COVID-19 Sero-Prevalence and Risk Factors in a Sample of Community Health Center Employees in New York State

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Objective: To document COVID-19 sero-prevalence, prior testing, symptom experiences, and risk factors in a sample of community health center (CHC) workers. **Methods:** Descriptive statistics and log-binomial regression were used to analyze an electronic employee survey linked with COVID-19 antibody results. The sample included 378 employees who completed the survey; 325 had complete lab data. **Results:** The sero-positivity rate was 15.4%. One third of sero-positive participants had no previous COVID-19 symptoms or were unsure. Working on-site only and/or with direct patient contact was not associated with sero-positivity. Employees in their 20s were more likely to test positive than employees ages 50+, controlling for sex, race, and region (PR = 2.96; $P < 0.05$). **Conclusions:** With CHCs central to COVID-19 response and vaccination efforts, public health messaging should remind CHC workers, especially younger employees, of their risks of community-based exposure.

Keywords: antibody testing, community health centers, COVID-19, healthcare workforce, sero-prevalence

Community health centers (CHCs) serve as a medical home for roughly 30 million underserved and uninsured people in the U.S. and disproportionately serve low-income and minority populations that have shown a heightened risk of COVID-19 infection, complications, and death.[1] A recent study estimated that 47% of CHC patients meet the criteria for Phase 1 vaccination under the guidelines of the Centers for Disease Control and Prevention (CDC), predominantly due to high-risk medical conditions.[1] The National Association of Community Health Centers (NACHC) estimates that as of mid-December 2020, roughly 7 million CHC patients had been tested for COVID-19, with a positivity rate of 12%.[2]

CHC employees have played a vital role in sustaining access to routine health services as well as COVID-19 testing and treatment for high-risk, vulnerable populations throughout the pandemic.[1] The CHC workforce is comprised of over 220,000 providers and staff employed by approximately 1400 centers across 13,000 locations.[3] As of early December 2020, roughly 30,000 CHC workers were reported as testing positive for COVID-19.[4] Understanding the exposures, risk factors, and COVID-19 testing and symptom experiences of CHC workers is critical to protecting the workforce that provides essential safety-net services for patients throughout the U.S.

The objective of this study was to document COVID-19 sero-prevalence, prior COVID-19 testing and symptom experience, and potential risk factors associated with sero-prevalence among workers employed by Sun River Health, the largest CHC in New York State. Sun River serves roughly 245,000 patients across 43 locations throughout the Hudson Valley, Long Island and New York City (NYC) regions and employs approximately 1,800 doctors, nurses, and other healthcare professionals. This paper reports the study's findings and implications for employee health precautions during the pandemic.

METHODS

Design

The study was a cross-sectional analysis of primary data collected through an electronic survey of Sun River employees and their antibody testing results. All of Sun River's workforce—approximately 1,800 employees—were invited via email to participate in the study on a voluntary basis. Participation entailed a brief online eligibility screener, a demographic survey and, if eligible, a blood draw for an antibody test. (The eligibility screener and survey are shown in Appendix 1, http://links.lww.com/JOM/A982.) Blood draws were performed by a designated phlebotomy team employed by Sun River on a rotating schedule throughout 39 clinical and administrative sites. Blood samples were processed by a commercial lab using the Roche Elecsys Anti-Sars CoV-2 assay. All study protocols and confidentiality safeguards were approved by the Biomedical Research Alliance of New York Institutional Review Board.

Data Collection

Recruitment and data collection occurred from late July through mid-September 2020. A total of 378 employees consented and completed an online survey, which included questions about: prior COVID-19 symptoms, testing, and potential exposure; demographic characteristics; work location during the pandemic; and job position. All employees were deemed eligible *unless* they reported having either: COVID-19 symptoms within the past 3 weeks; a known exposure within the past 3 weeks; or a positive PCR test within the past 2 weeks. These conditions were considered exclusion criteria since it would have been too recent for antibody detection at the time of the blood draw. Eleven employees were deemed ineligible for these reasons. The remaining 367 employees scheduled an antibody test; 325 participants received the test and had complete lab data available. The remaining 42 were presumed to be no-shows for their appointments, either due to scheduling conflicts or logistical issues.

Measures and Hypotheses

The study relied on several key measures to address the study objective of documenting sero-prevalence, prior COVID-19 testing and symptom experience, and potential risk factors associated with sero-prevalence. The primary outcome of interest was a binary

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Clinical significance: This study highlights the importance of continued vigilance among community health center (CHC) workers in COVID-19 prevention in the workplace and in their daily lives at home and in the community. As CHCs accelerate vaccination efforts, public health messaging should remind this workforce of their personal risks of exposure.

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indicator of whether the participant tested positive for COVID-19 antibodies, as collected from the lab data. For descriptive purposes, binary indicators of prior COVID-19 testing and symptom experience were derived from survey questions 1 to 12 (see Appendix 1, http://links.lww.com/JOM/A982).

We tested hypotheses in three areas: race/ethnicity; potential work-related exposures; and geographic region. Given existing evidence on racial/ethnic disparities in COVID-19 risk,[5] we hypothesized that non-White employees would be at a greater risk for testing positive for antibodies, controlling for age and biological sex (Hypothesis 1). To examine potential work-related exposure, we used question 16 (work location) to test the hypothesis that employees who worked exclusively on-site during the pandemic would be at a greater risk for testing positive (Hypothesis 2a). We also used question 22 (job position) to identify employees who would have had direct contact with patients during the pandemic, with input from Sun River's human resource department; we tested the hypothesis that employees with direct patient contact would be at a greater risk for testing positive for antibodies (Hypothesis 2b). Finally, we examined the geographic region where the employee worked, derived from the office location where they scheduled their antibody test. We hypothesized that employees working in the NYC region would be at a greater risk for testing positive, given that NYC was the epicenter of the U.S. COVID-19 outbreak in the spring of 2020 (Hypothesis 3).[6]

Analysis

Descriptive statistics were used to summarize characteristics of the sample, antibody results, and prior COVID-19 symptoms and testing experience. Chi-square tests and t-tests were used to examine bivariate relationships between key variables and to identify potential confounding. We used bivariate and multivariable regression to test the aforementioned hypotheses and to control for potential confounders. Log-binomial regressions were fitted to calculate prevalence ratios, since odds ratios could potentially overestimate the effects in a cross-sectional epidemiological study.[7–10] As a sensitivity analysis, we also fitted the models using Poisson regression with robust standard errors; no substantive differences were found between the log-binomial and Poisson regressions in either the estimates generated or the 95% confidence intervals. All regressions were fitted using Stata generalized linear models (glm).[10]

RESULTS

Participant Characteristics and Potential Risk Factors

Participant demographic characteristics and potential risk factors for COVID-19 exposure are shown in Table 1. Study participants were on average 42 years old, with ages ranging from 20 to 77, and 86% were female. The sample was racially diverse, with 13.5% Black or African American, 45.5% Hispanic or Latino, 4.8% Hispanic/Latino and another racial/ethnic group, 5.6% Asian, and 29.4% White.

The 5 most commonly reported job categories were patient representative/navigator, medical assistant, nursing (including registered and licensed practical nurses), management (including medical director, administrator, legal, finance, procurement, marketing, and human resources), and care manager. Nearly two thirds (65.3%) of the sample worked in positions with direct patient contact, and 53.7% worked exclusively on site throughout the pandemic. About one third (37.3%) reported that they had contact with someone who had tested positive for COVID-19 (outside of the workplace while wearing protective equipment), and another 25.9% were unsure. About one quarter of the sample (26.4%) worked in the NYC region, the epicenter of the U.S. epidemic in the spring of 2020.

TABLE 1. Participant Characteristics and Potential Risk Factors ($N = 378$)

	%/Mean (SD)
Female (biological sex)	84.1%
Age, mean (SD)	41.9 (12.6)
Age (categorical)	
20–29	16.9%
30–39	30.2%
40–49	25.4%
50–59	15.9%
60+	11.6%
Race/ethnicity	
Black or African American	13.5%
Hispanic or Latino	45.5%
Hispanic/Latino and another racial/ethnic group	4.8%
Asian	5.6%
White	29.4%
Other	1.3%
5 most commonly reported job categories	
Patient representative/navigator	16.9%
Medical assistant	13.2%
Nursing (including registered and licensed practical nurses)	13.2%
Management	11.1%
Care manager	8.5%
Direct contact with patients	
Yes	65.3%
Typically yes, but transitioned to remote due to pandemic	12.2%
No	22.5%
Work location since the start of the U.S. COVID-19 epidemic	
On-site only	53.7%
Remote only	11.6%
Combination of on-site and remote	34.7%
Contact with someone who tested positive for COVID-19 (outside of work while wearing PPE)	
Yes	37.3%
No	36.8%
Unsure	25.9%
Geographic region (based on $N = 367$ who scheduled a blood draw)	
New York City	26.4%
Hudson Valley	42.2%
Long Island	31.3%

Sero-Prevalence, Prior COVID-19 Symptoms and Testing Experience

Of the 325 participants with complete lab data, 15.4% ($n = 50$) tested positive for COVID-19 antibodies. Table 2 reports participant responses to selected screener questions about previous COVID-19 symptoms and testing experience, for both the full sample ($N = 378$) and the sero-positive subset ($n = 50$). In the full sample, about a quarter of participants (25.1%) reported they had previously experienced COVID-19 symptoms, whereas 66.9% had not. Forty percent of the sample had previously received a PCR test, with a positivity rate of 20.4% in this group. Only 13.0% had previously received an antibody test, and 22.5% of this group tested positive for antibodies in this prior test.

In the sero-positive subset ($N = 50$), 68.0% reported having prior COVID-19 symptoms, whereas the remaining 32.0% had no prior symptoms or were unsure. Sixty-two percent of sero-positive participants had previously received a PCR test; among those with a prior PCR test, 71.0% had tested positive for COVID-19. As expected, the proportion of sero-positive participants with prior symptoms, as well as the PCR positivity rate, were notably higher than the equivalent figures in the full sample (25.1% and 40.2%, respectively). The proportion of sero-positive participants who had an antibody test prior to this study was 16.0%, similar to the

TABLE 2. Prior COVID-19 Symptoms and Testing Experience in Full Sample and Sero-positive Subset

	Full Sample ($N = 378$) % (freq)	Sero-positive Subset ($N = 50$) % (freq)
Previously experienced any symptoms of COVID-19 (eg, fever, dry cough, shortness of breath)		
Yes	25.1% ($n = 95$)	68.0% ($n = 34$)
No symptoms or unsure	74.8% ($n = 283$)	32.0% ($n = 16$)
Previously received a PCR test	40.2% ($n = 152$)	62.0% ($n = 31$)
Positive PCR result (among those with a prior PCR test)	20.4% ($n = 31$)	71.0% ($n = 22$)
Previously received an antibody test	13.0% ($n = 49$)	16.0% ($n = 8$)
Positive prior antibody test (among those with a prior antibody test)	22.5% ($n = 11$)	*

*Denominator is too small to report a clinically meaningful percentage.

full-sample proportion. (The percentage of this group who had prior positive antibody results is not reported; the denominator is too small to be clinically meaningful.).

Potential Risk Factors Associated with a Positive Antibody Result

We ran bivariate and multivariable log-binomial regressions to identify potential risk factors for sero-positivity (Table 3). Of particular interest were the effects of race, work location, direct contact with patients, and geographic region. We also examined gender and age as standard covariates.

In bivariate models, non-White employees had roughly double the risk of testing positive for antibodies than White employees (PR = 2.17; $P < 0.05$) (Hypothesis 1). No significant effects were detected based on whether employees worked exclusively on-site (vs remote or a combination of on-site and remote; Hypothesis 2a) or had direct contact with patients (Hypothesis 2b). Additionally, employees working in the NYC region had an increased risk of testing positive relative to employees in all other regions (PR = 1.85; $P < 0.05$; Hypothesis 3). Employees aged 20 through 29 had nearly twice the risk of testing positive for antibodies as all other age groups (PR = 1.87; $P < 0.05$).

Variable selection for the multivariable model was informed by the statistical significance of selected variables in bivariate regressions, conventional risk adjustment (eg, age, sex), and the need for parsimony, given the small sample size. The final multivariable model presented here collapses selected categories in age (50 to 59 and 60+) and geographic region (Long Island and Hudson Valley) as reference groups. Race no longer demonstrated a significant effect on sero-positivity when adjusting for age, sex, and geography (Hypothesis 1). The increased risk associated with working in NYC was slightly lower in the multivariable model, though it bordered on statistical significance (Hypothesis 3). The effect of being in the youngest age category remained significant and increased in magnitude when adjusting for other factors (PR = 2.96; $P < 0.05$). In the multivariable model, employees ages 40 to 49 also showed a significantly greater risk of testing positive (PR = 2.62; $P < 0.05$).

TABLE 3. Bivariate and Multivariable Log-Binomial Regressions Testing Associations of Potential Risk Factors with Sero-Positivity ($N = 325$)

	Bivariate Models PR (95% CI)	Multivariable Model PR (95% CI)
Female	0.98 (0.47–2.06)	0.98 (0.48–2.00)
Age group		
20–29	1.87 (1.08–3.23)*	2.96 (1.18–7.45)*
30–39	0.96 (0.54–1.69)	1.95 (0.78–4.87)
40–49	1.35 (0.79–2.32)	2.62 (1.07–6.41)*
50–59	0.48 (0.18–1.27)	Ref
60+	0.29 (0.07–1.14)	
Non-White	2.17 (1.06–4.44)*	1.54 (0.73–3.25)
Direct contact with patients	0.97 (0.56–1.65)	–
Working on-site only	1.24 (0.74–2.09)	–
Geographic region		
New York City	1.85 (1.11–3.08)*	1.59 (0.95–2.67)
Long Island	0.89 (0.51–1.55)	Ref
Hudson Valley	0.64 (0.37–1.11)	

CI, confidence interval; PR, prevalence ratio; Ref, reference group.
*$P < 0.05$.

Exploratory Analyses of Potential Confounding

Given that the effects of race and geographic region were no longer significant when controlling for age and sex, we conducted further analyses to identify potential confounding that may have driven the significant bivariate findings. Notably, t-tests showed that the age distribution differed by race, with a mean age of 39.6 among non-White employees compared to 47.5 among white employees ($P < 0.0001$). Moreover, employees working in NYC had a mean age of 39.6 compared to 42.6 among employees in the two other regions combined ($P < 0.05$). Considering these correlations, the significant bivariate effects of both race and region may have been partly driven by an age effect, given that age remained significant in the multivariable model.

DISCUSSION

This study examined COVID-19 sero-positivity, prior testing, symptom experience, and risk factors in a sample of employees of the largest CHC in New York State. The 15.4% sero-positivity rate was comparable to that of an employee sero-survey conducted at Northwell Health System—New York State's largest healthcare provider and largest private employer within the healthcare sector—which found that 13.7% of a sample of 40,329 employees had COVID-19 antibodies.[6] Northwell is a multi-site health system providing a range of acute inpatient and routine outpatient services, as well as sub-acute rehabilitation, home care and hospice throughout NYC and Long Island, thus overlapping in the geographic regions served by Sun River. The fact that the sero-positive percentage in our sample of Sun River employees is similar to Northwell's figure suggests that working in a CHC—which generally serves a population shown to have a higher burden of disease related to COVID-19[1]—may not pose a dramatically higher risk of exposure to employees than the risks faced by the healthcare workforce in general.

That employees who worked on-site only and had direct contact with patients were no more likely to test positive for antibodies suggests that employees were as likely to be exposed in the community or at home as they were at work. This suggests that workplace safety precautions—including use of personal

protective equipment, social distancing, hand hygiene, appropriate ventilation and sanitation practices—may have been protective factors, especially given the possibility that CHC employees are exposed to a particularly at-risk patient population.[1,2] Conversely, these findings suggest that employees should be cautioned to maintain as much vigilance in their daily lives outside the workplace as they do at work.

It is noteworthy that among the subset of participants who were sero-positive, roughly one third reported that they had no previous COVID-19 symptoms or were unsure. This is consistent with prior evidence showing that asymptomatic spread of COVID-19 is a major driver of transmission in the general population.[11,12] It is also important that employees in their 20s were nearly 3 times as likely as employees ages 50 and older to test positive for antibodies, controlling for sex, race, and region of employment. This finding aligns with prior research suggesting that young adults may be perceive a greater sense of safety with more relaxed community mitigation strategies,[13] and may have more difficulty maintaining preventive behaviors.[14]

Non-White employees and those working in the NYC region appeared to be more likely to test positive for antibodies in bivariate analyses. However, these effects were no longer significant in multivariable analyses, most likely due to younger age distributions in both the non-White and NYC-based subgroups. Thus, what initially appeared as race and regional effects may have been at least partly driven by the observed age effects, which remained significant in multivariable regression. We note, however, that the NYC effect still bordered on significance in multivariable models; it is possible that other unmeasured confounders may have masked the importance of community spread in NYC during the surge in the spring of 2020.

Some study limitations should be noted. The sample size is small and is not intended to be generalizable to the larger CHC workforce. We also acknowledge that participants who consented to the study may not fully reflect the entire employee population of Sun River. There may be selection bias related to participants' beliefs about their prior exposures, and the rotating testing schedule across Sun River locations may have made it challenging for some interested employees to fully participate. Additionally, we recognize the limitations of the cross-sectional design; collecting data in multiple waves or on a rolling basis could potentially add further insights into sero-prevalence among Sun River employees and their risk factors throughout the pandemic. Finally, we note that the confidence intervals for the categorical age groups were wide in the adjusted model, posing limitations to inferences that may be drawn from these findings. We chose to retain the categorical age variable in the model, since continuous age was obfuscating some important group-level effects; we acknowledge there may be other unmeasured confounders that were not available to examine within the scope of this study.

Implications

This study highlights the critical importance of healthcare workers' continued vigilance in COVID-19 prevention both in the workplace and in their daily lives at home and in the community. Moreover, continuing to raise awareness among younger people of their risks of contracting and spreading COVID-19 is as essential in the healthcare workforce as it is in the general population. CHCs in particular are featured as a key component of the current federal COVID-19 response and vaccination plan, including a proposal for additional congressional funds to provide technical assistance to CHCs in implementing vaccine distribution.[15] As CHC workers are called upon to accelerate vaccination efforts, consistent and ongoing public health messaging should remind members of this workforce of their personal risks of exposure, as well as the uncertainties regarding the risk of transmitting the virus after being vaccinated.

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