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RESEARCH ARTICLE

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Functional disabilities and adverse well-being by COVID-19 and Long COVID history and employment status: 2022 Behavioral Risk Factor Surveillance System

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Abstract

Background: Long COVID can lead to functional disabilities and decreased well-being and limit the ability to work. No study has yet assessed associations of SARS-CoV-2-infection and Long COVID with specific measures of well-being and functional disabilities among workers by employment status.

Methods: Using data from the U.S. Behavioral Risk Factor Surveillance System, we assessed the prevalence of functional disabilities and well-being measures among adults of prime working age (25–54 years) by employment status and self-reported COVID-19 and Long COVID history. Within each employment status, we generated adjusted prevalence ratios (aPRs) comparing respondents from each 2022 COVID-19/Long COVID category to respondents in that employment status before the pandemic (2019).

Results: In 2022, prevalences of each functional disability except vision and all adverse well-being measures were highest among the 9.2% of respondents reporting a history of Long COVID. For each outcome, prevalences were lowest for workers and highest among those unable to work. 2022 prevalence of cognitive disability (16.4% of employees, 21.4% of the self-employed) and depression (31.2% and 36.4%, respectively) among workers reporting a history of Long COVID were more than double 2019 levels. Increases in cognitive disability and depression were lower but statistically significant among workers not reporting a history of Long COVID.

Conclusions: The high prevalence of functional disabilities and adverse well-being among workers reporting a history of Long COVID have implications for workers and employers. Also concerning are smaller increases among workers not reporting a history of Long COVID, given the large number of affected workers. Mitigating the effects of Long COVID on workers will involve efforts in multiple domains: reducing incidence, increasing healthcare practitioner awareness, improving diagnosis and treatments, and increasing employer awareness of best practices for accommodating workers with Long COVID.

KEYWORDS
COVID-19, employment status, functional disability, Long COVID, well-being

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1 | INTRODUCTION

Long COVID (also referred to as Post-COVID Conditions) comprises a large array of symptoms and incident diagnoses affecting multiple organ systems[1,2] and can lead to decreased well-being and functional limitations.[3–5] In some cases, limitations associated with Long COVID affect the ability to work, leading to changes in jobs or job duties, reduction in hours, increased need for workplace accommodations, and, in severe cases, exit from the labor market.[2,6–11]

Quantitative estimates of the impact of Long COVID on employment differ by study timing and design, Long COVID definition and ascertainment, type of work, and other considerations.[12,13] A mid-2022 report using Household Pulse Survey data estimated that 2–4 million Americans were out of the labor force due to Long COVID.[6] Small studies of Long COVID clinic patients in the European Union and the United Kingdom have assessed the effects of Long COVID on work. Findings include that half of patients were no longer working or had reduced working hours and, therefore, reduced income.[9] Further, the inability to work was associated with higher levels of fatigue, and many employed patients were having difficulty at work due to their symptoms.[7] In addition, among working-aged patients with physical complaints, health-related quality of life and self-reported ability to work were lower compared to the general public.[14] Moreover, a U.S. study found increased economic hardship among families in which the head of household had Long COVID, regardless of pre-pandemic income level.[15]

A report using Federal Reserve Economic Database data noted that while the number of Americans with disabilities has risen, the number of labor force participants with disabilities has increased more sharply.[6] An analysis of Current Population Survey (CPS) data comparing the pre-pandemic period (2017–2019) to 2022 found that the increase in the number of people working with a disability was greater than the number of labor-market departures attributable to Long COVID.[3] Further, a comparison of CPS data from Q1 2020 to Q2 2022 found that levels of employment and labor-market participation increased among adults aged 18–64 years with functional disabilities but not among those without disabilities.[16] At the same time, declines in well-being and health-related quality of life have been noted among people with Long COVID[4,5] and could affect the ability of those affected to remain fully employed.

To date, no study has assessed the impact of COVID-19 illness and Long COVID on specific measures of well-being and functional disabilities across employment status: employed, self-employed, out of work (short-term and long-term), and unable to work. A number of key questions are unanswered: Do those currently working have a higher prevalence of functional disabilities and adverse well-being than pre-pandemic workforces? Do the short-term unemployed, long-term unemployed, and those who report they are unable to work face higher prevalences of conditions that might make re-employment more difficult? How do the answers to these questions differ by history of COVID-19 illness and Long COVID? This information is key to understanding impacts of COVID-19 and Long COVID on the labor market and the workforce.

The Behavioral Risk Factor Surveillance System (BRFSS) presents an opportunity to address these questions by (1) assessing the prevalence of select well-being and functional disability measures by employment status among 2022 BRFSS respondents of prime working age (25 to 54 years) by COVID-19 and Long COVID histories and (2) comparing the prevalence of well-being and functional disability measures to those in the pre-pandemic (2019) population.

2 | METHODS

2.1 | Data source

BRFSS is an annual, state-based, nationally representative survey of the noninstitutionalized U.S. civilian population aged 18 years and older. All states, the District of Columbia, and select territories conduct the study, using random-digit dialed landline and cellular telephone calls, to collect self-reported information about healthcare access, health-related risk behaviors, and health outcomes. In 2019, New Jersey was unable to collect enough data to meet requirements for inclusion in the aggregated, national data set, and the U.S. Virgin Islands did not participate that year. Median BRFSS response rates across states and territories were 53.3% for landline and 45.9% for cellphone in 2019 and 46.3% for landline and 44.7% for cellphone in 2022. Response rates overall and by jurisdiction are found at https://www.cdc.gov/brfss/data_documentation/index.htm.

BRFSS was reviewed by the Human Research Protection Office of the Centers for Disease Control and Prevention and determined to be exempt research. Survey information was collected under OMB control number 0920-1061.

2.2 | Employment status and inclusion criteria

The core survey includes a question about employment: "Are you currently employed for wages, self-employed, out of work for 1 year or more, out of work for less than 1 year, a student, a homemaker, retired, or unable to work?" We included in our study population respondents who reported their employment status as employed for wages (henceforth "employed"), self-employed ("self-employed"), out of work less than 1 year ("short-term unemployed"), out of work for 1 year or more ("long-term unemployed"), and unable to work ("unable to work"). BRFSS does not ask whether those who report not working are currently looking for work; "unemployment" is used here as shorthand for "not working" rather than to indicate labor market engagement. We excluded adults who reported they were retired, homemakers, or students, as they are more likely to represent voluntary exits from the workforce. Respondents who responded "don't know/not sure" or refused to answer the question about testing positive for COVID-19 were excluded from the analyses. In addition, we defined our study population as adults of prime working age

(25–54 years); U.S. adults in this age range are most likely to be in the labor force full time or seeking work.[17]

2.3 | COVID-19 and Long COVID history

In 2022, in an emerging core section used to field newly-developed questions, all BRFSS respondents were asked, "Has a doctor, nurse, or other health professional ever told you that you tested positive for COVID-19?" Respondents who said "no" were categorized as "no self-reported COVID-19" Those who answered "yes" or indicated that they had tested positive using a home test without a health professional were considered to have reported having had COVID-19. The respondents classified as having had COVID-19 were then asked, "Did you have any symptoms lasting 3 months or longer that you did not have prior to having coronavirus or COVID-19?" Those who said "no" were categorized as "reported COVID-19, no Long COVID" and those who said yes were categorized as "reported COVID-19 and Long COVID." For brevity, these three mutually-exclusive groups are referred to henceforth as "no COVID-19"; "COVID-19, no Long COVID;" and "Long COVID".

2.4 | Disability and well-being measures

Every year, the BRFSS core includes questions covering six areas of functional disability: vision, hearing, cognitive (serious difficulty concentrating, remembering, or making decisions due to a physical or mental condition), ambulatory (serious difficulty walking or climbing stairs), self-care (serious difficulty dressing or bathing), and independent living (serious difficulty doing errands alone). We constructed an "any functional disability" measure which was coded as positive for respondents indicating they had at least one specific disability. We also included questions asked in BRFSS annually about well-being: general health, physical health, mental health, activity limitations due to poor physical or mental health, and diagnosed depression. Responses to well-being questions involving number of days of the past 30 the respondent reported experiencing activity limitations or reported their physical or mental health was not good were dichotomized; responses of 14 days or greater were coded as experiencing activity limitations, poor physical health, or poor mental health, respectively. All questions, response options, and analytic groupings are found in Supplemental Table 1.

2.5 | Demographic characteristics and model adjustments

To examine the demographic composition of respondents in each employment status, we assessed weighted prevalences within multiple descriptors: sex (male, female); age in years (25–34, 35–44, 45–54); race/Hispanic ethnicity combined (White Non-Hispanic, Black Non-Hispanic, multi-racial or another Non-Hispanic race, Hispanic); educational attainment (less than high school, high school/GED, some college, and college graduate), and annual household income (<$10,000, $10,000– < $15,000, $15,000– < $20,000, $20,000– < $25,000, $25,000– < $35,000, $35,000– < $50,000, $50,000– < $75,000, and ≥$75,000). We present these distributions as descriptive information but used only a subset of these characteristics for adjustment in subsequent modeling: race/Hispanic ethnicity, sex, and age. We adjusted for these characteristics because they were strongly associated with distribution of COVID-19 cases early in the pandemic (race/Hispanic ethnicity), with severity of COVID-19 illness (age), and with prevalence of Long COVID (sex). The BRFSS program provides imputed values for age and race/Hispanic ethnicity; <2.5% of responses in each category were missing before imputation. Sex and educational attainment were missing for less than 1% of respondents. Income was missing for 19% of respondents in 2022; because we did not adjust for income, we did not impute missing values.

BRFSS ascertains weight and height, as well as a subset of health conditions that have been associated with risk for Long COVID, but does not ask about immunosuppression or neurological conditions. Moreover, some of the conditions queried, such as obesity, hypertension, and cardio-cerebrovascular disease, are closely related. Given the complexities of adjusting for chronic conditions in this context, we instead conducted a secondary analysis adjusting for body-mass index based on self-reported height and weight (BMI, categorized here as <25 kg/m^2 [underweight or normal weight], 25- < 30 kg/m^2 [overweight], 30- < 40 kg/m^2 [obesity], and >=40 kg/m^2 [severe obesity]), which is associated with both Long COVID[18,19] risk and some of the survey measures of disability[20] and well-being.[21,22] BMI was missing for 11% of respondents; we did not impute missing values, so fewer responses were included in the secondary than in the primary analyses.

2.6 | Statistical analyses

We assessed the prevalence of functional disabilities and well-being measures by COVID-19/Long COVID status for each employment category. As a baseline for comparison of prevalence, we used data from 2019, the last survey year before COVID-19 cases were diagnosed in the U.S.

We calculated distributions of self-reported responses to demographic, disability, and well-being questions for respondents of each included employment status for 2019 and, for 2022, by COVID-19 and Long COVID history. We conducted all analyses using SAS version 9.4 (SAS Institute Inc.) and SAS-callable SUDAAN version 11.0.1 (RTI International, Research Triangle Park) to account for the complex survey design and incorporate respondent sampling weights in BRFSS. The BRFSS program provides data weights based on state demographic distributions. We aggregated the results to obtain national estimates. We used the SURVEYFREQ procedure to estimate population counts and weighted unadjusted prevalence (95% Confidence Intervals [CI]) for all variables. The Rao-Scott chi-square

test was used to assess the statistical significance of differences of demographic distributions within each COVID-19/Long COVID status. To assess temporal changes, for each employment status we compared changes in prevalence of disability and well-being indicators between 2019 and 2022, considering those with nonoverlapping 95% CIs statistically significant.

We used the RLOGIST procedure to perform logistic regression and to estimate adjusted prevalence in each year-employment status-COVID-19/Long COVID category[23] and used the LOGLINK procedure to perform robust Poisson regression[24] to generate adjusted prevalence ratios (aPRs) comparing workers of each employment status from each 2022 COVID-19/Long COVID category to the reference group (all workers in that employment status in 2019). We calculated 95% CIs and considered prevalence with nonoverlapping 95% CIs and aPRs with 95% CIs not spanning the null statistically significant. These same methods were used for the secondary analysis adjusting for BMI.

3 | RESULTS

Of 418,268 respondents to the 2019 survey, 166,702 were excluded because they were retired, homemakers, students, or did not provide employment status information, leaving 251,566 respondents. Further excluded due to age restrictions were 6201 respondents aged 18–24 years and 103,981 aged 55 years or older, leaving 136,384 adults of prime working age (25–54 years) in the study population.

In 2022, the survey had 445,132 respondents. Of these, the 9740 respondents from New Jersey and the U.S. Virgin Islands were excluded because the two locations were not included in the 2019 survey data set. An additional 173,483 respondents fell under employment status exclusions, leaving 261,909 eligible respondents based on employment status and state of residence. Age exclusions involved 17,511 respondents aged 18–24 years and 94,723 aged 55 years or older, leaving 149,675 adults of prime working age in the study population. In addition, respondents to the 2022 survey who were not asked, responded "don't know/not sure," or refused to answer the questions about having had COVID-19 (n = 16,279) or Long COVID (n = 1163) were included in the study population but excluded from analyses involving COVID-19 and/or Long COVID, leaving 149,675 respondents in COVID-19 analyses and 52,001 respondents who reported having had COVID-19 and answered "yes" or "no" to the Long COVID question.

3.1 | Demographics and body mass index

Among respondents to the 2022 survey who met inclusion criteria and had information for the corresponding outcomes, 60.1% reported never having had COVID-19, 30.7% reported having had COVID-19 but not Long COVID, and 9.2% reported having had both COVID-19 and Long COVID. Percentages differed by demographic characteristics and employment status (Table 1). Supplemental Table 2 presents results in column display by demographic category and employment status for 2019 and, for 2022, also by COVID-19/Long COVID status.

While respondents aged 25–34 years had the highest prevalence of having a history of COVID-19 without experiencing Long COVID (32.3%), the highest prevalence of Long COVID was among those aged 35–44 years (9.7%), although differences in Long COVID between age groups were not statistically significant (Table 1). In contrast, despite having only a slightly higher prevalence than men of having had COVID-19 without experiencing Long COVID, women were 83% more likely to report Long COVID (12.1% vs. 6.6%). Hispanic respondents had the highest prevalence of both COVID-19 without Long COVID and Long COVID, but confidence intervals overlapped for most race/Hispanic ethnicity categories. Respondents who had college degrees had the highest prevalence, and those who had not completed high school the lowest prevalence, of reported COVID-19. However, respondents with some college or technical school had the highest prevalence and those who had completed college the lowest prevalence of reported Long COVID.

Respondents employed for wages had the highest prevalence of a history of COVID-19 without experiencing Long COVID (33.3%) and those unable to work had the lowest prevalence of this history (20.4%). In contrast, those unable to work had the highest prevalence of reported Long COVID (10.8%), followed by those out of work less than a year (10.3%) and workers employed for wages (9.2%), the self-employed (8.4%), and those out of work more than a year (7.5%).

Among all included respondents, prevalence of obesity and severe obesity combined increased from 34.0% in 2019 to 36.8% in 2022 (data not shown). Compared to 2019 comparison levels, obesity and severe obesity had a nonsignificant increase in the no COVID-19 group, a somewhat larger, statistically significant increase in the COVID-19, no Long COVID group, and the largest increase among those experiencing Long COVID. Obesity (including severe obesity) was observed in 47.2% and severe obesity in 12.4% of those experiencing Long COVID (with the latter comprising double the 6.2% prevalence of severe obesity observed at the 2019 baseline, data not shown).

3.2 | Prevalence of functional disabilities and well-being overall and by employment status, 2019 and 2022

Between 2019 and 2022, the prevalence of any functional disability in the study population increased from 21.0% to 22.7%; the increase was statistically significant (Table 2). Along with any disability, vision, cognitive, and independent living disabilities had statistically significant increases during this time, and the increase for hearing disability approached statistical significance. Increases in several well-being measures – depression, poor mental health, and activity limitations – were also statistically significant. In contrast, two types of disability, self-care and ambulatory, and one well-being measure, fair/poor general health, had statistically significant decreases for the full study population between 2019 and 2022.

TABLE 1 Demographics, body-mass index, and self-reported history of COVID-19 and Long COVID among Behavioral Risk Factor Surveillance System respondents of prime working age (25–54 years) who were employed, self-employed, unemployed, or unable to work in 2022.*

Demographic Item	Category	Unweighted *N*	Weighted N (thousands)**	No reported COVID-19 Weighted % (95% CI)**	Reported COVID-19 but not Long COVID Weighted % (95% CI)**	Reported COVID-19 and LONG COVID Weighted % (95% CI)**
	Total	149,675	108,692	60.1 (59.6, 60.6)	30.7 (30.2, 31.2)	9.2 (8.9, 9.5)
Age***	Age 25 to 34 years	40,622	37,496	58.8 (57.9, 59.7)	32.3 (31.4, 33.1)	8.9 (8.4, 9.4)
	Age 35 to 44 years	51,503	37,141	59.5 (58.6, 60.4)	30.8 (30.0, 31.7)	9.7 (9.1, 10.2)
	Age 45 to 54 years	57,550	34,055	62.3 (61.4, 63.1)	28.8 (28.0, 29.7)	8.9 (8.4, 9.4)
	p-value****			<0.001	<0.001	0.074
Sex***	Male	76,752	57,921	63.3 (62.6, 64.0)	30.1 (29.5, 30.8)	6.6 (6.2, 6.9)
	Female	72,923	50,771	56.5 (55.7, 57.3)	31.4 (30.7, 32.1)	12.1 (11.6, 12.7)
	p-value****			<0.001	0.011	<0.001
Race/Hispanic Ethnicity***	Non-Hispanic White	101,928	58,860	59.6 (59.0, 60.1)	30.9 (30.4, 31.4)	9.5 (9.2, 9.9)
	Non-Hispanic Black	13,359	13,845	62.4 (60.9, 63.9)	29.2 (27.8, 30.6)	8.4 (7.6, 9.3)
	Multi-racial and other Non-Hispanic	14,383	13,104	63.7 (61.9, 65.3)	29.1 (27.5, 30.7)	7.3 (6.4, 8.3)
	Hispanic	20,005	22,882	58.3 (56.8, 59.7)	32.0 (30.7, 33.4)	9.7 (8.9, 10.6)
	p-value****			<0.001	0.004	<0.001
Education***	Below high school	8143	11,672	68.7 (66.6, 70.7)	23.3 (21.5, 25.2)	8.0 (6.8, 9.3)
	High school graduate	31,423	25,858	61.6 (60.5, 62.7)	29.4 (28.3, 30.4)	9.0 (8.4, 9.7)
	Some college or technical school	38,130	31,583	57.4 (56.4, 58.4)	31.3 (30.4, 32.3)	11.3 (10.7, 12.0)
	College graduate or more	71,432	39,147	58.8 (58.1, 59.5)	33.3 (32.6, 34.0)	7.9 (7.5, 8.3)
	p-value****			<0.001	<0.001	<0.001
Household Income***	<$10,000	3629	3019	74.6 (71.5, 77.5)	18.0 (15.4, 20.8)	7.4 (5.9, 9.2)
	$10,000–$14,999	2604	1937	71.9 (67.4, 76.0)	16.9 (14.5, 19.6)	11.2 (7.4, 16.1)
	$15,000–$19,999	3680	3076	65.7 (62.4, 68.9)	24.4 (21.5, 27.5)	9.9 (8.2, 11.8)
	$20,000–$24,999	5333	4275	62.7 (59.9, 65.4)	26.5 (24.0, 29.1)	10.8 (9.3, 12.5)
	$25,000–$34,999	12,214	9756	60.8 (59.0, 62.6)	28.6 (26.9, 30.3)	10.6 (9.6, 11.7)
	$35,000–$49,999	13,999	10,408	59.9 (58.3, 61.6)	30.0 (28.5, 31.5)	10.1 (9.1, 11.1)
	$50,000–$74,999	20,152	13,847	57.6 (56.2, 59.0)	32.0 (30.7, 33.3)	10.4 (9.6, 11.3)
	>=$75,000	66,101	44,413	56.9 (56.1, 57.7)	34.5 (33.8, 35.3)	8.6 (8.1, 9.0)
	p-value****			<0.001	<0.001	<0.001
Body-mass index category***	Underweight/normal weight (<25 kg/m^2)	38,246	27,882	63.8 (62.8, 64.7)	29.1 (28.2, 30.1)	7.1 (6.6, 7.6)
	Overweight (25- < 30 kg/m^2)	46,240	33,036	60.3 (59.4, 61.2)	31.3 (30.5, 32.2)	8.3 (7.8, 8.8)
	Obesity (30- < 40 kg/m^2)	39,844	28,482	56.9 (55.9, 57.9)	32.3 (31.3, 33.2)	10.8 (10.2, 11.4)
	Severe obesity (>=40 kg/m^2)	10,119	6,950	54.2 (52.2, 56.1)	30.1 (28.4, 31.8)	15.7 (14.1, 17.5)
	p-value****			<0.001	<0.001	<0.001

(Continues)

TABLE 1 (Continued)

Demographic Item	Category	Unweighted *N*	Weighted N (thousands)**	No reported COVID-19 Weighted % (95% CI)**	Reported COVID-19 but not Long COVID Weighted % (95% CI)**	Reported COVID-19 and LONG COVID Weighted % (95% CI)**
Employment Status	Employed for wages	113,405	79,941	57.5 (56.9, 58.1)	33.3 (32.7, 33.8)	9.2 (8.8, 9.5)
	Self-employed	18,268	14,347	66.4 (65.0, 67.8)	25.2 (23.9, 26.5)	8.4 (7.6, 9.3)
	Out of work for <1 year	4526	3876	65.9 (63.2, 68.6)	23.7 (21.4, 26.2)	10.3 (8.8, 12.0)
	Out of work for 1+ year	4367	3723	69.7 (66.8, 72.5)	22.8 (20.2, 25.5)	7.5 (6.1, 9.2)
	Unable to work	9109	6805	68.8 (66.8, 70.8)	20.4 (18.7, 22.3)	10.8 (9.6, 12.1)
	p-value****			<0.001	<0.001	0.003

*New Jersey and U.S. Virgin Islands excluded from all analyses because they were not included in 2019 data set.

**Weighted, unadjusted prevalence.

***Income was missing for 19% of respondents in 2022. BRFSS provides imputed values for age and race/Hispanic ethnicity; <2.5% of responses in each category were missing before imputation. Sex and educational attainment were missing for <1% of respondents. BMI was missing for 11% of respondents.

****Rao-Scott chi-square test for prevalence difference among demographic categories within each column.

Across most disabilities and adverse well-being measures, statistically significant increases between 2019 and 2022 were most frequently observed among those employed for wages, the self-employed, and the short-term unemployed (Table 2). In 2022, the prevalence of any disability was 16.8% among those employed for wages and 19.8% among the self-employed. Among these groups, the most common disability was cognitive, reported by 9.6% of employed respondents, 11.1% of self-employed respondents, and 23.9% of those out of work for less than a year in 2022 (compared to 7.5%, 9.1%, and 21.4%, respectively in 2019). Changes in prevalence for most measures were smaller and not statistically significant among the long-term unemployed. In contrast to the employed and self-employed, those unable to work had decreases for most measures, with some changes statistically significant.

While temporal increases in the prevalence of disability and adverse well-being were more pronounced among workers, within each year the prevalence of every outcome increased through the continuum from the employed/self-employed to the unemployed to those unable to work (Table 2). In both years, prevalences of every disability, along with the well-being measures poor general health, poor physical health, and activity limitations were higher among the self-employed than among those employed for wages, although some confidence intervals overlapped. In contrast, the prevalence of depression was higher among those employed for wages, with the prevalence difference between the two employment types increasing from 1.1% in 2019 to 3.0% in 2022, reflecting primarily the 3.7% increase in depression among the employed. In 2022, the prevalence of poor mental health was also higher among those employed for wages. The prevalence of almost every adverse well-being outcome was higher among the long-term unemployed than among the short-term unemployed in both years. For most outcomes, differences in prevalence between the short and long-term unemployed decreased between 2019 and 2022.

3.3 | Disability by year, employment status, and self-reported COVID-19 and Long COVID history

Among those with Long COVID, one in four respondents employed for wages and nearly one-third of the self-employed reported at least one functional disability (Table 3). Among employed and self-employed workers, aPRs for every functional disability had statistically significant elevations comparing 2022 respondents with Long COVID to respondents in the same employment status in 2019 (Table 3). The aPRs exceeded 2.0 for hearing, vision, and self-care disabilities among the self-employed and for cognitive and independent living disabilities among both the employed and self-employed with Long COVID compared to employed and self-employed respondents in 2019.

Cognitive disability had the highest prevalence of any functional disability for both years, in every employment category except unable to work, and, in 2022, every COVID-19/Long COVID status (Table 3). In 2019, the prevalence of cognitive disability was 7.5% among the employed and 9.1% among the self-employed. In 2022, the prevalence of cognitive disability among the employed was 9.1% (no COVID-19), 8.7% (COVID-19, no Long COVID), and 16.4% (Long COVID); among the self-employed, corresponding prevalences were 10.7%, 9.0%, and 21.4%. Prevalences of cognitive disability increased with duration of unemployment and were highest among those unable to work, reaching a prevalence of 60.8% among those who reported a history of Long COVID in 2022.

Among the Long COVID group, the prevalence of every statistically reportable disability was higher among those who were not working (short-term unemployed, long-term unemployed, unable to work) in 2022 than among the employed and self-employed (Table 3). However, for many disabilities, the relative increases in prevalence, as measured by aPRs comparing those reporting Long COVID by 2022 to those in the same employment status in 2019, were larger

TABLE 2 Weighted, unadjusted prevalence of functional disability and well-being measures 2019 versus 2022 by employment status** among Behavioral Risk Factor Surveillance System respondents ages 25–54 years.

Disability or well-being measure	Employment status	2019 Unadjusted prevalence (95% CI)	2022 Unadjusted prevalence (95% CI)
Any functional disability***	All below	*21.0 (20.6, 21.5)*	*22.7 (22.3, 23.1)*
	Employed for wages	*14.5 (14.0, 14.9)*	*16.8 (16.4, 17.3)*
	Self-employed	*17.3 (16.2, 18.5)*	*19.8 (18.6, 21.1)*
	Out of work for <1 year	32.6 (30.1, 35.1)	35.8 (33.1, 38.5)
	Out of work for 1+ year	44.2 (41.3, 47.1)	44.9 (42.0, 47.7)
	Unable to work	*82.3 (80.9, 83.7)*	*77.7 (75.7, 79.6)*
Hearing	All below	3.3 (3.1, 3.5)	3.5 (3.4, 3.7)
	Employed for wages	2.5 (2.3, 2.7)	2.8 (2.6, 2.9)
	Self-employed	3.5 (2.9, 4.2)	3.6 (3.1, 4.2)
	Out of work for <1 year	3.8 (3.0, 4.7)	4.3 (3.2, 5.5)
	Out of work for 1+ year	5.2 (4.0, 6.7)	6.1 (4.8, 7.6)
	Unable to work	10.2 (9.3, 11.3)	10.7 (9.4, 12.0)
Vision	All below	*4.1 (3.9, 4.3)*	*4.5 (4.3, 4.8)*
	Employed for wages	2.7 (2.5, 2.9)	2.9 (2.7, 3.1)
	Self-employed	3.1 (2.7, 3.6)	4.2 (3.5, 4.9)
	Out of work for <1 year	5.7 (4.5, 7.1)	6.4 (5.4, 7.7)
	Out of work for 1+ year	10.1 (8.5, 12.0)	10.6 (8.9, 12.5)
	Unable to work	17.6 (16.3, 18.9)	20.0 (18.3, 21.8)
Cognitive	All below	*11.8 (11.5, 12.1)*	*13.3 (13.0, 13.7)*
	Employed for wages	*7.5 (7.2, 7.8)*	*9.6 (9.2, 9.9)*
	Self-employed	*9.1 (8.3, 9.9)*	*11.1 (10.2, 12.1)*
	Out of work for <1 year	21.4 (19.2, 23.6)	23.9 (21.6, 26.3)
	Out of work for 1+ year	27.5 (25.0, 30.2)	29.1 (26.5, 31.8)
	Unable to work	51.2 (49.4, 53.0)	47.5 (45.4, 49.5)
Ambulatory (difficulty walking or climbing stairs)	All below	*8.5 (8.3, 8.8)*	*7.7 (7.5, 8.0)*
	Employed for wages	4.1 (3.8, 4.3)	4.0 (3.7, 4.2)
	Self-employed	5.0 (4.4, 5.8)	5.5 (4.8, 6.3)
	Out of work for <1 year	10.5 (9.1, 12.1)	10.0 (8.5, 11.8)
	Out of work for 1+ year	18.3 (16.3, 20.3)	16.5 (14.5, 18.7)
	Unable to work	*57.6 (55.9, 59.4)*	*50.4 (48.3, 52.5)*
Self-care (dressing or bathing)	All below	3.1 (3.0, 3.3)	2.8 (2.7, 3.0)
	Employed for wages	1.0 (0.9, 1.1)	1.0 (0.9, 1.1)
	Self-employed	1.3 (1.0, 1.7)	1.7 (1.2, 2.2)
	Out of work for <1 year	*4.2 (3.1, 5.6)*	*3.3 (2.4, 4.3)*
	Out of work for 1+ year	6.3 (5.2, 7.5)	6.3 (5.0, 7.8)
	Unable to work	27.7 (26.2, 29.3)	24.7 (22.9, 26.4)
Independent living (difficulty doing errands alone)	All below	*5.9 (5.7, 6.1)*	*6.4 (6.1, 6.7)*
	Employed for wages	*2.2 (2.1, 2.4)*	*3.0 (2.8, 3.2)*

(Continues)

TABLE 2 (Continued)

Disability or well-being measure	Employment status	2019 Unadjusted prevalence (95% CI)	2022 Unadjusted prevalence (95% CI)
	Self-employed	*3.1 (2.6, 3.7)*	*4.3 (3.7, 5.0)*
	Out of work for <1 year	8.3 (7.0, 9.7)	9.8 (8.3, 11.5)
	Out of work for 1+ year	16.6 (14.7, 18.7)	17.4 (15.2, 19.8)
	Unable to work	44.9 (43.1, 46.7)	42.8 (40.8, 44.9)
Depression	All below	*19.5 (19.1, 19.8)*	*22.1 (21.7, 22.4)*
	Employed for wages	*15.8 (15.5, 16.2)*	*19.5 (19.1, 19.9)*
	Self-employed	*14.7 (13.7, 15.8)*	*16.5 (15.5, 17.6)*
	Out of work for <1 year	29.6 (27.3, 32.0)	30.8 (28.4, 33.4)
	Out of work for 1+ year	34.8 (32.1, 37.5)	32.5 (29.9, 35.1)
	Unable to work	54.9 (53.1, 56.7)	53.4 (51.3, 55.5)
Fair/poor general health	All below	*15.9 (15.5, 16.2)*	*14.9 (14.5, 15.2)*
	Employed for wages	11.3 (10.9, 11.6)	10.9 (10.5, 11.3)
	Self-employed	12.3 (11.4, 13.2)	11.4 (10.5, 12.4)
	Out of work for <1 year	22.5 (20.3, 24.8)	22.6 (20.3, 24.9)
	Out of work for 1+ year	31.2 (28.7, 33.9)	29.5 (27.0, 32.2)
	Unable to work	*61.6 (59.9, 63.3)*	*57.1 (55.0, 59.1)*
Poor mental health (14+ days of past 30 mental health not good)	All below	*14.6 (14.3, 15.0)*	*17.5 (17.1, 17.9)*
	Employed for wages	*11.3 (10.9, 11.7)*	*14.8 (14.4, 15.2)*
	Self-employed	11.9 (10.9, 12.9)	13.8 (12.8, 14.9)
	Out of work for <1 year	*24.7 (22.6, 26.9)*	*30.7 (28.1, 33.3)*
	Out of work for 1+ year	28.2 (25.8, 30.7)	28.7 (26.2, 31.2)
	Unable to work	44.7 (42.9, 46.4)	43.6 (41.6, 45.6)
Poor physical health (14+ days of past 30 physical health not good)	All below	10.3 (10.0, 10.6)	10.5 (10.2, 10.8)
	Employed for wages	*6.1 (5.8, 6.4)*	*7.1 (6.7, 7.4)*
	Self-employed	8.0 (7.2, 8.9)	8.3 (7.5, 9.1)
	Out of work for <1 year	15.8 (14.0, 17.7)	16.5 (14.3, 18.8)
	Out of work for 1+ year	20.9 (18.8, 23.1)	19.2 (17.1, 21.4)
	Unable to work	*53.1 (51.4, 54.9)*	*48.7 (46.6, 50.8)*
Activity limitations (14+ days poor physical or mental health preventing usual activities)	All below	*8.0 (7.8, 8.3)*	*8.8 (8.6, 9.1)*
	Employed for wages	*3.7 (3.5, 3.9)*	*5.0 (4.8, 5.2)*
	Self-employed	5.5 (4.8, 6.3)	6.6 (5.9, 7.4)
	Out of work for <1 year	*16.0 (14.2, 17.9)*	*20.4 (18.2, 22.7)*
	Out of work for 1+ year	22.2 (20.0, 24.5)	22.6 (20.3, 25.2)
	Unable to work	*49.9 (48.1, 51.7)*	*45.8 (43.8, 47.9)*

Italics indicate statistically significant differences between 2019 and 2022 for an outcome-employment status combination based on prevalence with nonoverlapping 95% CIs.

*New Jersey and U.S. Virgin Islands excluded from all analyses because they were not included in 2019 data set.

**Excludes respondents self-reporting employment status as retired, homemaker, or student.

***Any of the six functional disabilities ascertained by BRFSS.

TABLE 3 Functional disabilities among Behavioral Risk Factor Surveillance System* respondents ages 25–54 years by employment status and self-reported COVID-19 and Long COVID: 2022 prevalence and adjusted prevalence ratios (aPRs) compared to 2019 respondents in same employment category.

		2019	2022		
		Unadjusted prevalence (95% CI)**	Unadjusted prevalence (95% CI)**		
		Adjusted prevalence (95% CI)***	aPR (95% CI) compared to 2019***		
Outcome	Employment status		No COVID-19	COVID-19, no Long COVID	COVID-19 and Long COVID
Any functional disability	Employed for wages	14.5 (14.0, 14.9) 14.5 (14.1, 14.9)	16.1 (15.5, 16.7) *1.12 (1.07, 1.17)*	15.2 (14.5, 16.0) 1.05 (0.99, 1.12)	25.7 (24.0, 27.5) *1.75 (1.63, 1.88)*
	Self-employed	17.3 (16.2, 18.5) 17.5 (16.4, 18.6)	19.7 (18.1, 21.5) *1.14 (1.03, 1.27)*	15.6 (13.7, 17.6) 0.90 (0.78, 1.03)	31.3 (26.3, 36.7) *1.78 (1.49, 2.12)*
	Out of work for <1 year	32.6 (30.1, 35.1) 32.2 (29.8, 34.7)	33.7 (30.3, 37.3) 1.05 (0.92, 1.19)	35.5 (30.1, 41.2) 1.07 (0.91, 1.27)	50.2 (42.1, 58.2) *1.51 (1.27, 1.80)*
	Out of work for 1+ year	44.2 (41.3, 47.1) 43.6 (40.8, 46.5)	44.0 (40.5, 47.6) 1.01 (0.92, 1.12)	41.5 (34.8, 48.3) 0.92 (0.77, 1.09)	53.1 (42.4, 63.6) 1.17 (0.95, 1.45)
	Unable to work	82.3 (80.9, 83.7) 82.0 (80.6, 83.4)	77.2 (74.7, 79.5) *0.93 (0.91, 0.98)*	77.8 (73.2, 82.0) *0.94 (0.88, 0.99)*	87.7 (82.7, 91.6) 1.05 (1.00, 1.11)
Hearing	Employed for wages	2.5 (2.3, 2.7) 2.5 (2.4, 2.7)	2.6 (2.4, 2.8) 1.02 (0.92, 1.14)	2.5 (2.2, 2.8) 1.00 (0.88, 1.14)	4.2 (3.4, 5.2) *1.84 (1.47, 2.30)*
	Self-employed	3.5 (2.9, 4.2) 3.3 (2.7, 3.9)	3.4 (2.8, 4.1) 0.97 (0.76, 1.24)	2.4 (1.7, 3.3) 0.70 (0.49, 1.01)	7.3 (3.7, 12.6) *2.28 (1.29, 4.03)*
	Out of work for <1 year	3.8 (3.0, 4.7) 4.0 (3.3, 5.0)	4.5 (3.1, 6.3) 1.20 (0.80, 1.79)	3.4 (1.8, 5.7) 0.90 (0.51, 1.60)	**** 1.45 (0.72, 2.92)
	Out of work for 1+ year	5.2 (4.0, 6.7) 5.5 (4.3, 7.1)	6.5 (4.9, 8.6) 1.22 (0.85, 1.77)	4.1 (2.1, 7.1) 0.82 (0.44, 1.54)	**** 0.93 (0.38. 2.28)
	Unable to work	10.2 (9.3, 11.3) 10.1 (9.2, 11.2)	10.4 (9.0, 11.9) 1.00 (0.85, 1.19)	10.7 (7.0, 15.5) 1.10 (0.75, 1.61)	14.5 (10.5, 19.4) *1.52 (1.12, 2.07)*
Vision	Employed for wages	2.7 (2.5, 2.9) 2.7 (2.5, 3.0)	2.9 (2.6, 3.2) 1.07 (0.95, 1.21)	2.7 (2.3, 3.2) 1.02 (0.87, 1.20)	3.6 (3.0, 4.2) *1.29 (1.08, 1.54)*
	Self-employed	3.1 (2.7, 3.6) 3.2 (2.8, 3.6)	4.0 (3.2, 5.0) 1.27 (0.99, 1.63)	3.0 (2.1, 4.2) 0.94 (0.66, 1.33)	8.8 (5.3, 13.5) *2.65 (1.67, 4.21)*
	Out of work for <1 year	5.7 (4.5, 7.1) 5.4 (4.3, 6.7)	5.9 (4.6, 7.6) 1.06 (0.77, 1.48)	5.5 (3.8, 7.7) 0.94 (0.63, 1.40)	10.3 (6.5, 15.3) *1.67 (1.05, 2.66)*
	Out of work for 1+ year	10.1 (8.5, 12.0) 9.2 (7.7, 10.9)	12.1 (9.7, 14.8) 1.24 (0.95, 1.62)	6.1 (3.6, 9.5) *0.55 (0.33, 0.89)*	11.7 (7.0, 18.0) 1.06 (0.65, 1.72)
	Unable to work	17.6 (16.3, 18.9) 16.0 (14.8, 17.3)	19.2 (17.1, 21.4) 1.09 (0.95, 1.24)	22.7 (18.1, 27.7) 1.22 (0.99, 1.51)	20.7 (16.5, 25.4) 1.20 (0.96, 1.51)

(Continues)

TABLE 3 (Continued)

Outcome	Employment status	2019 Unadjusted prevalence (95% CI)** Adjusted prevalence (95% CI)***	2022 Unadjusted prevalence (95% CI)** aPR (95% CI) compared to 2019***		
			No COVID-19	COVID-19, no Long COVID	COVID-19 and Long COVID
Cognitive	Employed for wages	7.5 (7.2, 7.8) 7.4 (7.1, 7.7)	9.1 (8.7, 9.6) *1.23 (1.15, 1.31)*	8.7 (8.1, 9.3) *1.15 (1.06, 1.24)*	16.4 (15.1, 17.7) *2.12 (1.94, 2.31)*
	Self-employed	9.1 (8.3, 9.9) 9.5 (8.7, 10.4)	10.7 (9.5, 12.1) *1.18 (1.02, 1.37)*	9.0 (7.6, 10.6) 0.98 (0.82, 1.18)	21.4 (17.2, 26.0) *2.27 (1.82, 2.83)*
	Out of work for <1 year	21.4 (19.2, 23.6) 20.7 (18.7, 22.9)	22.4 (19.6, 25.5) 1.06 (0.90, 1.25)	24.6 (19.6, 30.2) 1.12 (0.89, 1.41)	34.6 (27.5, 42.2) *1.59 (1.27, 2.00)*
	Out of work for 1+ year	27.5 (25.0, 30.2) 27.5 (24.9, 30.2)	28.3 (25.0, 31.8) 1.04 (0.90, 1.21)	27.4 (21.7, 33.7) 0.97 (0.78, 1.22)	41.0 (31.2, 51.3) *1.47 (1.11, 1.94)*
	Unable to work	51.2 (49.4, 53.0) 53.3 (51.5, 55.1)	47.0 (44.4, 49.6) *0.92 (0.86, 0.98)*	44.4 (39.6, 49.4) *0.85 (0.76, 0.94)*	60.8 (54.7, 66.6) *1.14 (1.03, 1.26)*
Ambulatory (walking or climbing stairs)	Employed for wages	4.1 (3.8, 4.3) 4.2 (3.9, 4.4)	3.9 (3.6, 4.2) 0.96 (0.87, 1.05)	3.3 (2.9, 3.8) *0.83 (0.72, 0.95)*	6.8 (6.0, 7.7) *1.63 (1.42, 1.86)*
	Self-employed	5.0 (4.4, 5.8) 4.9 (4.3, 5.6)	5.6 (4.6, 6.7) 1.12 (0.89, 1.41)	4.4 (3.3, 5.7) 0.87 (0.65, 1.18)	9.4 (6.6, 13.0) *1.86 (1.32, 2.62)*
	Out of work for <1 year	10.5 (9.1, 12.1) 11.0 (9.6, 12.6)	8.1 (6.4, 10.1) 0.80 (0.62, 1.04)	10.2 (6.9, 14.4) 0.98 (0.67, 1.44)	17.7 (11.8, 24.9) *1.60 (1.12, 2.29)*
	Out of work for 1+ year	18.3 (16.3, 20.3) 17.4 (15.6, 19.4)	16.6 (14.1, 19.4) 0.95 (0.79, 1.14)	14.9 (10.5, 20.1) 0.81 (0.58, 1.12)	22.9 (14.9, 32.6) 1.15 (0.80, 1.64)
	Unable to work	57.6 (55.9, 59.4) 51.9 (50.1, 53.8)	49.6 (47.0, 52.2) *0.89 (0.84, 0.94)*	50.9 (45.9, 55.8) 0.90 (0.80, 1.01)	58.3 (52.1, 64.3) 0.99 (0.90, 1.10)
Self-care (dressing or bathing)	Employed for wages	1.0 (0.9, 1.1) 1.0 (0.9, 1.1)	1.0 (0.8, 1.2) 1.00 (0.81, 1.24)	0.8 (0.6, 1.0) 0.84 (0.66, 1.08)	1.8 (1.4, 2.3) *1.88 (1.44, 2.46)*
	Self-employed	1.3 (1.0, 1.7) 1.3 (1.0, 1.6)	1.6 (1.0, 2.4) 1.24 (0.76, 2.02)	1.0 (0.6, 1.6) 0.76 (0.45, 1.29)	**** *2.63 (1.28, 5.40)*
	Out of work for <1 year	4.2 (3.1, 5.6) 4.4 (3.3, 5.8)	2.6 (1.6, 3.9) 0.62 (0.37, 1.02)	3.1 (1.6, 5.5) 0.75 (0.40, 1.42)	**** 1.36 (0.71, 2.60)
	Out of work for 1+ year	6.3 (5.2, 7.5) 6.2 (5.2, 7.3)	6.1 (4.5, 8.0) 0.98 (0.71, 1.36)	4.8 (2.5, 8.3) 0.76 (0.42, 1.36)	**** *1.97 (1.04, 3.72)*
	Unable to work	27.7 (26.2, 29.3) 25.5 (24.0, 27.1)	23.5 (21.6, 25.6) *0.85 (0.77, 0.94)*	24.0 (19.3, 29.2) 0.88 (0.71, 1.09)	31.0 (25.5, 36.9) 1.13 (0.94, 1.36)

TABLE 3 (Continued)

Outcome	Employment status	2019 Unadjusted prevalence (95% CI)** Adjusted prevalence (95% CI)***	2022 Unadjusted prevalence (95% CI)** aPR (95% CI) compared to 2019***		
			No COVID-19	COVID-19, no Long COVID	COVID-19 and Long COVID
Independent living (doing errands alone)	Employed for wages	2.2 (2.1, 2.4) 2.2 (2.0, 2.4)	2.9 (2.6, 3.1) *1.30 (1.16, 1.46)*	2.6 (2.2, 3.0) 1.16 (1.00, 1.36)	5.7 (4.6, 7.0) *2.47 (1.99, 3.07)*
	Self-employed	3.1 (2.6, 3.7) 3.3 (2.8, 3.8)	4.4 (3.5, 5.4) *1.40 (1.08, 1.82)*	3.1 (2.2, 4.1) 0.98 (0.70, 1.37)	8.4 (5.5, 12.1) *2.57 (1.71, 3.86)*
	Out of work for <1 year	8.3 (7.0, 9.7) 8.3 (7.0, 9.7)	10.0 (8.0, 12.2) 1.23 (0.95, 1.59)	8.8 (5.9, 12.5) 1.04 (0.71, 1.54)	12.2 (8.1, 17.4) 1.43 (0.97, 2.13)
	Out of work for 1+ year	16.6 (14.7, 18.7) 16.6 (14.7, 18.7)	16.7 (13.9, 19.9) 1.03 (0.84, 1.27)	16.3 (12.0, 21.4) 0.98 (0.72, 1.32)	23.3 (15.2, 33.2) 1.34 (0.90, 2.01)
	Unable to work	44.9 (43.1, 46.7) 45.4 (43.6, 47.2)	41.8 (39.3, 44.4) 0.95 (0.88, 1.02)	42.3 (37.3, 47.4) 0.94 (0.83, 1.07)	55.3 (49.1, 61.4) *1.16 (1.03, 1.30)*

Abbreviations: aPR, adjusted prevalence ratio.

Italicization indicates aPR elevation or deficit comparing adjusted prevalence in 2022 category to 2019 baseline is statistically significant based on aPRs with 95% CIs not spanning the null.

*New Jersey and U.S. Virgin Islands excluded from all analyses because they were not included in 2019 data set.

**Weighted

***Weighted and adjusted for age in years (25–34, 35–44, 45–54), sex (male/female), and race/Hispanic ethnicity (White Non-Hispanic, Black Non-Hispanic, multi-racial or another Non-Hispanic race, Hispanic).

****Not reportable, Relative Standard Error (RSE) > 30%.

TABLE 4 Measures of well-being among Behavioral Risk Factor Surveillance System respondents* ages 25–54 years by employment status and self-reported COVID-19 and Long COVID: 2022 unadjusted prevalence and adjusted prevalence ratios (aPRs) compared to 2019 respondents in same employment category.

		2019	2022		
		Unadjusted prevalence (95% CI)**	Unadjusted prevalence (95% CI)**		
		Adjusted prevalence (95% CI)***	aPR (95% CI) compared to 2019***		
Outcome	Employment status		No COVID-19	COVID-19, no Long COVID	COVID-19 and Long COVID
Depression	Employed for wages	15.8 (15.5, 16.2) 15.6 (15.2, 15.9)	18.7 (18.1, 19.3) *1.20 (1.16, 1.25)*	19.3 (18.6, 20.1) *1.21 (1.16, 1.27)*	31.2 (29.5, 33.0) *1.82 (1.71, 1.93)*
	Self-employed	14.7 (13.7, 15.8) 15.8 (14.8, 16.9)	15.5 (14.2, 16.9) 1.07 (0.96, 1.20)	17.3 (15.3, 19.5) *1.18 (1.03, 1.35)*	30.4 (25.9, 35.2) *1.90 (1.62, 2.24)*
	Out of work for <1 year	29.6 (27.3, 32.0) 29.8 (27.6, 32.1)	30.1 (26.8, 33.6) 1.06 (0.93, 1.21)	31.7 (26.6, 37.1) 1.05 (0.88, 1.26)	38.7 (31.3, 46.5) *1.25 (1.04, 1.51)*
	Out of work for 1+ year	34.8 (32.1, 37.5) 35.0 (32.4, 37.8)	31.6 (28.4, 34.9) 0.95 (0.84, 1.07)	34.6 (28.3, 41.3) 1.01 (0.83, 1.23)	46.1 (35.9, 56.5) 1.21 (0.93, 1.58)
	Unable to work	54.9 (53.1, 56.7) 55.1 (53.4, 56.9)	53.2 (50.6, 55.9) 1.01 (0.95, 1.07)	51.4 (46.4, 56.4) 0.95 (0.86, 1.05)	67.1 (61.0, 72.7) 1.09 (1.00, 1.20)
Fair/poor general health	Employed for wages	11.3 (10.9, 11.6) 11.4 (11.0, 11.8)	10.1 (9.6, 10.7) *0.90 (0.85, 0.96)*	10.3 (9.6, 11.1) *0.92 (0.85, 0.99)*	17.3 (15.7, 19.0) *1.52 (1.38, 1.68)*
	Self-employed	12.3 (11.4, 13.2) 12.0 (11.1, 12.9)	11.2 (9.9, 12.5) 0.91 (0.80, 1.04)	9.5 (7.9, 11.3) *0.76 (0.63, 0.92)*	18.8 (15.1, 23.0) *1.51 (1.22, 1.86)*
	Out of work for <1 year	22.5 (20.3, 24.8) 22.2 (20.1, 24.5)	20.4 (17.5, 23.5) 0.91 (0.76, 1.09)	21.6 (17.1, 26.7) 0.93 (0.74, 1.18)	37.3 (29.8, 45.3) *1.61 (1.27, 2.04)*
	Out of work for 1+ year	31.2 (28.7, 33.9) 30.1 (27.7, 32.7)	30.6 (27.3, 34.0) 1.00 (0.87, 1.14)	27.0 (20.8, 34.0) 0.80 (0.63, 1.02)	35.5 (26.4, 45.5) 1.11 (0.86, 1.43)
	Unable to work	61.6 (59.9, 63.3) 60.2 (58.4, 61.9)	54.5 (51.9, 57.2) *0.87 (0.82, 0.93)*	56.4 (51.4, 61.3) *0.88 (0.80, 0.96)*	74.1 (68.2, 79.4) *1.20 (1.11, 1.30)*
Poor mental health (14+ days of past 30 mental health not good)	Employed for wages	11.3 (10.9, 11.7) 11.2 (10.8, 11.5)	14.0 (13.5, 14.5) *1.25 (1.19, 1.32)*	14.1 (13.4, 14.9) *1.24 (1.17, 1.32)*	24.7 (23.0, 26.4) *2.10 (1.95, 2.26)*
	Self-employed	11.9 (10.9, 12.9) 12.6 (11.6, 13.7)	13.0 (11.8, 14.3) 1.10 (0.97, 1.24)	12.6 (10.7, 14.6) *1.06 (0.89, 1.25)*	21.1 (17.4, 25.3) *1.68 (1.38, 2.05)*
	Out of work for <1 year	24.7 (22.6, 26.9) 24.1 (22.1, 26.3)	31.3 (27.9, 35.0) *1.28 (1.12, 1.47)*	28.7 (23.5, 34.3) 1.15 (0.93, 1.41)	35.2 (28.1, 42.8) *1.39 (1.12, 1.73)*
	Out of work for 1+ year	28.2 (25.8, 30.7) 28.1 (25.7, 30.6)	28.4 (25.3, 31.7) 1.02 (0.89, 1.18)	27.8 (22.1, 34.0) 0.99 (0.80, 1.24)	44.4 (34.2, 54.9) *1.51 (1.16, 1.96)*
	Unable to work	44.7 (42.9, 46.4) 45.9 (44.1, 47.7)	42.7 (40.1, 45.4) 0.97 (0.90, 1.05)	42.1 (37.4, 46.9) 0.94 (0.83, 1.06)	60.4 (54.2, 66.3) *1.28 (1.16, 1.42)*

TABLE 4 (Continued)

Outcome	Employment status	2019 Unadjusted prevalence (95% CI)** Adjusted prevalence (95% CI)***	2022 Unadjusted prevalence (95% CI)** aPR (95% CI) compared to 2019***		
			No COVID-19	COVID-19, no Long COVID	COVID-19 and Long COVID
Poor physical health (14+ days of past 30 physical health not good)	Employed for wages	6.1 (5.8, 6.4) 6.1 (5.9, 6.4)	6.1 (5.7, 6.6) 1.01 (0.93, 1.09)	6.8 (6.2, 7.4) *1.11 (1.01, 1.23)*	13.6 (11.9, 15.3) *2.18 (1.91, 2.48)*
	Self-employed	8.0 (7.2, 8.9) 7.8 (7.1, 8.7)	8.0 (6.9, 9.2) 1.01 (0.85, 1.21)	6.9 (5.8, 8.3) 0.87 (0.71, 1.07)	16.0 (11.9, 21.0) *1.98 (1.49, 2.65)*
	Out of work for <1 year	15.8 (14.0, 17.7) 16.3 (14.5, 18.3)	16.0 (12.8, 19.6) 1.04 (0.82, 1.32)	15.6 (12.0, 19.7) 0.99 (0.76, 1.28)	26.6 (20.0, 34.1) *1.65 (1.24, 2.19)*
	Out of work for 1+ year	20.9 (18.8, 23.1) 20.8 (18.8, 23.0)	18.2 (15.6, 21.1) 0.89 (0.75, 1.06)	16.8 (12.2, 22.3) 0.79 (0.58, 1.07)	28.6 (21.1, 37.0) 1.31 (0.98, 1.76)
	Unable to work	53.1 (51.4, 54.9) 51.3 (49.5, 53.1)	45.8 (43.1, 48.4) *0.87 (0.82, 0.93)*	49.7 (44.6, 54.8) 0.94 (0.85, 1.04)	*70.1 (63.9, 75.7)* *1.27 (1.17, 1.38)*
Activity limitations (14+ days poor physical or mental health preventing usual activities)	Employed for wages	3.7 (3.5, 3.9) 3.7 (3.5, 3.9)	4.5 (4.2, 4.9) *1.23 (1.12, 1.35)*	4.9 (4.4, 5.3) *1.31 (1.18, 1.46)*	8.4 (7.5, 9.4) *2.23 (1.96, 2.53)*
	Self-employed	5.5 (4.8, 6.3) 5.6 (4.9, 6.4)	6.2 (5.3, 7.2) 1.13 (0.92, 1.38)	5.7 (4.5, 7.2) 1.05 (0.81, 1.37)	12.3 (8.4, 17.1) *2.20 (1.52, 3.17)*
	Out of work for <1 year	16.0 (14.2, 17.9) 16.1 (14.4, 17.9)	19.5 (16.6, 22.7) *1.24 (1.03, 1.49)*	20.5 (16.1, 25.6) 1.28 (0.99, 1.64)	26.6 (20.2, 33.8) *1.64 (1.26, 2.15)*
	Out of work for 1+ year	22.2 (20.0, 24.5) 22.4 (20.2, 24.7)	22.5 (19.5, 25.7) 1.02 (0.87, 1.21)	19.5 (14.6, 25.1) 0.87 (0.66, 1.16)	33.4 (24.3, 43.6) *1.47 (1.08, 2.00)*
	Unable to work	49.9 (48.1, 51.7) 50.1 (48.2, 51.9)	44.6 (42.0, 47.2) *0.90 (0.84, 0.97)*	45.6 (40.6, 50.6) 0.92 (0.82, 1.02)	65.4 (59.5, 70.9) *1.26 (1.15, 1.38)*

Abbreviations: aPR, adjusted prevalence ratio.

Italicization indicates aPR elevation or deficit comparing adjusted prevalence in 2022 category to 2019 baseline is statistically significant based on aPRs with 95% CIs not spanning the null.

*New Jersey and U.S. Virgin Islands excluded from all analyses because they were not included in 2019 data set.

**Weighted.

***Weighted and adjusted for age (25–34, 35–44, 45–54), sex (male/female), and race/Hispanic ethnicity (White Non-Hispanic, Black Non-Hispanic, multi-racial or another Non-Hispanic race, Hispanic).

****Relative Standard Error (RSE) > 30.

among workers. Still, aPRs for multiple disabilities were significantly elevated among the unemployed, as well as those who were unable to work, who reported Long COVID.

Among respondents who did not report Long COVID (regardless of COVID-19 history), most aPRs comparing 2022 to 2019 prevalence by employment status did not have statistically significant elevations (Table 3). Exceptions include cognitive disability, which was significantly elevated among the employed regardless of COVID-19 history, as well as independent living, which was significantly elevated among the employed and self-employed who had not had COVID-19. The aPR for ambulatory disability had a statistically significant deficit among employed workers with a history of COVID-19 but not Long COVID.

After additional adjustment for BMI (Supplemental Table 3), aPRs described above decreased somewhat without, for most employment and COVID/Long COVID status groups, leading to changes in direction or statistical significance. However, among those unable to work, elevated aPRs lost statistical significance or aPR deficits became statistically significant for a number of disabilities.

3.4 | Well-being measures by year and COVID-19/Long COVID history

In 2022, prevalence estimates for every adverse well-being measure were higher among respondents who self-reported Long COVID than among the no COVID and COVID, no Long COVID groups, regardless of employment status (Table 4). Adjusted PRs comparing prevalence among respondents reporting Long COVID to the 2019 baseline had statistically significant elevations across all outcomes for each employment group except, for some measures, the long-term unemployed. Depression was the most common adverse well-being measure among those reporting Long COVID. While in 2019 depression was reported by 15.8% of employed respondents and 14.7% of self-employed respondents, the 2022 prevalence among workers who reporting Long COVID was approximately double the pre-pandemic levels, at 31.2% and 30.4%, respectively. In addition, nearly one-quarter of employed and more than one fifth of the self-employed reporting Long COVID also reported their mental health was poor for at least 14 of the past 30 days. Poor physical health in the past month was reported by 13.6% of the employed and 16.0% of the self-employed who reported Long COVID, and activity limitations were reported by 8.4% and 12.3% of these groups, respectively. Among those reporting Long COVID, the aPRs exceeded 2.0 for poor mental health among the employed, for poor physical health among the employed (and approached 2.0 among the self-employed), and for activity limitations among the employed and the self-employed.

Employees and the self-employed who did not report Long COVID experienced prevalences of multiple adverse well-being measures that, while lower than those reported by the Long COVID group, were higher than the 2019 baseline (Table 4). The aPRs for both depression and poor mental health were significantly elevated among employees who did not report Long COVID, regardless of COVID-19 history, and the aPR for depression was significantly elevated among the self-employed in the COVID-19, no Long COVID group. For activity limitations, the aPR was significantly elevated among the employed, but not the self-employed, who did not report Long COVID (regardless of COVID-19 history).

As with disabilities, adjustment for BMI category led to somewhat lower aPRs compared to the 2019 baseline for well-being measures (Supplemental Table 4). In most cases, statistical significance did not change. However, loss of statistical significance (for elevated aPRs) or gain of statistical significance (for aPR deficits) occurred for several well-being measures for specific employment statuses in specific COVID-19/Long COVID history combinations: among the employed, poor physical health in the COVID, no Long COVID group; among the short-term unemployed, activity limitations in the no COVID group and depression and poor mental health among those with Long COVID; and among those unable to work, activity limitations and depression in the CVOID-19, no Long COVID group and fair/poor general health among those with Long COVID.

4 | DISCUSSION

The high prevalence of both functional disabilities and adverse well-being among employed and self-employed 2022 BRFSS survey respondents with a history of Long COVID have implications for both workers and employers. Also concerning is the finding of lower but statistically significant increases observed in prevalences of cognitive disability, diagnosed depression, poor mental health, and activity limitations among the larger number of employees (and some self-employed workers) reporting they had not had Long COVID.

Among workers with Long COVID, aPRs comparing 2022 prevalence to the 2019 baseline were significantly elevated for every functional disability and every adverse well-being measure ascertained in BRFSS (although the aPR for self-care was not reportable for the self-employed). Adverse well-being measures related to mental health were high among both employed and self-employed respondents, reinforcing the need for mental health supports across the workforce. The picture for functional disabilities differed somewhat, with higher prevalences of each statistically reportable disability among the self-employed than those employed for wages. While the higher prevalence of disability among the self-employed may indicate greater flexibility to manage disability in the context of self-employment, the finding is nonetheless problematic. The self-employed were significantly less likely than the employed to have health insurance before the pandemic,[25] potentially hindering access to the medical and rehabilitation services needed to address these issues. In a U.S. internet survey that did not query employment status, adults currently experiencing Long COVID were more likely than adults not currently experiencing Long COVID or never diagnosed with COVID-19 to not have received needed healthcare in the past year due to cost, along with increased logistical difficulties accessing care.[26] Affordable, accessible healthcare will be key to continued employability in workers with Long COVID and to the ability

to seek employment among those with Long COVID who are unemployed. In addition, workers with Long COVID may need workplace accommodations, such as remote work and flexible scheduling.[27] Consistent with other U.S. surveys,[28,29] respondents with Long COVID in this study were more likely to be female or Hispanic; thus, developing treatments for Long COVID, ensuring that people with Long COVID can access healthcare, and addressing resulting workplace accommodation needs are health equity issues.

While the 2022 prevalence of functional disability and adverse well-being measures were lower among the employed and self-employed not reporting Long COVID, regardless of history of COVID-19, these workers also had statistically significant increased prevalence compared to 2019 respondents in the same employment categories for multiple disability and well-being measures that might affect workplace performance: cognitive and independent living disabilities, depression, poor mental health and, for the employed, poor physical health. Concerns about healthcare access and workplace accommodations apply to these groups as well.

Cognitive disability was the most common functional disability for employed and self-employed respondents of each COVID-19/Long COVID status. An internet study found that neurocognitive symptoms were associated with reduced likelihood of working full time.[30] An assessment of patients in a Long COVID clinic followed for an average of 7 months after acute illness found that 44% had cognitive impairments compared to healthy controls; deficits were particularly pronounced in global cognition, working memory and executive function, and less pronounced but present in verbal fluency, verbal learning, and verbal memory.[31] Another study found marked slowing on multiple domains among Long COVID clinic patients; the cognitive slowing was associated with level of depression and appeared to worsen with time since infection.[32] In both investigations, cognitive effects were independent of whether the subjects had been hospitalized during the acute phase of illness.[31,32] These findings are concerning, given the prevalence of cognitive impairment in our study population in 2022. For employees with Long COVID, this finding is consistent with those of other research.[3] The additional finding in our study of increased cognitive disability among workers who had not experienced Long COVID, including those who had not had COVID-19, may reflect under-ascertainment of COVID-19 and Long COVID among respondents, cognitive effects of worsening mental health during this time period,[33] or temporal changes in other domains related or unrelated to the pandemic.

Findings of previous research about the prevalence of Long COVID, as well as the impact of Long COVID on employment, vary by when the research was conducted, definitions of Long COVID (ascertainment criteria, including duration and severity of symptoms), study type, study population, and more.[3,34] Longitudinal data from the Understanding America Study suggest that as of June 2021, respondents with Long COVID whose condition affected their ability to work were more likely than other respondents to have altered their employment type (employed to self-employed or the converse) and that those with Long COVID had reduced their work week by an average of nearly 10 hours.[8] Data from a nationally representative cross-sectional survey with a shorter symptom duration threshold (≥4 weeks) found adults of working age with Long COVID were more likely to be out of the labor force due to health or disability than those who had been diagnosed with COVID-19 but did not have Long COVID (11% vs. 5%). In addition, 24% of respondents with Long COVID had limited their activities outside of work to keep working.[18,27]

Strengths of this study are that BRFSS is a nationally representative survey (although NJ and USVI were omitted from these analyses) that collects data from a large number of respondents, with more than 135,000 employed or self-employed respondents in 2019 and nearly 150,000 respondents in 2022 survey meeting inclusion criteria for this study. This large sample facilitates generation of reportable estimates even for many less common disabilities. While early pandemic closures of schools and business may have contributed to some of the adverse mental health findings, by 2022, most of these were again open in person. While the COVID-19 and Long COVID history measures are effectively cumulative in BRFSS, reflecting infections and sequelae from the start of the pandemic in the U.S. to the interview date, responses about disability and all well-being measures except diagnosed depression refer to the interview date. Thus 2022 responses for these items are less likely to reflect acute reactions to job loss and other events that were most common during the first 18 months of the pandemic.

This study has a number of limitations, foremost of which is the cross-sectional nature of the data. Most notably, temporal relationships between COVID-19 illness, the development of Long COVID symptoms, other health changes, and employment status, cannot be determined from this cross-sectional data set. Data were collected throughout 2022 and timing of infection was not collected; infections leading to Long COVID could be from wild-type SARS-CoV-2 or any variant present through the time of survey completion. Bias must also be considered. Adjustment for BMI category generally led to small decreases in aPRs, with loss of statistical significance for some functional disabilities; these changes concentrated among those with Long COVID who were unable to work. However, height or weight was missing for 11% of respondents. Moreover, height and weight, like all data in BRFSS, are self-reported. Self-reported height and weight are subject to bias; a variety of correction factors have been proposed,[35–38] with some including variables that are outcomes in the current study (e.g., self-rated health). As we did not include a correction factor in the secondary analyses adjusting for BMI category, our findings may underestimate the effects that would have been observed had BMI been calculated using regression-corrected height and weight. Respondents reporting Long COVID had the largest increases in prevalence of obesity and severe obesity compared to 2019 levels, and those reporting Long COVID who were unable to work comprised the employment status group with the highest prevalence of these conditions in both 2019 and 2022. Changes to well-being measures after adjustment for BMI category were not concentrated in a specific COVID-19/Long COVID or employment status category. The finding that aPRs decreased

somewhat across employment and COVID-19/Long COVID status after adjustment for BMI category may reflect the general increase in obesity between 2019 and 2022 reported by study respondents or additional risk conferred by elevated BMI for other chronic conditions,[39] functional disabilities[20] and adverse well-being,[21] or Long COVID.[18,19] The directionality of these association cannot be assessed in the context of this cross-sectional study. Regardless, the prevalence of disability and adverse well-being was elevated among respondents with Long COVID, even after this adjustment.

The trajectory of Long COVID is unclear; while the overall prevalence of symptoms decreases with time and some patients have slowly recovered, others experience remitting/relapsing symptoms and some develop new symptoms and conditions.[2,40–42] Alongside Long COVID, the consequences of both new SARS-CoV-2 infections and unrelated health problems may appear; while the former has been addressed in at least one longitudinal study,[42] both remain understudied. We do not know from the BRFSS data whether Long COVID symptoms are leading directly to disability, although other research has observed that significant activity limitations are common, reported by 26.4% of adults experiencing Long COVID in June 2023.[43] Similarly, the trajectory of workers through employment status (from employed/self-employed to unable to work, and, for some, re-entry to the workforce), the reasons for this trajectory (changes in Long COVID symptoms, other physical or mental health conditions, or economic conditions) could not be observed. Robust, longitudinal studies are needed to fully understand these trajectories and how to support all workers, particularly those with Long COVID. In addition, large, well-controlled studies designed to identify effective rehabilitation strategies for the multitude of symptoms in general and those that cause workplace limitations specifically are lacking, with existing studies often having limited sample sizes, strategies, endpoints, or follow-up, as well as substantial potential for bias in some cases.[44–46] Guidance from the American Academy of Physical Medicine and Rehabilitation on Long COVID symptoms and conditions provides updated strategies for addressing these issues.[47]

Information that could provide additional insight into the severity of Long COVID, as well as the impact of COVID-19 and Long COVID on work, was not collected by the survey. The functional disabilities ascertained in BRFSS are ascertained in each year's survey and are not specific to COVID-19. Moreover, they are dichotomous and are defined as serious impairment, rather than assessing a range of severity as in instruments developed for Long COVID such as the Post-Covid-19 Functional Scale (PCFS), although the latter does not differentiate types of limitations.[48] Questions related to mental health were limited to diagnosed depression, days of poor mental health, and activity limitations due to physical or mental health; anxiety, which has been associated with Long COVID,[49] was not assessed, nor was a standardized instrument such as the Patient Health Questionnaire-4[50] used.

The BRFSS data set lacks measures for "work ability" and does not differentiate between part-time and full-time employment. Some studies have found that workers with Long COVID are more likely to have reduced their hours, while others have found this to be the case only among those with Long COVID who say their health conditions impact work[8]; the current study could not explore this issue. Thus, while the extent of work limitations among respondents reporting disabilities is critical to understanding the impact on individuals and sustainability of an individual's return to work, as well as productivity,[13] these measures could not be assessed in this study. The possibility that Long COVID exacerbated pre-existing functional disabilities to the point of impacting labor market participation, working hours, or job performance could not be assessed.

Misclassification of COVID-19 and Long COVID histories is also of concern. Underascertainment of COVID-19 history in the BRFSS data is highly likely; while a seroprevalence survey of blood donors aged at least 16 years found that 70.3% had antibodies to SARS-CoV-2 from infection (with or without vaccination) as of June-September 2022,[51] self-reported prevalence of ever having had COVID-19 was less than half of that level among all 2022 BRFSS respondents (data not shown) and was 39.9% among participants included in our study. The availability of testing was limited during the early months of the pandemic, so asymptomatic or minimally symptomatic cases, particularly, may not have been screened or identified through medical care or testing, leading to misclassification into the "never had COVID-19" group. Misclassification did not disappear once tests were readily available, as testing might have been more or less likely based on workplace testing requirements, access to testing and other healthcare, cost of testing, and level of concern about COVID-19. Long COVID may have been underreported among respondents who did not realize they had COVID-19 and therefore may not have attributed persistent symptoms to Long COVID. Respondents who knew they had had COVID-19 also may have underreported Long COVID. In addition, some respondents would not have accrued 3 months postinfection when completing the survey, although they might be experiencing symptoms that limit daily activities or decrease well-being. Others with mild Long COVID symptoms that have resolved may not recall or have identified the experience as Long COVID. At the same time, some respondents reporting Long COVID may have symptoms that started after they had COVID-19 but are attributable to other health conditions. However, the marked differences in well-being and disability observed between those who did and did not report Long COVID are apparent despite any misclassification. History of COVID-19 vaccinations was only asked in an optional module of the 2022 BRFSS survey and thus was not available for the majority of respondents and could not be accounted for, and no information about treatment during acute COVID-19 illness was collected. Longitudinal studies with data on functional disabilities and well-being metrics from 2019 and continuing ascertainment of these metrics and infection and symptom status after the emergence of SARS-CoV-2 are needed to confirm and further elucidate these findings.

Staying up to date with immunization against SARS-CoV-2 has been shown to reduce the risk of developing Long COVID,[52,53] and administration of approved antivirals soon after infection has been shown in some studies to have a mitigating effect, although the estimated benefit differs by study population and many other variables.[2,53–55] Efforts to prevent transmission of airborne respiratory viruses can reduce long-term sequelae, as well as the number of acute cases. Continued support, including social and economic support, for layered mitigation strategies such as provision of flexible, nonpunitive paid sick leave, ventilation and

filtration, and the use of masks and respirators can help to reduce workplace transmission.[56–58] While an economic analysis is beyond the scope of this research, some costs of these control strategies may be recoverable if they offset increased workplace costs stemming from an increased prevalence of adverse mental health outcomes and disabilities among those reporting Long COVID. Some costs of providing adequate sick leave so that workers who are infectious can stay home to reduce workplace transmission and so those who are ill can recover adequately may be recouped as well. An analysis of Household Pulse Survey data from Fall 2022-Spring 2023 found increased difficulty with household expenses, being behind on housing payments, and being at risk for eviction or foreclosure among those with Long COVID compared to respondents with a history of COVID-19 but not Long COVID.[59] Elevations were particularly pronounced among respondents of lower socioeconomic status and those with functional limitations. These findings point to additional personal and social costs of Long COVID. An analysis of 2022 National Health Interview Survey (NHIS) data noted that respondents with Long COVID were more likely than respondents without Long COVID to defer or not receive needed medical care, therapy, and prescriptions due to cost.[60] Other potential economic benefits of reduced transmission may include reduced medical and productivity costs associated with other post-acute sequelae of COVID-19 ranging from newly diagnosed type 2 diabetes[61] and dementia[62] to increased risk of cardiovascular disease.[63] An examination of NHIS data found that people who have Long COVID and cardiovascular disease miss more than twice as many workdays as respondents with cardiovascular disease but not Long COVID. Results were similar among respondents with cancer and diabetes; smaller elevations were observed among those with asthma and COPD. However, the cross-sectional design precluded identification of whether diagnoses of chronic conditions preceded or followed COVID-19 diagnosis.[18] These findings further highlight the need to prevent Long COVID and support those already diagnosed.

While research suggests that infection with an omicron SARS-CoV-2 variant may be less likely to lead to Long COVID than infection with wild-type SARS-CoV-2 or previous common variants[2,53,64] and that vaccination decreases risk of Long COVID,[53] the overall number of Long COVID cases is unlikely to decline in the context of high levels of infections.[55] Year-round infections continue, with two or more surges per year apparent from wastewater surveillance.[65]

5 | CONCLUSIONS

Overall well-being among adults of prime working age was worse and many functional disabilities more prevalent in 2022 compared to 2019, with the most pronounced changes occurring among those reporting a history of Long COVID. These findings highlight the need to improve the well-being of the workforce, regardless of Long COVID history, and the need for more research into the prevention and treatment of Long COVID. In the interim, given the activity limitations and decreased well-being associated with Long COVID observed in this study, critical needs include identification and implementations of tailored workplace accommodations to support current employees and facilitate future employment among jobseekers with Long COVID.

AUTHOR CONTRIBUTIONS

Sharon Silver conceived the paper. Jia Li conducted the analyses. All authors participated in (a) interpretation of the data; (b) drafting the article or revising it critically for important intellectual content; and (c) approval of the final version. All authors approved the version to be published.

CONFLICTS OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DISCLOSURE BY AJIM EDITOR OF RECORD

John Meyer declares that he has no conflict of interest in the review and publication decision regarding this article.

INSTITUTION AND ETHICS APPROVAL AND INFORMED CONSENT

The BRFSS study protocol was reviewed and approved by institutional Review Board at CDC.

DATA AVAILABILITY STATEMENT

BRFSS data are publicly available at https://www.cdc.gov/brfss/index.html.

DISCLAIMER

The findings and conclusions presented in this article are those of the authors and do not necessarily represent the views of the National Institute for Occupational Safety and Health and the Centers for Disease Control and Prevention.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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