with the least food insecurity, "enough to eat," (21%). The prevalence of GAD is 35% for those with no vaccination, 25.39% for those with one dose, and 24% for those fully vaccinated.

Turning to the regression models (see Table 3), when controlling for age and gender (Model 1), the odds of having GAD for Hispanic Americans are at least 20% higher than for White Americans (odds ratio [OR] = 1.20, 95% confidence interval [95% CI] [1.06, 1.37]) and are even higher for Other Races (OR = 1.21, 95% CI [1.01, 1.46]). Meanwhile, older adults are less susceptible to GAD than nonolder adults

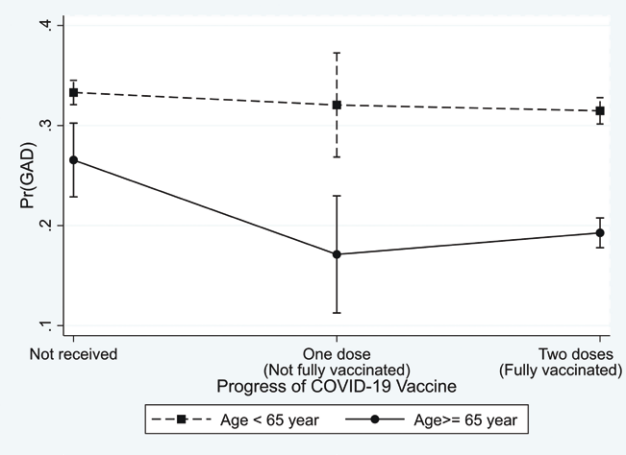

Figure 1. Predictive margins of the status of COVID-19 vaccination on older adult versus nonolder adult groups with 95% confidence intervals. COVID-19 = coronavirus disease 2019; GAD = generalized anxiety disorder; Pr = probability. Whiskers indicate 95% confidence intervals.

(OR = 0.43, 95% CI [0.39, 0.48]). However, when further controlling for lost jobs (see Model 2), we found that both the Hispanic American and Other Races classification were no longer significant risk factors for experiencing GAD. Moreover, the odds of having GAD for those who lost jobs were more than twice as high as those who did not experience job loss (OR = 2.16, 95% CI [2.00, 2.34]). Together, these results suggest that job losses may partially account for the significant differences in GAD susceptibility between racial and ethnic groups, as found in Model 1. Additional support for this is provided by Supplementary Table S3, where job losses are shown to be much more prevalent among Hispanic Americans and Other Races than White Americans (with respective job loss percentages of 59%, 53%, and 39% [$p < .01$]). When adding food insecurity (see Model 3), GAD odds for respondents who reported "often not enough to eat" was eight times higher than for those who reported "enough to eat" (OR = 8.20, 95% CI [5.82, 11.56]). In this case, both Black Americans (OR = 0.80, 95% CI [0.68, 0.94]) and Hispanic Americans (OR = 0.80, 95% CI [0.69, 0.92]) are significantly less likely to suffer from GAD than White Americans. This suggests that food insecurity may also account for some of the significant differences between racial and ethnic groups with respect to GAD susceptibility. Additional support is provided by Supplementary Table S4, where the percentages of Hispanic Americans (17%) and Black Americans (16%) suffering from severe food insecurity (either "sometimes not enough to eat" or "often not enough to eat") are both significantly higher ($p < .01$) than that of White Americans (6%).

Further, vaccinations act as a protective factor against GAD (see Model 4). Compared to those who did not receive vaccinations, respondents who received one dose but were not fully vaccinated were less susceptible to GAD, though this finding is not statistically significant (OR = 0.84, 95% CI [0.66, 1.07]). However, fully vaccinated respondents were significantly less susceptible to GAD than those with no vaccinations (OR = 0.87, 95% CI [0.80, 0.95]).

Finally, such protective effects are more significantly presented among older adults than their counterparts (see Model 5). Older adults who had received one dose but were not fully vaccinated were less susceptible to GAD than nonolder adults who also received one dose but not fully vaccinated, though at a marginally statistically significant level (OR = 0.57; 95% CI [0.33, 1.01]). However, fully vaccinated older adults were significantly less susceptible to GAD than nonolder adults who were also fully vaccinated (OR = 0.69; 95% CI [0.54, 0.89]).

When analyzing the protective effects of vaccinations against GAD, its special role for older adults is further underscored by the fact that Model 5 provides a significantly better fit to our data than Model 4 (Wald test, F (2, 63467) = 4.71, $p < .01$). These relationships are further plotted by the predictive margins of COVID-19 vaccination status on the different age groups, as visualized in Figure 1 and detailed in Supplementary Table S1. Compared to the nonolder adult group (age < 65 years) who have not received any dose of the COVID-19 vaccine, the probability of having GAD for this age group is reduced by about 6% when fully vaccinated (Probability (Pr) = 0.33; 95% CI [0.32, 0.35] vs Pr = 0.31; 95% CI [0.30, 0.33]). However, decreased probability of GAD is much more conspicuous and significant for the older adult group (age ≥ 65 years) across the different vaccination scenarios (Pr = 0.27; 95% CI [0.23, 0.30] vs Pr = 0.19; 95% CI [0.18, 0.20]), with the probability of GAD in older adults reduced by 30% when fully vaccinated.

Discussion

Ample evidence suggests that the COVID-19 pandemic dramatically increased GAD levels among U.S. adults (Czeisler et al., 2020; NCHS, 2020; Twenge et al., 2021). Analysis of Census data showed that by March 2021, more than 30% of U.S. adults suffered from GAD, almost four times the March 2019 prepandemic rate of 8% (NCHS, 2020). Previous studies also indicated that during the initial stage of the pandemic, these increased rates were disproportionately higher among certain racial and ethnic groups, in particular, Hispanic Americans and Black Americans (Czeisler et al., 2020). Our first research question asks whether these disparities have persisted a full year after the initial outbreak, especially given the peaks of daily COVID-19 cases and mortality in January 2021 (CDC, 2024a). We found that such disparities persisted through March 2021; however, in addition to Hispanic and Black Americans, by this time, the category of Other non-Hispanic Americans (Other Races) also exhibited higher levels of GAD than White Americans. Although Census data provide no further breakdown of this group, the Brookings Institution (Akee & Reber, 2021) reported that AIAN had the highest COVID-19 death rate among all racial groups. Therefore, it seems reasonable to speculate that our present result is largely due to the inclusion of AIAN in this racial grouping.

Echoing the Black-White Mental Health Paradox literature, the initial results in Model 1 demonstrate that racial and ethnic disparities in GAD are not consistent with the paradox; however, after accounting for job loss and food insecurity, we found Black Americans became less likely to suffer from GAD than White Americans. This finding is consistent with prior research exploring Black-White differences across mental health outcomes (Breslau et al., 2008; Louie & Wheaton, 2019). Additionally, the results in Models 2–4 provide the first empirical evidence of SPT, demonstrating that, during the pandemic, having GAD was a dynamic process in which (i) disaster-related stressors (job loss and food insecurity) were

linked to certain demographic characteristics, (ii) personal coping resources (i.e., COVID-19 vaccinations) mitigated GAD risk; and (iii) these life stressors and personal coping resources had a direct impact on mental health outcomes. Evidence in support of these findings is further detailed throughout the remainder of this discussion section.

Our second research question explores the reasons behind such disparities, specifically focusing on possible disparities in pandemic-related job losses and food insecurity levels. With respect to job loss, our results are consistent with earlier disparity findings from the initial stage of the pandemic (Saenz & Sparks, 2020) and show that such disparities persisted through March 2021. For instance, job loss rates for Hispanic Americans, Black Americans, and Other Races were, respectively, 51%, 25%, and 36% higher than that of White Americans in March 2021 (see Supplementary Table S3). Moreover, results from Model 2 suggest that job loss disparities account for a high rate of racial and ethnic disparities in GAD levels.

The results for food insecurity are quite similar. In terms of racial and ethnic disparities, if we focus solely on the most extreme level of food insecurity ("Often not enough to eat"), the prevalence among Hispanic Americans, Black Americans, and Other Races was, respectively, 203%, 154%, and 61% higher than White Americans. Moreover, after controlling for food insecurity as well as job loss (see Model 3), Hispanic and Black Americans were actually less likely to suffer from GAD than White Americans, suggesting that these two factors, when taken together, account for most of the disparities among racial and ethnic vulnerabilities to GAD.

Finally, results from the third research question provide evidence that receiving COVID-19 vaccinations during the pandemic reduced GAD risk among U.S. adults, especially older adults who are fully vaccinated. In Model 4, we found a strong mitigating effect of full-vaccination status versus no-vaccination status among respondents, even after controlling for pandemic-related economic hardships. Further, by incorporating a possible interaction between older adults and VS in Model 5, we found that, relative to older adults who did not receive the vaccine, there was a significant reduction (30%) in GAD risk for older adults who were fully vaccinated. To determine whether partial VS is significantly different from being fully vaccinated, we employed two additional weighted logistic regressions to compare GAD susceptibility for each group, namely the main effect model and the moderated effect model for older adults in Supplementary Table S5. The results from both models suggest that the fully vaccinated group was not statistically significant different from the partially vaccinated group in terms of susceptibility to GAD.

During the study period, social distancing measures, including stay-at-home policies and business lockdowns, were essential to slow the spread of COVID-19 (Fazio et al., 2021). However, such policies also had adverse effects on mental health outcomes (Marroquín et al., 2020). Since social distancing measures nationwide continued throughout early 2021, our results indicate that older adults were less susceptible to GAD than middle-aged and young adults. This finding is consistent with reports from European countries and Israel, which also found fewer reports of GAD among older adults than their younger adult counterparts when social distancing measures were implemented (Yastrebov & Maskileyson, 2022). We speculate that older adults were less vulnerable than middle-aged and young adults to job loss and food insecurity during the study period, and that locking-down businesses led to more severe economic hardships for middle-aged and young adults. Indeed, the results presented in Supplementary Tables S3 and S4 suggest older adults were less likely to experience job loss (Supplementary Table S3) and food insecurities (Supplementary Table S4) than their middle-aged and young adult counterparts. Thus, social distancing measures as a response to the pandemic may partially explain different GAD prevalence rates between older adults and middle-aged and younger adults.

Limitations

As with any study involving secondary data, there are limitations to the questions that can be addressed. First, we do not know if a higher susceptibility to GAD among certain racial and ethnic groups was also influenced by inadequate administration of COVID-19 vaccines to these groups. The Advisory Committee on Immunization Practices at the CDC (Dooling et al., 2021) recommended that, in addition to older adults, essential workers and those 18 through 64 years of age at high risk of severe COVID-19 be offered the vaccination first. On March 11, 2021, The White House (2021) announced that it would "direct all states, Tribes, and territories to make all adults eligible for the COVID-19 vaccine no later than May 1st." Therefore, during the study period, adults under age 65 might have been ineligible to be vaccinated unless they were essential workers or had high-risk medical conditions. Although this criteria limited our ability to study the possible impacts of COVID-19 vaccinations on racial disparities in GAD, future studies should investigate these questions when appropriate data becomes available.

A second limitation with respect to vaccinations involves the distinction between those nonvaccinated individuals who wished to be vaccinated versus those who were fearful of the vaccines and thus refused to be vaccinated. The degree to which these distinctions are related to individual perceptions of COVID-19 risk could potentially influence associated anxiety levels. The study data provides information about such attitudes, with 4.97% of respondents stating that they would "not get a vaccine once available." When this small fraction of respondents is removed from our sample, all regression results remain virtually the same. Thus, this potential source of bias appears to have little influence.

Our study only examined the effects of COVID-19 vaccinations with respect to "nonvaccinated," "partially vaccinated," and "fully vaccinated" status (CDC, 2024b; Fast et al., 2022). However, given our study period ended in March 2021 and the vaccine "booster shot" (or third dose) did not become widely available until the end of that year (FDA, 2021), the extent to which this booster shot might further mitigate GAD risk was not addressed in the present study. Thus, further studies are needed to address this potential source of additional mitigation. Finally, the present study does not address whether the observed racial and ethnic disparities in GAD rates during the COVID-19 pandemic were because of historical distrust due to longstanding and still ongoing racial discrimination in the United States (Soto et al., 2011). Future studies should test this hypothesis when the relevant data are available.

Conclusion

This study has certain implications for future pandemic response policies. First, our findings show that

pandemic-related job loss and food insecurity are not only major risk factors for GAD, but that certain racial and ethnic minorities are particularly vulnerable to these risks. This suggests that unemployment assistance and food support programs should play a central role in effective pandemic responses, with emphasis placed on more vulnerable racial and ethnic groups. Second, heavily impacted by lockdown policies during the pandemic, middle-aged and young adults were much more vulnerable than older adults to job loss and food insecurity. In contrast, social distancing measures had less influence on older adults, who were less susceptible to GAD than their middle-aged and young adult counterparts. Third, results from this study add to the disaster response literature by illustrating that rapid deployment of COVID-19 vaccines played an effective role in suppressing GAD during the pandemic, especially among older adults. This demonstrates that rapid vaccine dissemination, especially for older adults, should also be a high priority in future disaster responses.

Supplementary Material

Supplementary data are available at *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences* online.

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Conflict of Interest

None.

Data Availability

The data are available and can be accessed from the U.S. Census Bureau. This study was not preregistered.

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