



## Short communication

# COVID-19 stressors and one-year changes in depression and anxiety in a longitudinal cohort of low-income adults in the United States

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## ABSTRACT

Emerging data suggest that adults with low income are at highest risk for COVID-19-related stressors and mental health disorders. This study aimed to determine if COVID-19-related stressors were associated with worsening depression and anxiety in a cohort of low-income adults one year after the start of the pandemic. Participants included 253 Medicaid and commercial accountable care organization recipients from 5 community health centers around Boston, MA who enrolled December 2019-March 2020 in a larger longitudinal study of a Medicaid program. Participants completed surveys at baseline and one-year follow-up that measured depression (Patient Health Questionnaire-8 [PHQ-8]) and anxiety (Generalized Anxiety Disorder-7 [GAD-7]) symptoms. Follow-up surveys assessed COVID-19-related stressors experienced over the prior 12 months. A stressor score included COVID-19-related infectious, social, and economic stressors categorized into tertiles (low, 0–3; medium, 4–6; high, 7–19).

Mean age (SD) was 45.2 (11.5) years; 71.2% were female, 42.3% Hispanic and 14.6% Black. At baseline, 126 (49.8%) had moderate or severe depression (PHQ-8  $\geq 10$ ), and 109 (43.1%) had moderate or severe anxiety (GAD-7  $\geq 10$ ). The mean (SD) number of COVID-19 stressors was 4.9 (3.1); the most frequent were food insecurity (52.2%) and job or income loss (43.9%). Compared to the low tertile, those in high and medium tertiles had significantly greater one-year increases in depression and anxiety symptoms.

Low-income adults facing multiple COVID-19-related stressors, particularly health-related social needs, had worsening mental health symptoms over one year. Interventions are urgently needed to address the dual burden of health-related social needs and poor mental health exacerbated by COVID-19.

## 1. Introduction

Although the coronavirus disease 2019 (COVID-19) pandemic is a collectively experienced trauma, emerging data from the US suggest that adults with low income are at highest risk for COVID-19-related economic and social stressors and mental health disorders such as depression and anxiety. (Ettman et al., 2020; Rudenstine et al., 2020; Karmakar et al., 2021; Shim, 2020; Ettman et al., 2021; Nagata et al., 2021) However, few studies have examined risk factors that contribute to differences in long-term mental health outcomes among adults with low income that could help inform medical, public health, and policy-based

responses to the growing mental health crisis (Veldhuis et al., 2021). We analyzed data from a longitudinal cohort of low-income adults surveyed before the pandemic and one year later to determine if the accumulation of COVID-19-related stressors was associated with worsening depression and anxiety symptoms.

## 2. Methods

This study is a secondary analysis of a subgroup of participants enrolled in the LiveWell study. LiveWell is a longitudinal evaluation of a new Medicaid initiative in Massachusetts to screen and provide

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resources for food and housing needs (MassHealth Flexible Services). Eligibility criteria for the LiveWell study included: ages 21 to 61 years, receiving care at one of five community health centers affiliated with the Mass General Brigham (MGB) health care system in greater Boston, MA, being enrolled in the MGB Medicaid or a commercial accountable care organization (ACO), and speaking English or Spanish. Commercial ACO participants had the additional eligibility criteria of having either food or housing insecurity. Prior to recruitment, we identified 5853 eligible Medicaid ACO participants and 5957 potentially eligible commercial ACO participants. The rate of food or housing insecurity among commercial ACO participants screened during recruitment was 37%. Between December 19, 2019 and December 8, 2020, a total of 1056 patients (846 Medicaid ACO and 210 commercial ACO participants) were enrolled in LiveWell and completed baseline surveys. The study protocol was approved by the MGB Institutional Review Board on August 27, 2019.

The current study included LiveWell participants that were enrolled pre-pandemic. A total of 283 were enrolled between December 19, 2019 and March 31, 2020, and of these, 253 (89%) fully completed one-year follow-up surveys and were included in the analytic sample. The 30 participants who did not complete one-year follow-up were similar in demographics and baseline PHQ-8 and GAD-7 scores to those who completed one-year surveys; 3 died prior to one-year follow-up.

Food security and housing stability were assessed at baseline using the 10-item US Department of Agriculture food security module (Bickel et al., 2000) and a 3-item screener that assessed current housing situation, number of times moved in past 12 months, and worry about not having housing. Follow-up surveys assessed 19 different COVID-19-related stressors experienced over the prior 12 months (Supplemental Table 1) that included food insecurity and housing stability, as well as other socioeconomic factors (e.g., job loss, financial stress), COVID-19-related infection or exposure (e.g., COVID-19 diagnosis or hospitalization; death of loved one), school or work difficulties (e.g., children's remote schooling), and loneliness. A COVID-19 stressor score was calculated as the sum of stressors (range 0 to 19) and participants were categorized into COVID-19 stressor tertiles (low, 0–3; medium, 4–6; or high, 7–19).

The primary outcomes of this study were changes in depression and anxiety symptoms. Depression and anxiety were measured at baseline and one-year follow-up with the Patient Health Questionnaire-8 (PHQ-8) (Kroenke et al., 2009) and Generalized Anxiety Disorder-7 (GAD-7) (Spitzer et al., 2006) scales. PHQ-8 and GAD-7 scores indicate no (0–4), mild (5–9), and moderate or severe ( $\geq 10$ ) depression or anxiety symptoms, respectively. Sociodemographic characteristics assessed at baseline included age, gender, race and ethnicity, primary language, marital status, employment, education, and household income.

Differences in participants' baseline characteristics were examined by tertile of COVID-19 stressor scores and compared using chi-square and Kruskal-Wallis (age only) tests. Mean PHQ-8 and GAD-7 scores by COVID-19 stressor tertile were calculated at baseline and one-year follow-up. One-year PHQ-8 and GAD-7 change scores were compared for those in the medium and high COVID-19 stressor tertiles to those in the low tertile, using multiple linear regression to control for baseline characteristics, including sex, race/ethnicity, education, children < 18 years old in the household, employment, food security, and housing stability, and for baseline PHQ-8 or GAD-7 scores, respectively. The assumptions of linear regression were checked and were adequately satisfied. We explored effect modification of gender by conducting additional multiple linear regression analyses using interaction terms between gender and COVID-19 stressor tertile, then performed a joint significance (Wald) test of the interaction terms, controlling for baseline characteristics and baseline PHQ-8 or GAD-7.

### 3. Results

Participants' mean age (SD) was 45.2 (11.5) years; 180 (71.1%) were

**Table 1**

Baseline (pre-pandemic) characteristics and number of COVID-19 stressors experienced at one-year follow-up.

Baseline (pre-pandemic) characteristics	Tertiles of COVID-19 stressors at follow-up <sup>a</sup>			P-value
	Low (0–3) (N = 95)	Medium (4–6) (N = 88)	High (7–19) (N = 70)	
Age, Mean [SD]	48.6 [11.2]	44.2 [10.8]	41.7 [11.5]	<0.001
Female, N (%)	68 (71.6)	59 (67.0)	53 (75.7)	0.49
Race/ethnicity, N (%)				
Hispanic	36 (37.9)	36 (40.9)	35 (50.0)	0.27
White	36 (37.9)	40 (45.5)	20 (28.6)	
Black	18 (18.9)	8 (9.1)	11 (15.7)	
Other races <sup>b</sup>	5 (5.3)	4 (4.5)	4 (5.7)	
Primary language	21 (22.1)	19 (21.6)	24 (34.3)	0.13
Spanish, N (%)				
Married/living with significant other, N (%)	36 (37.9)	30 (34.1)	19 (27.1)	0.37
Children < 18 years old in household, N (%)	34 (35.8)	54 (61.4)	45 (64.3)	<0.001
Employed full/part-time, N (%)	32 (33.7)	37 (42)	33 (47.1)	0.22
Education, N (%)				
Less than high school	18 (18.9)	15 (17.0)	15 (21.4)	0.89
High school	33 (34.7)	28 (31.8)	19 (27.1)	
Some college	28 (29.5)	31 (35.2)	21 (30.0)	
College and higher	16 (16.8)	13 (14.8)	14 (20.0)	
Household income < \$30,000, N (%)	72 (75.8)	67 (76.1)	53 (75.7)	0.99
Food security, <sup>c</sup> N (%)				
High	21 (22.1)	14 (15.9)	7 (10.0)	0.073
Marginal	23 (24.2)	16 (18.2)	10 (14.3)	
Low/very low	51 (53.7)	58 (65.9)	52 (74.3)	
Unstable housing, <sup>d</sup> N (%)	26 (27.4)	39 (44.3)	41 (58.6)	<0.001
Moderate/severe financial stress, N (%)	21 (22.1)	33 (37.5)	36 (51.4)	<0.001
Health insurance, N (%)				
Medicaid ACO	86 (90.5)	84 (95.5)	61 (87.1)	0.24
Commercial ACO	9 (9.5)	4 (4.5)	9 (12.9)	

Abbreviation: ACO, Accountable Care Organization

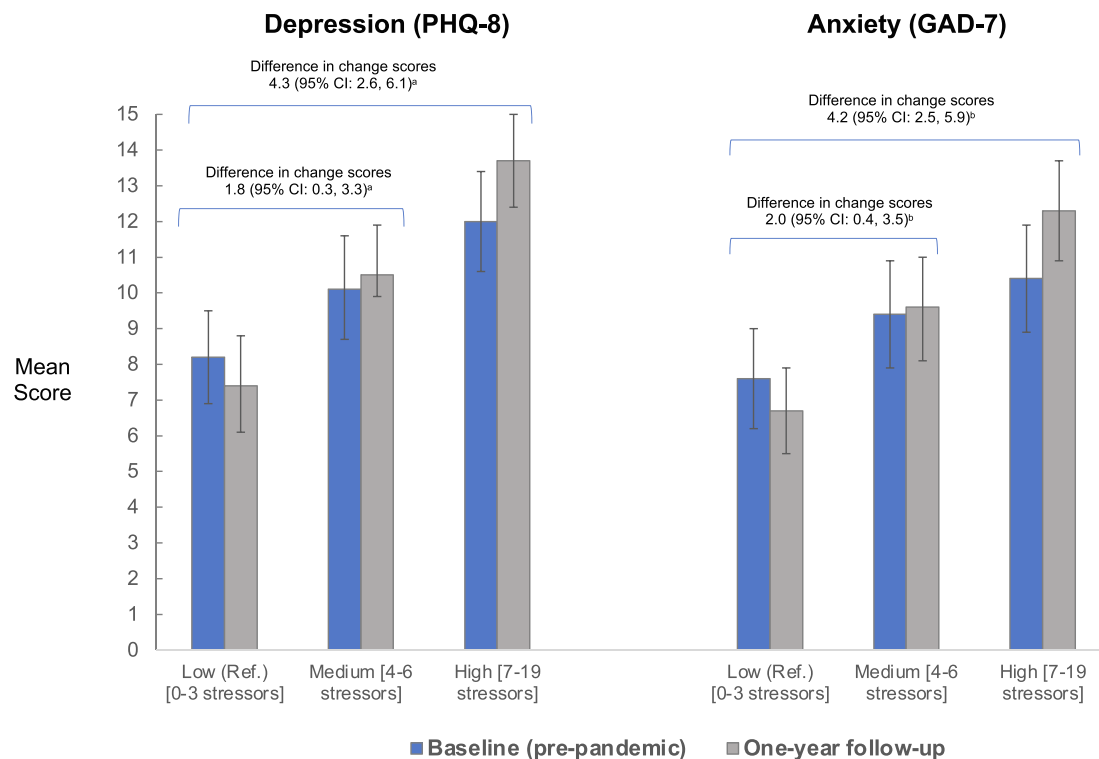
<sup>a</sup> COVID-19 stressors assessed at one-year follow-up included: moderate/severe financial stress; low/very low food security; unstable housing; lost job/income; household member lost job/income; COVID-19 diagnosis; COVID-19 hospitalization; household member COVID-19 diagnosis; household member COVID-19 hospitalization; loved one died from COVID-19; told to isolate due to infection/exposure; not able to isolate (e.g., caregiver); loneliness; and pandemic-related difficulties with: children's remote schooling; finding child-care/eldercare; working from home; risk of exposure at work; taking care of non-COVID-19 health condition; or family/friend moving into household.

<sup>b</sup> Includes 4 Asian, 1 Native American, 4 mixed race, and 4 other (self-identified) race.

<sup>c</sup> Food security was measured with US Department of Agriculture 10-item food security screening tool.

<sup>d</sup> Housing stability was assessed with 3 items: not having own housing today, moving  $\geq 2$  times in past year, or worry about not having housing in next 2 months. A positive answer to any of the items was considered unstable housing.

female, 107 (42.3%) Hispanic, 96 (37.9%) White, and 37 (14.6%) Black. At baseline, 161 (63.6%) had low or very low food security, 106 (41.9%) had unstable housing, 126 (49.8%) had moderate or severe depression (PHQ-8  $\geq 10$ ), and 109 (43.1%) had moderate or severe anxiety (GAD-7  $\geq 10$ ). The mean (SD) number of COVID-19 stressors at follow-up was 4.9 (3.1). The most frequent COVID-19 stressors reported at follow-up were: low or very low food security (N = 132 [52.2%]), job or income loss (N = 111 [43.9%]), COVID-19-related death of a loved one (N = 102 [40.3%]), unstable housing (N = 93 [36.8%]), and having to isolate due to COVID-19 (N = 92 [36.4%]) infection or exposure. Thirty-seven (14.6%) reported diagnosis of and 6 (2.4%) reported hospitalization with COVID-19.



**Fig. 1.** One-year change from before the pandemic in depression and anxiety symptoms, stratified by number of COVID-19-related stressors. Abbreviation: PHQ-8, Patient Health Questionnaire-8; GAD-7, Generalized Anxiety Disorder-7. Mean PHQ-8 and GAD-7 scores are unadjusted. Error bars represent 95% Confidence Intervals. COVID-19 stressor tertile groups: Low, N = 95; Medium, N = 88; High, N = 70. <sup>a</sup> Difference in mean changes (95% CI) in PHQ-8 scores comparing high vs. low and medium vs. low stressor tertile groups, adjusting for the following baseline characteristics: age, sex, race/ethnicity, education, children < 18 years old in the household, employment, food security, housing stability, and PHQ-8 score. <sup>b</sup> Difference in mean changes (95% CI) in GAD-7 scores comparing high vs. low and medium vs. low stressor tertile groups, adjusting for the following baseline characteristics: age, sex, race/ethnicity, education, children < 18 years old in the household, employment, food security, housing stability, and GAD-7 score.

Participants who experienced the highest number of COVID-19 stressors were more likely to be younger and to have children at home, financial stress, or unstable housing before the pandemic (Table 1). Baseline depression and anxiety were highest for the participants in the high stressor tertile (Mean PHQ-8 score: 12.0 [95% CI: 10.6, 13.4]; Mean GAD-7 score: 10.4 [95% CI: 8.9, 11.9]) and lowest for participants in the low stressor tertile (Mean PHQ-8 score: 8.2 [95% CI: 6.9, 9.5]; Mean GAD-7 score: 7.6 [95% CI: 6.2, 9.0]) (Fig. 1). Compared to the low stressor tertile, participants in the high and medium tertiles had greater increases from baseline to one-year follow-up in mean PHQ-8 (high vs. low: 4.3 [95% CI: 2.6, 6.1]; medium vs. low: 1.8 [95% CI: 0.3, 3.3]) and GAD-7 scores (high vs. low: 4.2 [95% CI: 2.5, 5.9]; medium vs. low: 2.0 [95% CI: 0.4, 3.5]), after adjusting for individual baseline characteristics (Fig. 1). Exploratory analyses found no statistically significant interaction between gender and COVID-19 stressor tertile for change in PHQ-8 (p-interaction = 0.060) or GAD-7 (p-interaction = 0.44) scores (Supplemental Table 2).

#### 4. Discussion

In a diverse sample of low-income adults with high rates of pre-pandemic food insecurity and unstable housing, those who experienced a higher number of COVID-19 stressors were more likely to have worsening symptoms of depression and anxiety compared to those with fewer stressors. Moreover, participants reporting more COVID-19 stressors had higher pre-pandemic depression and anxiety symptoms. This finding is consistent with prior studies of population-representative samples from the U.S. and Canada demonstrating that people with anxiety or mood disorders were more negatively affected by COVID-19 than those without mental health disorders. (Asmundson et al., 2020;

Jenkins et al., 2021) In our study, the most frequent stressors were social and economic factors, with over half of participants reporting low or very low food security and over 40% reporting losing a job or income in the prior 12 months. The most common COVID-19 infection-related stressors included death of a loved one and needing to isolate due to infection or exposure. While previous studies have shown that having low income is associated with higher risk of depression symptoms during the COVID-19 pandemic, (Ettman et al., 2020; Rudensine et al., 2020; Ettman et al., 2021) our results indicate that the accumulation of COVID-19-related health-related social needs contributed to worsening mental health symptoms among adults with low income. Prior research has also demonstrated that food insecurity, independent of income, is associated with both depression and anxiety symptoms (Nagata et al., 2021; Jones, 2017; McAuliffe et al., 2021).

Our results suggest the pandemic may be worsening mental health disparities within marginalized populations known to face substantial barriers to accessing mental health care. (Ettman et al., 2020; Rudensine et al., 2020; Shim, 2020; Auerbach and Miller, 2020) These barriers include a shortage of mental health professionals, lack of access to technology and telehealth, and lack of culturally appropriate care (Auerbach and Miller, 2020). To develop solutions for this evolving crisis, it is critical that clinicians, health care systems, and policy makers acknowledge the relationship between health-related social needs, mental health, and disparities in health outcomes (Shim, 2020). A cross-sectional analysis of the U.S. Census Household Pulse Survey showed that access to free groceries or meals attenuated the relationship between food insufficiency and mental health symptoms (Nagata et al., 2021). Health care interventions designed to address health-related social needs, such as food insecurity, could provide important opportunities to identify and address both social needs and mental health

disorders.

This study was limited to insured adults receiving care within a large urban health system and may not be generalizable to uninsured adults or non-urban settings. There was also limited power to detect interactions between gender and stressors on outcomes. Finally, measures of COVID-19 stressors, depression symptoms, and anxiety symptoms were based on self-reported survey data that was subject to potential recall or social desirability bias. However, depression and anxiety were measured with previously validated measures (Kroenke et al., 2009; Spitzer et al., 2006).

## 5. Conclusions

Among this cohort of US adults with low-income, depression and anxiety symptoms worsened over one year among those who experienced the highest number of COVID-19 stressors. The most frequent stressors included health-related social needs such as food insecurity, loss of job or income, and unstable housing. Healthcare and policy interventions are urgently needed to address the dual burden of health-related social needs and poor mental health that have been exacerbated by the COVID-19 pandemic (Shim, 2020). Future research will be needed to understand and address the long-term mental health impacts of the pandemic on marginalized populations at highest risk for health-related social needs.

## 6. Ethics approval and consent to participate

Ethical approval was provided by the Mass General Brigham Institutional Review Board. All participants provided verbal consent prior to the baseline surveys and received remuneration to compensate for their time.

### *CRedit authorship contribution statement*

**Anne N. Thorndike:** Conceptualization, Methodology, Investigation, Writing – original draft, Supervision, Project administration, Funding acquisition. **Vicki Fung:** Conceptualization, Methodology, Writing – review & editing, Funding acquisition. **Jessica L. McCurley:** Conceptualization, Methodology, Writing – review & editing, Funding acquisition. **Cheryl R. Clark:** Conceptualization, Writing – review & editing, Funding acquisition. **Sydney Howard:** Methodology, Software, Formal analysis, Writing – review & editing. **Douglas E. Levy:** Conceptualization, Methodology, Writing – review & editing, Funding acquisition.

### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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### Role of Funder/Sponsor

NIH had no role in the design and conduct of the study; in the collection, analysis, and interpretation of data; in the writing of the report; or in the decision to submit the article for publication.

### Conflicts of Interest

The authors have no conflicts of interest to declare.

### Access to Data Statement

Dr. Thorndike had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

### Additional Contributions

We acknowledge the clinical research coordinators, Emma Anderson, Christian Espino, Alexa Reilly, Karina Roye, Ross Sonnenblick, and Delaney Tevis, for their dedication and hard work in recruitment and data collection.

### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.pmedr.2022.101730>.

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