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Associations between social vulnerability and long COVID: A nationwide US study among symptomatic outpatients

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INTRODUCTION

- Studies conducted during the early phase of the COVID-19 pandemic have documented disparities in the risk of acute SARS-CoV-2 exposure and access to healthcare across vulnerable communities [1-7].
- Evidence on the potential differences in long-term symptoms and health-related impacts following SARS-CoV-2 infection across vulnerable communities is still limited [7].

OBJECTIVE

- This study evaluated differences in the prevalence of Long COVID by vulnerability status during a post-pandemic period of predominance of the Omicron variant in the United States (US).

METHODS

- US adults testing positive for SARS-CoV-2 at a CVS Health test site and reporting at least 1 symptom were recruited between 03/02-05/18/2023 (CT.gov: NCT05160636).
- Socio-demographics, clinical characteristics and COVID-19 vaccination status were self-reported by patients via an online questionnaire completed upon registration for SARS-CoV-2 testing.
- A Long COVID questionnaire with 30 CDC-based symptoms [8] was administered at week 4, month 3 and month 6 post-infection.
- The CDC Long COVID definition [8] was operationalized as the reporting of ≥3 new or persistent symptoms at 4 weeks or later since the acute infection.
- Patients were divided into quartiles of Social Vulnerability Index (SVI), with quartile 4 representing highest vulnerability [9].
- Mixed-effects logistic regression models [10] were applied to predict Long COVID status based on SVI, controlling for multiple covariates including age, gender, race, region, vaccination status. Assessment time was fitted as a categorical covariate and a repeated effect (repeated by subject) with unstructured covariance matrix.

RESULTS

- Among 640 study participants, 503 self-reported ≥1 Long COVID associated symptom at week 4
- Distribution based on SVI was 126 (25%) were in quartile 1, 193 (38%) in quartile 2, 119 (24%) in quartile 3, and 65 (13%) in quartile 4. Their mean SVI scores were, respectively, 0.16, 0.38, 0.61, and 0.83 (p<0.001). (Table 1)
- Age, race, and geographic distribution differed among groups. COVID-19 bivalent vaccination and antiviral coverage were lower (p<0.001) in more vulnerable groups (quartiles 3 and 4). (Table 1)
- Respectively, at 4 weeks and 6 months since testing positive, compared with quartile 1, quartile 4 participants had higher odds of ≥3 Long COVID symptoms (44.6% vs 24.6%; adjusted odds ratio (OR) 2.10, 95% confidence interval (CI) 1.03-4.26; 34.5% vs 15.5%; adjusted OR 2.32, 95% CI 1.03-5.23). (Table 2)

Table 1. Patient Characteristics (N=503)

	Quartile 1 (least vulnerable)	Quartile 2	Quartile 3	Quartile 4 (most vulnerable)	P-value**
Total n	126	193	119	65	
Age, years, mean (SD)	50.8 (14.4)	45.4 (16.3)	44.9 (15.0)	42.4 (14.2)	0.001
Female, % (n)	81 (64.3%)	140 (72.5%)	84 (70.6%)	51 (78.5%)	0.214
Race / Ethnicity					<0.001
White or Caucasian	90 (71.4%)	131 (67.9%)	63 (52.9%)	19 (29.2%)	.
Black or African American	7 (5.6%)	13 (6.7%)	10 (8.4%)	10 (15.4%)	
Hispanic	9 (7.1%)	17 (8.8%)	21 (17.6%)	26 (40.0%)	
Other	20 (15.9%)	32 (16.6%)	25 (21.0%)	10 (15.4%)	
US Geographic Region					<0.001
Northeast	31 (24.6%)	24 (12.4%)	6 (5.0%)	6 (9.2%)	.
South	38 (30.2%)	86 (44.6%)	51 (42.9%)	26 (40.0%)	
Midwest	29 (23.0%)	50 (25.9%)	27 (22.7%)	7 (10.8%)	
West	28 (22.2%)	33 (17.1%)	35 (29.4%)	26 (40.0%)	
Social Vulnerability Index, mean (SD)	0.16 (0.06)	0.38 (0.08)	0.61 (0.07)	0.83 (0.06)	<0.001
≥1 comorbid condition*	29 (23.0%)	48 (24.9%)	28 (23.5%)	21 (32.3%)	0.522
Prior positive test	50 (42.7%)	74 (40.9%)	50 (45.0%)	30 (47.6%)	0.787
Vaccination Status					<0.001
Up-to-date (BNT162b2 Bivalent)	84 (66.7%)	102 (52.8%)	47 (39.5%)	25 (38.5%)	
Unvaccinated or not up-to-date	42 (33.3%)	91 (47.2%)	72 (60.5%)	40 (61.5%)	
Time since BNT162b2 bivalent dose, days, mean (SD)	167 (42)	172 (44)	150 (53)	162 (46)	0.021
Self-reported antiviral medication, n	41 (32.5%)	44 (22.8%)	21 (17.6%)	15 (23.1%)	0.049

- Comorbid conditions include asthma or chronic lung disease, cirrhosis of the liver, immunocompromised conditions or weakened immune system, diabetes, heart conditions or hypertension, overweight or obesity, smoking. Bivalent (Original/Omicron BA4.5) COVID-19 is no longer authorized in the US.
- **P-Value of ANOVA for continuous variables, and chi-square tests for categorical variables or Fisher's exact tests when any one cell has an expected frequency less than 5.

Table 2. Prevalence of ≥3 Long COVID symptoms in SVI quartile Q4 vs quartile Q1

	Quartile 1 (least vulnerable)	Quartile 4 (most vulnerable)	Odds Ratio (95% CI)	P-value**
N (%) with ≥3 symptoms at Week 4	31 (24.6%)	29 (44.6%)	2.10 (1.03-4.26)	**0.041**
N (%) with ≥3 symptoms at Month 3	26 (21.3%)	20 (33.3%)	1.74 (0.83-3.68)	0.144
N (%) with ≥3 symptoms at Month 6	18 (15.5%)	19 (34.5%)	2.32 (1.03-5.23)	**0.042**

- CDC-based long COVID symptoms included tiredness or fatigue that interferes with daily life, symptoms that get worse after physical or mental activities (also known as "post-exertional malaise"), fever, general pain/discomfort, chills, exercise intolerance, difficulty breathing or shortness of breath, cough, chest pain, sore throat, fast-beating or pounding heart (also known as heart palpitations), difficulty thinking or concentrating (sometimes referred to as "brain fog"), headache, sleep problems, dizziness when you stand up (lightheadedness), vertigo, pins-and-needles feeling, change in smell or taste, mood changes, memory loss, confusion, depression or anxiety, diarrhea, stomach pain, nausea with or without vomiting, loss of appetite, joint or muscle pain, rash, changes in menstrual cycles, hair loss,
- **P-Value of type 3 tests

CONCLUSIONS

- **This study provides evidence of disparities in the prevalence of Long COVID in outpatient settings.**
- **Relative to the least vulnerable group (quartile 1 on SVI), the most vulnerable group (quartile 4 on SVI) had twice the odds of Long COVID than quartile 1 at Week 4 and Month 6 post-infection.**
- **SVI can help identify communities at higher risk of Long COVID and opportunities to increase vaccination and treatment coverage.**
- **Key limitations include self-reported data and limited sample size.**
- **These findings can inform public health efforts to advance health equity in COVID-19 long-term outcomes.**

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Disclosures

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