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RESEARCH ARTICLE

Depressive Symptoms and Perception of COVID-19 Risk in Ohio Adults

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ABSTRACT

Background: We assessed the relationship between depressive symptoms and perceived COVID-19 risk in the next month.

Methods: This analysis used survey data collected during a July 2020 cross-sectional study using a household-based probability sampling design. A total of 615 noninstitutionalized, English- and/or Spanish-speaking adults in Ohio were included. Depressive symptoms screening occurred using the Patient Health Questionnaire-2 (PHQ-2). We applied survey weights so that presented analyses represent the adult population in Ohio. We performed log-risk regression modeling (generalized linear model with binomial distribution and log link) to estimate unadjusted and covariate-adjusted prevalence ratios examining the association between screening positive for depressive symptoms and perceived risk of COVID-19 in the next month.

Results: The study population was majority female (59.1%) and White (90.3%). The mean age was 55.9 years (standard deviation (SD)=17.3). About 1 in 20 (4.6%) screened positive for depressive symptoms. A positive depressive symptoms screen was not significantly associated with perceived risk of COVID-19 in the next month (prevalence ratio [PR]=0.75; 95% confidence interval [CI]=0.25–2.24). After confounder adjustment, the adjusted prevalence ratio (aPR) was nearly unchanged (aPR=0.78; 95% CI=0.24–2.55).

Conclusion: As depression is often associated with anxiety and pessimism toward the future, the lack of association between depressive symptoms screening and perception of COVID-19 risk in the next month is surprising. Social withdrawal, which is also associated with depression, may have concealed any increased perceived COVID-19 risk, as depressed individuals who remained socially isolated may have had lower perceived COVID-19 risk.

Keywords: COVID-19; Depressive symptoms; PHQ-2; Risk perception

INTRODUCTION

The COVID-19 pandemic has been associated with reduced mental health, including feelings of stress, isolation, and loneliness for many people,[1,2] and a rise in mental illnesses, such as depression.[3] Stay-at-home orders, lockdowns, and social distancing requirements restricted activities in ways never previously experienced by most people alive today. Many continue to endure financial strains from a slowed economy and emotional crises after the deaths of loved ones. In nationally representative data from the United States, the prevalence of depression symptoms was 3-fold higher during the COVID-19 pandemic compared to 2 years before the pandemic.[4]

Globally, depression (characterized by a continual feeling of sadness and a loss of interest in typical life activities[5]) is one of the most common mental health disorders, with nearly 300 million people affected.[6] In the United States in 2019, about 5% of adults experienced regular feelings of depression.[7] Depression is also associated with symptoms of hopelessness and anxiety.[5] These feelings can lead to a general negative outlook on life, including negative attitudes toward the future.[8] One Lebanese study found

these pessimistic emotions to be closely linked with cynical feelings of impending doom during the COVID-19 pandemic.[9] A sense of impending doom can often occur while catastrophizing[10], defined as imagining worst-case scenarios for the future.[11] People who catastrophize generally overestimate their risk for a negative outcome,[12] such as COVID-19. In China, a depressive state was associated with increased perceived COVID-19 risk.[13] Our study sought to examine this association in the United States in the state of Ohio.

Perception of risk for disease during an outbreak is also correlated with how well one follows outbreak-related guidelines.[14] Therefore, we aimed to examine the relationship between screening positive for depressive symptoms and perception of risk of COVID-19 in the next month, as this relationship could impact the success of pandemic control measures. No other study to our knowledge has examined this relationship in Ohio or the United States generally. Using data from a cross-sectional, population-representative study of Ohio adults conducted in July 2020, we characterized the association between screening positive for depressive symptoms (using the validated Patient Health Questionnaire-2 (PHQ-2)) and perceived risk of COVID-19 in the next month.

METHODS

Study Setting and Design

This cross-sectional study was conducted in July 2020 in the state of Ohio.

Study Sample

We selected the sample using probability-proportionate-to-size cluster sampling (PPS-CS). This sampling method is described in detail elsewhere.[15,16] We sampled 30 census tracts from within each of Ohio's 8 planning regions.[17] From each census tract, we planned to enroll 5 households. Using a marketing database, and to account for expected refusal, we randomly selected a total of 50 household addresses within each sampled census tract to approach for recruitment. Only single- and multi-unit residential addresses were eligible. Post office box addresses were excluded due to the household recruitment design.

Overall, 11 974 households were selected for potential recruitment using PPS-CS, although not all were approached (see Analytic Sample under Results). Persons eligible for study inclusion were noninstitutionalized, English- and/or Spanish-speaking adults in Ohio capable of providing informed consent. In total, 727 people enrolled in the study. As this analysis investigates the relationship between depressive symptoms screening and perception of COVID-19 risk in the next month, only the 615 participants with complete data for these variables (84.6% of the enrolled sample) were included in the analysis.

Recruitment

All staff wore personal protective equipment during fieldwork. To notify selected households about the opportunity for participation, as well as how to opt out, we mailed a postcard to each home. A household was able to opt out either by declining to participate when a study team visited, by emailing, calling, or texting staff, or by filling out a web form. In the days before the study team planned to visit, the household received an invitation letter providing more detail on study procedures and timeframe.

For safety purposes, field staff visited selected households in pairs. Staff were trained on administering informed consent and the study survey through the Research Electronic Data Capture (REDCap) system.[18,19] All staff underwent COVID-19 polymerase chain reaction (PCR) testing prior to entering the field.

A team of 2 recruiters visited each sampled household to confirm an eligible adult was present. If no adult was home, the team left an informational letter, including an estimated time that they would return. In the first region, a team then attempted another visit, and if again no adult was home, recruiters left a letter with details about a future final visit attempt. All visit attempts took place at different times on different days. If no adult was home after the third attempt, recruiters moved on to another household. Repeated visit attempts in that region were found not to increase recruitment: nearly every person who enrolled in the study did so with the first visit attempt. Therefore, in the remaining regions, if no adult was home during the initial recruiter visit attempt, the team left a flier inviting an adult to contact the study if the household wanted to participate. No further household visit attempts occurred if the household did not contact study staff.

Recruiters recorded the name and birth year for all eligible adults in the household (defined as having slept at least 4 of the last 7 days in the household). If more than 1 adult lived in the household, recruiters randomly selected 1 adult to participate. If the selected adult was home, recruiters asked if this adult was willing to participate. Partial participation was not allowed; the sampled adult had to agree to participate in both the survey and full sample collection (blood and nasopharyngeal swab) to be eligible. If the selected adult declined to participate, recruiters did not sample another adult from the household. Instead, recruiters moved on to the next sampled household.

Data Collection

The field team administered a 10-minute survey via REDCap. The survey gathered information on demographics, symptoms of respiratory illness, history of COVID-19 testing, social distancing and other behavioral practices, the PHQ-2, and other topics.

Data Analysis

All analyses account for the PPS-CS design by applying survey weights, such that all presented analyses represent the adult pop-

ulation in Ohio. We used Stata (IC 16) software for all statistical analyses.

We performed log-risk regression modeling (generalized linear model with binomial distribution and log link) to estimate unadjusted and covariate-adjusted prevalence ratios examining the association between screening positive for depressive symptoms and perceived risk of COVID-19 in the next month. The outcome was captured through the survey item, "how likely do you think you are to get COVID-19 in the next month?" Responses included very likely, likely, unlikely, or very unlikely. For analysis, we collapsed responses into 2 categories: unlikely and likely. Responses of "don't know" (n=100) or "declined to answer" (n=2) were excluded. We defined the primary exposure, positive depressive symptoms screen, using the composite score on the PHQ-2, coded dichotomously (negative/positive). Prior work demonstrates that major depressive disorder is likely with PHQ-2 scores of 3 or higher[20]; thus, we dichotomized PHQ-2 scores as < 3 vs 3 or greater. We determined the minimally sufficient adjustment set for the analysis using a directed acyclic graph (DAG), which is most often used for causal relationships but can also aid in visualizing associations between potential confounding variables and the exposure and outcome of interest.[21,22] We selected covariates to include in the DAG based on existing literature[23-34] and hypothesized plausible associations between the exposure, outcome, and covariates.

The minimally sufficient adjustment set included age, gender, race, education, marital status, self-rated health, work status, social distancing behavior, number of adults in the household, and number of children in the household. We performed some consolidation of survey item response categories when including covariates in the regression model: age was coded continuously, race (Black/African American vs non-Black/African American), education (completed high school or less vs completed at least some postsecondary education), marital status (married vs not married), number of adults in the household (1 adult vs 2 or more adults), and number of children in the household (no children vs 1 or more children). Work status combined data on employment and retirement.

We also assessed whether social distancing behavior modified the association between depressive symptoms and perceived COVID-19 risk in the next month. We assessed for modification first using Pearson's chi-square tests with correction for the PPS-CS design. For variables which appeared to be significant modifiers, we then examined the magnitude of the association between depressive symptoms and perceived COVID-19 risk within levels of the putative modifier. We examined both ratio measures, to identify multiplicative interaction, and difference measures, to identify additive interaction. We added 0.1 to each cell in any contingency table originally containing a zero cell to permit computation and comparison of stratified measures of effect. We repeated this approach for 8 social distancing behaviors over 2 time periods: the past 30 days and during the stay-at-home period from March 15, 2020, to May 25, 2020 (Table 1).

Finally, we performed a sensitivity analysis to assess the robustness of our findings to changes in PHQ-2 score cut-points. We repeated the analyses as previously described but using a PHQ-2 score cut-point of 2 or greater (whereas the primary analysis had used a PHQ-2 cut-point of 3 or greater), which enhances the sensitivity of the PHQ-2.

RESULTS

Analytic Sample

Of 11 974 households selected for potential participation which received postcards and invitation letters, 415 letters were returned as undeliverable, and 1482 households opted out by email, phone, or webform. Of the remaining households, 5347 were not visited because the target enrollment was met for the census tract

Table 1. Survey Items Used to Investigate Social Distancing as a Potential Modifier of the Effect of Positive Depressive Symptoms Screen on Perceived COVID-19 Risk in Next Month

Survey Item
During the past 30 days, I have stayed home except for going outdoors to exercise, or going to the grocery store, pharmacy, or to get other needed supplies, or getting medical care.[a]
During the stay-at-home period from March 15 to May 25, I stayed home except for going outdoors to exercise, or going to the grocery store, pharmacy, or to get other needed supplies, or getting medical care.
During the past 30 days, I have avoided visiting friends, neighbors, or relatives who don't live with me.
During the stay-at-home period from March 15 to May 25, I avoided visiting friends, neighbors, or relatives who didn't live with me.
During the past 30 days, I have avoided letting friends, neighbors, or relatives who don't live with me come into my home.
During the stay-at-home period from March 15 to May 25, I avoided letting friends, neighbors, or relatives who didn't live with me come into my home.
During the past 30 days, have you attended any gatherings, not including work, with more than 10 people who do not live in the same house as you?
During the stay-at-home period from March 15 to May 25, did you attend any gatherings, not including work, with more than 10 people who did not live in the same house as you?

[a]Social distancing was found to be a potential effect measure modifier in the primary exposure-outcome relationship only when defining social distancing by response to this survey item.

or due to staffing limitations. Therefore, 4730 households were visited in person. After visiting, 585 addresses were considered ineligible due to being vacant/abandoned, inaccessible, a duplicate address, a nonresidential address, or if no adult was home, there was a language barrier, or the selected adult was not competent to consent. Ultimately, 727 households enrolled, resulting in a response rate of 18.5%. The present analysis included n=615 (84.6% of the enrolled sample).

Participant Characteristics

All frequencies and means are weighted to represent Ohio adults. Participant age ranged from 18 to 97 years. The mean age was 55.9 years (standard deviation [SD]=17.3). Most (59.1%) were female. Regarding race and ethnicity, 5.9% reported Black/African American race, 90.3% reported White race, 1.4% reported Asian race, 0.6% reported Native American/American Indian/Alaskan Native race, and 2.6% reported Hispanic/Latinx/Spanish ethnicity. Nearly all (95.3%) had completed high school or additional education. Approximately half (52.2%) were married, but 16.8% were never married. Of those who were not retired, most (59.4%) were employed full-time, and 31.6% were unemployed. Overall, 70% of those who were not employed were retired. Nearly all (94.8%) had health insurance. A plurality (38.2%) self-reported very good health, with only 3.3% reporting poor health. Most (54.0%) reported 2 adults in their household, and 72.2% reported no children in the household. Approximately two-thirds (68.7%) reported they had stayed home during the past 30 days except for going outdoors to exercise, or going to the grocery store, pharmacy, or to get other needed supplies, or getting medical care (Table 2).

We generally observed few differences between those who believed they were likely to get COVID-19 in the next month and those who believed they were unlikely to get COVID-19 in the next month (Table 2). However, about half (48.9%) of those who believed they were likely to get COVID-19 in the next month had no children in the household, compared to three-fourths (75.2%) of those who believed they were unlikely to get COVID-19 in the next month who reported no children in the household. Additionally, 57.7% of those who believed they were likely to get COVID-19 in the next month reported they had stayed home during the past 30 days except for going outdoors to exercise, or going to the grocery store, pharmacy, or to get other needed supplies, or getting medical care, but 70.1% of those who believed they were unlikely to get COVID-19 in the next month reported they had stayed home during the past 30 days. Further, 38.0% of those who believed they were likely to get COVID-19 in the next month reported being in good health, whereas 29.0% of those who believed they were unlikely to get COVID-19 in the next month reported good health. Of those who were not employed, less than half (42.0%) who believed they were likely to get COVID-19 in the next month were retired, compared to approximately three-quarters (72.5%) who believed they were unlikely to get COVID-19 in the next month who were retired (Table 2). The mean age of those who believed they were likely to get COVID-19 in the next month was 44.9 years (SD=17.8), and the mean age of those who believed they were unlikely to get COVID-19 in the next month was substantially older, at 57.3 years (SD=16.7).

Depressive Symptoms Screening and Perceived Risk of COVID-19 in the Next Month

About 1 in 20 (4.6%) screened positive for depressive symptoms. A positive depressive symptoms screen was not significantly associated with perceived risk of COVID-19 in the next month. Overall, 11.7% believed they were likely to get COVID-19 in the next month, including 8.8% who screened positive for depressive symptoms and 11.8% who screened negative for depressive symptoms (corrected Pearson's chi-squared test *p* value=0.59).

This finding was reinforced in the log-linear model, which generated an unadjusted prevalence ratio (PR) of 0.75 (95% confidence interval [CI]=0.25–2.24) for the association between positive depressive symptoms screen and believing one is likely to acquire COVID-19 in the next month. After adjustment for age, gender, race, education, marital status, self-rated health, work status, social distancing behavior, number of adults in the household, and number of children in the household, the adjusted prevalence ratio (aPR) was nearly unchanged (aPR=0.78; 95% CI=0.24–2.55) (Table 3).

Social Distancing as a Potential Effect Measure Modifier

Of the 8 social distancing measures, we observed modification of the primary association of interest by 1 measure ("during the past 30 days, I have stayed home except for going outdoors to exercise, or going to the grocery store, pharmacy, or to get other needed supplies, or getting medical care" (*p* value>4.46)). The PR for the association between depressive symptoms and perceived COVID-19 risk in the next month for those who reported staying home was 1.03 (95% CI=0.34–3.15), whereas for those who did not report staying home, the PR was 0.16 (95% CI=0.00–73.70), providing evidence of modification on the multiplicative scale. We did not observe meaningful differences in the prevalence difference measures and conclude that there was no interaction on the additive scale.

Sensitivity Analysis

The association between screening positive for depressive symptoms and perceived COVID-19 risk in the next month was sensitive to a change in PHQ-2 score cut-point. When using a PHQ-2 score cut-point of 2 or greater to indicate a positive depressive symptoms screen, 11.7% screened positive for depressive symptoms. (In contrast, in the primary analysis that used a PHQ-2 score cut-point of 3 or greater, 4.6% screened positive for depressive symptoms (Table 2).) When using a PHQ-2 score cut-point of 2 or greater, the unadjusted PR was attenuated compared to the primary analysis (PR=1.02, 95% CI=0.49–2.10). The adjusted PR in the sensitivity analysis was similarly attenuated (aPR=1.12, 95% CI=0.52–2.43) (Table 3).

Table 2. Characteristics of a Cross-sectional Sample (Overall and According to Perception of Likelihood to Get COVID-19 in the Next Month) of Ohio Adults in July 2020

	Total (*N=615*)		Believed they were **likely** to get COVID-19 in next month (*N=84*)		Believed they were **unlikely** to get COVID-19 in next month (*N=531*)	
	N	Weighted %	N	Weighted %	N	Weighted %
Depressive Symptoms Screen[a]						
Negative	579	95.4	80	96.5	499	95.3
Positive	36	4.6	4	3.5	32	4.7
Age						
18 – 29 years	56	10.0	16	25.4	40	8.0
30 – 39 years	75	13.0	16	20.5	59	12.0
40 – 49 years	59	8.8	11	12.3	48	8.4
50 – 59 years	107	17.0	16	15.5	91	17.2
60 – 69 years	172	27.6	15	14.6	157	29.3
70 – 79 years	112	19.0	7	8.2	105	20.4
80 – 89 years	26	3.7	3	3.6	23	3.7
90 – 97 years	8	0.8	0	0.0	8	1.0
Gender						
Male	253	41.0	30	34.8	223	41.8
Female	361	59.1	54	65.2	307	58.2
Nonbinary	0	0.0	0	0.0	0	0.0
Other gender identity	0	0.0	0	0.0	0	0.0
Missing	1		0		1	
Race/Ethnicity[b]						
Black/African American	29	5.9	6	6.6	23	5.8
White	565	90.3	72	82.2	493	91.3
Asian	6	1.4	1	2.2	5	1.3
Native American/American Indian/Alaskan Native	4	0.6	2	2.2	2	0.3
Native Hawaiian/Pacific Islander	0	0.0	0	0.0	0	0.0
Missing	3		0		3	
Hispanic/Latinx/Spanish	14	2.6	4	7.9	10	1.9
Missing	3		0		3	
Education						
Less than first grade	0	0.0	0	0.0	0	0.0
First through eighth grade	2	0.2	0	0.0	2	0.3
Some high school, but no diploma	20	4.5	7	9.5	13	3.8
High school graduate or equivalent	178	29.2	20	23.5	158	29.9
Some college, but no degree	110	16.7	10	12.9	100	17.2
Associate degree	76	12.3	13	14.1	63	12.1
Four-year college graduate/bachelor's degree	125	20.4	17	22.5	108	20.1
Advanced degree	102	16.7	17	17.5	85	16.6
Missing	2		0		2	
Marital Status						
Married	326	52.2	38	46.3	288	53.0
Not married but living with partner	48	8.0	7	8.7	41	7.9
Widowed	62	8.7	5	5.6	57	9.1
Divorced/annulled	82	12.7	10	10.1	72	13.1
Separated	8	1.6	5	4.9	3	1.1
Never married	88	16.8	18	24.4	70	15.8
Missing	1		1		0	
Employment Status[c]						
Employed full-time	199	59.4	37	58.0	162	59.7
Employed part-time	32	9.0	6	11.4	26	8.5
Unemployed	108	31.6	22	30.6	86	31.8
Missing	276		19		257	
Retirement Status[d]						
Not retired	108	30.0	22	58.0	86	27.5
Retired	252	70.0	16	42.0	236	72.5
Missing	255		46		209	
Health Insurance Status						
Insured	581	94.8	76	91.0	505	95.3
Uninsured	33	5.2	8	9.0	25	4.7
Missing	1		0		1	

Table 2 (continued). Characteristics of a Cross-sectional Sample (Overall and According to Perception of Likelihood to Get COVID-19 in the Next Month) of Ohio Adults in July 2020

		Total (*N=615*)		Believed they were **likely** to get COVID-19 in next month (*N=84*)		Believed they were **unlikely** to get COVID-19 in next month (*N=531*)	
		N	Weighted %	N	Weighted %	N	Weighted %
Self-Rated Health Status							
Excellent		106	17.0	13	16.0	93	17.2
Very good		230	38.2	26	33.7	204	38.8
Good		187	30.1	30	38.0	157	29.0
Fair		67	11.4	11	10.2	56	11.5
Poor		23	3.3	4	2.0	19	3.5
Missing		2		0		2	
Adults in the Household							
1 Adult		209	33.7	32	34.2	177	33.7
2 Adults		337	54.0	41	52.1	296	54.3
3 Adults		39	6.6	5	5.5	34	6.7
4 Adults		22	3.9	4	6.3	18	3.6
5 Adults		6	1.5	2	1.9	4	1.5
6 Adults		0	0.0	0	0.0	0	0.0
7 Adults		0	0.0	0	0.0	0	0.0
8 Adults		1	0.2	0	0.0	1	0.3
9 Adults		0	0.0	0	0.0	0	0.0
10+ Adults		0	0.0	0	0.0	0	0.0
Missing		1		0		1	
Children in the Household							
No Children		450	72.2	45	48.9	405	75.2
1 Child		70	11.0	18	19.5	52	9.9
2 Children		53	10.6	13	23.6	40	8.9
3 Children		28	4.6	4	6.3	24	4.4
4 Children		7	1.1	0	0.0	7	1.2
5+ Children		3	0.6	1	1.7	2	0.4
Missing		4		3		1	
Social Distancing Behavior							
During the stay-at-home period…	I stayed home	516	83.7	70	81.8	446	84.0
	I avoided visiting others	470	77.2	69	84.8	401	76.1
	I avoided letting others into my home	459	78.1	64	79.3	395	78.0
	I attended gatherings	76	13.1	10	10.8	66	13.4
During the past 30 days…	I have stayed home	416	68.7	49	57.7	367	70.1
	I have avoided visiting others	319	53.3	44	46.3	275	54.2
	I have avoided letting others into my home	349	61.3	43	50.2	306	62.8
	I have attended gatherings	218	36.2	33	49.3	185	34.5

[a]Depressive symptoms screen was performed using the Patient Health Questionnaire-2 (PHQ-2).
[b]Race/ethnicity was select all that apply. Therefore, the values shown do not add up to our sample size of 615 and column percentages do not add up to 100%.
[c]Participants who reported they were retired were excluded from our employment status variable and categorized as missing.
[d]Those who reported they were employed were excluded from our retirement status variable and categorized as missing.

DISCUSSION

Depression is often associated with feelings of anxiety and pessimism toward the future.[5,8] In this study, we investigated the relationship between screening positive for depressive symptoms and perception of COVID-19 risk among Ohio adults in July 2020, a period of increased transmission and prior to the availability of COVID-19 vaccinations. We found that perception of COVID-19 risk in the next month was not significantly different for participants who screened positive for depressive symptoms compared to participants who screened negative for depressive symptoms.

Our sensitivity analysis further confirmed a lack of association between depressive symptoms screening and perception of COVID-19 risk in the next month, as was observed in our primary analysis. When we examined the primary exposure-outcome relationship using a decreased PHQ-2 score cut-point compared to that used in the primary analysis, we still obtained a null association, even though we had expanded the definition for positive depressive symptoms screen to capture more participants in this category.

In some people, depression can lead to social withdrawal, which is when a person minimizes their social contact and activity.[35] Social withdrawal may lead to increased time spent at home to keep away from others—thereby lowering potential exposure to SARS-CoV-2. Even if some participants who screened positive for depressive symptoms had increased perceived risk of COVID-19

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Table 3. Unadjusted and Adjusted Prevalence Ratios and 95% Confidence Intervals for the Association Between Positive Depressive Symptoms Screen and Believing One is Likely to Get COVID-19 in the Next Month[a]

	Primary Analysis[b]				Sensitivity Analysis[c]			
	Unadjusted		Adjusted		Unadjusted		Adjusted	
	PR	95% CI	PR	95% CI	PR	95% CI	PR	95% CI
Depressive Symptoms Screen								
Negative	1.		1.		1.		1.	
Positive	0.75	0.25–2.24	0.78	0.24–2.55	1.02	0.49–2.10	1.12	0.52–2.43

PR=prevalence ratio, 95% CI=95% confidence interval
[a]The adjusted PR was adjusted for age, gender, race, education, marital status, self-rated health, work status, social distancing behavior, number of adults in the household, and number of children in the household.
[b]The primary analysis was performed using a Patient Health Questionnaire-2 (PHQ-2) score cut-point of 3 or greater to indicate a positive depressive symptoms screen.
[c]Sensitivity analysis values were generated using a PHQ-2 score cut-point of 2 or greater to indicate a positive depressive symptoms screen.

compared to those who screened negative, others may have believed their COVID-19 risk to be low because of social isolation, and the cumulative effect of these influences may have led to our null finding. Our findings suggest that social distancing has a complex role in modifying the association between depressive symptoms and perceived COVID-19 risk.

As COVID-19 is a novel disease, the relationship between depressive symptoms and COVID-19 risk perception has been studied infrequently. Most related studies[36–38] have concentrated on investigating the opposite association: the effect of perceived risk of COVID-19 on depression and overall mental health during the pandemic. However, a study performed by Zhong et al (2020) in Wuhan, China, found depressive states to be positively related to perception of COVID-19 risk.[13] The disagreement between our findings and the results of the Zhong et al (2020) study may be explained by design differences between the 2 projects. Eligible participants in the Zhong et al (2020) study were current COVID-19 patients in Wuhan, China, whereas our study included noninstitutionalized, English- and/or Spanish-speaking adults in Ohio, United States. Additionally, the Zhong et al (2020) study took place in February 2020, only 2 months after COVID-19 was first reported in Wuhan, China.[39] Our study occurred in July 2020, approximately 4 months after COVID-19 was declared a pandemic and confirmed cases began to appear in Ohio.[40,41] Consequently, those with depressive symptoms in Wuhan may have perceived COVID-19 as a greater threat because the Zhong et al (2020) study occurred very soon after the COVID-19 outbreak began in Wuhan. At this early stage, the feelings of anxiety and negative attitudes about the future that are often associated with depression[5,8] were likely elevated in Wuhan study participants. In Ohio, participants with a positive depressive symptoms screen in July 2020 may have perceived a somewhat lower likelihood to get COVID-19 compared to those depressed in Wuhan because social distancing guidelines had been in place already for several months. Zhong et al (2020) also assessed risk perception of COVID-19 in the next year, whereas we assessed risk perception of COVID-19 only in the next month. Finally, Zhong et al (2020) used a modified version of the 20-item Hopkins Symptom Checklist Depression Scale,[42,43] and we used the PHQ-2 to screen for depressive symptoms. It is important to note that the PHQ-2 is a limited assessment measure that only screens for depressive symptoms through 2 questions. We did not incorporate any component of clinical diagnosis of depression.

As the data were collected in July 2020 during one of the earliest peaks of the COVID-19 pandemic, the applicability of our findings to this multi-year pandemic overall may be limited.

Selection bias may be another potential limitation of our study. It is possible that participants who decided to enroll were more concerned about their health than the average Ohioan and viewed COVID-19 to be a more serious disease than other adults in Ohio. Selection bias may also have resulted from the exclusion of adults who were institutionalized or non-English/non-Spanish speaking. Further, selection bias may be an issue as the participants excluded from study analyses differed in some measured characteristics from the participants kept in analyses. Out of the 727 initial participants that enrolled in the study, approximately 15% were excluded from this analysis because they were missing data for the survey question assessing risk perception for COVID-19 in the next month. We found that those included and excluded from analysis differed in (White) race (90.3% vs 81.3% White race, respectively), education (0.2% vs 5.1% first through eighth grade education), retirement status (70.0% vs 53.7% retired), and social distancing behavior (68.7% vs 50.8% stayed home during the past 30 days) (Appendix I). It is possible that these 2 groups may differ in other unmeasured characteristics as well. Additionally, the study sample was less racially diverse (90.3% (study) vs 81.7% (Ohio) White race) and more educated (37.1% (study) vs 28.9% (Ohio) with a bachelor's degree or higher) compared to the general population in Ohio.[44]

We have explored the relationship between depressive symptoms and risk perception of COVID-19 in the United States. Our analysis showed that perception of COVID-19 risk in the next month was unrelated to depressive symptoms screening status among Ohio adults in July 2020. As depression is often associated with anxiety and pessimism toward the future,[5,8] the lack of association was surprising. However, social withdrawal may partly explain this result.

PUBLIC HEALTH IMPLICATIONS

This study is the first of which we are aware to examine the relationship between depressive symptoms and risk perception of

COVID-19 in Ohio or the United States generally. The null association observed in this study between screening positive for depressive symptoms and perception of COVID-19 risk in the next month is an important finding for several reasons.

Perception of risk for disease during an outbreak is often a measure of how well one will follow recommended outbreak safety guidelines.[14] Since lower perception of disease risk often indicates a decreased likelihood to follow outbreak safety recommendations,[14] those with depression *may* be less likely to adhere to safety guidelines during an outbreak. We cannot say for certain whether those with depression truly are less likely to adhere to safety recommendations during an outbreak because reduced risk perception for COVID-19 does not necessarily indicate a lack of awareness about COVID-19. As previously mentioned, depression can present in the form of social withdrawal.[35] Thus, it is possible that those who are depressed may take outbreak safety guidelines (including social distancing) extremely seriously if they are already homebound from depression and could consequently have lower perceived COVID-19 risk. Therefore, social withdrawal could have masked any increased perceived COVID-19 risk in this study.

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APPENDIX I. Comparison of characteristics between study respondents who were included compared to excluded from analysis[a]

	Total Respondents (*N=727*)		Respondents who were excluded from analysis (*N=112*)		Respondents who were Included in analysis (*N=615*)		
	N	Weighted %	N	Weighted %	N	Weighted %	*p* value
Depressive Symptoms Screen[b]							0.101
Negative	671	94.8	92	91.1	579	95.4	
Positive	45	5.2	9	8.9	36	4.6	
Missing	11		11		0		
Gender							0.724
Male	295	41.3	42	43.2	253	41.0	
Female	425	58.7	64	56.8	361	59.1	
Nonbinary	0	0.0	0	0.0	0	0.0	
Other gender identity	0	0.0	0	0.0	0	0.0	
Missing	7		6		1		
Race/Ethnicity[c]							
Black/African American	33	5.5	4	3.4	29	5.9	0.299
White	659	88.9	94	81.3	565	90.3	**0.028**
Asian	8	1.7	2	3.5	6	1.4	0.251
Native American/American Indian/Alaska Native	4	0.5	0	0.0	4	0.6	0.437
Native Hawaiian/Pacific Islander	0	0.0	0	0.0	0	0.0	---
Missing	4		1		3		
Hispanic/Latinx/Spanish	20	3.2	6	6.9	14	2.6	0.052
Missing	4		1		3		
Education							**0.001**
Less than first grade	0	0.0	0	0.0	0	0.0	
First through eighth grade	6	1.0	4	5.1	2	0.2	
Some high school, but no diploma	23	4.2	3	3.0	20	4.5	
High school graduate or equivalent	214	29.7	36	32.5	178	29.2	
Some college but no degree	129	16.8	19	17.1	110	16.7	
Associate degree	88	12.0	12	9.3	76	12.3	
Four-year college graduate/bachelor's degree	149	21.0	24	24.2	125	20.4	
Advanced degree	111	15.5	9	8.2	102	16.7	
Missing	7		5		2		
Marital Status							0.380
Married	388	52.4	62	53.2	326	52.2	
Not married but living with a partner	53	7.1	5	2.2	48	8.0	
Widowed	72	9.1	10	11.3	62	8.7	
Divorced/annulled	98	13.4	16	17.1	82	12.7	
Separated	8	1.3	0	0.0	8	1.6	
Never married	102	16.7	14	16.2	88	16.8	
Missing	6		5		1		
Employment Status[d]							0.308
Employed full-time	234	57.4	35	48.0	199	59.4	
Employed part-time	42	9.7	10	12.9	32	9.0	
Unemployed	133	32.9	25	39.1	108	31.6	
Missing	318		42		276		
Retirement Status[e]							**0.041**
Not retired	133	32.4	25	46.3	108	30.0	
Retired	285	67.6	33	53.7	252	70.0	
Missing	309		54		255		
Health Insurance Status							0.938
Insured	682	94.8	101	94.6	581	94.8	
Uninsured	39	5.2	6	5.4	33	5.2	
Missing	6		5		1		
Self-Rated Health Status							0.948
Excellent	127	17.0	21	16.8	106	17.0	
Very good	270	37.9	40	36.1	230	38.2	
Good	214	30.1	27	30.4	187	30.1	
Fair	82	11.4	15	11.6	67	11.4	
Poor	27	3.6	4	5.2	23	3.3	
Missing	7		5		2		
Adults in the Household							0.170
1 Adult	249	34.5	40	38.9	209	33.7	
2 Adults	390	52.3	53	43.0	337	54.0	
3 Adults	52	7.6	13	13.3	39	6.6	
4 Adults	24	3.6	2	1.8	22	3.9	
5 Adults	9	1.7	3	2.9	6	1.5	
6 Adults	0	0.0	0	0.0	0	0.0	
7 Adults	0	0.0	0	0.0	0	0.0	
8 Adults	1	0.2	0	0.0	1	0.2	
9 Adults	0	0.0	0	0.0	0	0.0	
10+ Adults	0	0.0	0	0.0	0	0.0	
Missing	2		1		1		
Children in the Household							0.365
No Children	519	71.6	69	68.2	450	72.2	
1 Child	82	10.8	12	9.7	70	11.0	
2 Children	73	11.5	20	16.5	53	10.6	
3 Children	32	4.4	4	3.5	28	4.6	
4 Children	7	0.9	0	0.0	7	1.1	
5+ Children	4	0.8	1	2.2	3	0.6	
Missing	10		6		4		

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Social Distancing Behavior								
During the stay-at-home period…	I did not stay home	112	15.9	14	13.4	98	16.3	0.536
	I stayed home	608	84.1	92	86.6	516	83.7	
	Missing	7		6		1		
	I did not avoid visiting others	177	23.8	32	29.2	145	22.9	0.217
	I avoided visiting others	545	76.2	75	70.8	470	77.2	
	Missing	5		5		0		
	I did not avoid letting others into my home	183	22.3	29	24.4	154	21.9	0.604
	I avoided letting others into my home	537	77.8	78	75.6	459	78.1	
	Missing	7		5		2		
	I did not attend any gatherings	633	87.3	95	89.8	538	86.9	0.438
	I attended gatherings	88	12.7	12	10.2	76	13.1	
	Missing	6		5		1		
During the past 30 days…	I have not stayed home	249	34.0	50	49.2	199	31.4	**0.003**
	I have stayed home	473	66.0	57	50.8	416	68.7	
	Missing	5		5		0		
	I have not avoided visiting others	349	48.3	58	57.1	291	46.7	0.095
	I have avoided visiting others	367	51.7	48	42.9	319	53.3	
	Missing	11		6		5		
	I have not avoided letting others into my home	312	39.3	47	42.7	265	38.7	0.506
	I have avoided letting others into my home	409	60.7	60	57.3	349	61.3	
	Missing	6		5		1		
	I have not attended any gatherings	459	63.4	66	61.1	393	63.8	0.658
	I have attended gatherings	259	36.6	41	38.9	218	36.2	
	Missing	9		5		4		
		Weighted Mean	SD	Weighted Mean	SD	Weighted Mean	SD	*p* value
Age[f]		55.8	17.3	55.3	17.4	55.9	17.3	0.809

[a]Respondents were excluded from analysis if they were missing data for the survey questions assessing risk perception for COVID-19 in the next month or Patient Health Questionnaire-2 (PHQ-2) score. Statistical significance was determined using corrected Pearson's chi-square tests at the α=0.05 level. 'Missing' categories were not included in analysis. Participants included and excluded from analysis differed in (White) race, education, retirement status, and social distancing behavior (statistically significant *p* values are bolded).
[b]Depressive symptoms screen was performed using the PHQ-2.
[c]Race/ethnicity was select all that apply. Therefore, the values shown do not add up to the sample size of 727 and column percentages do not add up to 100%.
[d]Participants who reported they were retired were excluded from our employment status variable and categorized as missing.
[e]Those who reported they were employed were excluded from our retirement status variable and categorized as missing.
[f]To provide a comparison of weighted means for our continuous age variable, a weighted 2-sample t test was performed instead of a Pearson's chi-square test.