Prevalence of SARS-CoV-2 antibodies among market and city bus depot workers in Lima, Peru

Marco Tovar, Jesús Peinado, Santiago Palomino, Fernando Llanos, Claudio Ramírez, Gisella Valderrama, Roger I. Calderón, Roger B. Williams, Gustavo E. Velásquez, Carole D. Mitnick, Molly F. Franke, Leonid Lecca

*These authors contributed equally.

1 Socios En Salud Sucursal Perú, Lima, Perú
2 Escuela de Medicina, Facultad de Ciencias de la Salud, Universidad Peruana de Ciencias Aplicadas – UPC, Lima, Peru
3 Dirección de Redes Integradas de Salud Lima Norte (DIRIS), Lima, Perú
4 University of Texas Health Science Center at Houston, School of Public Health, Houston, TX, USA
5 Division of Infectious Diseases, Brigham and Women’s Hospital, Boston, MA, USA
6 Division of Global Health Equity, Brigham and Women’s Hospital, Boston, MA, USA
7 Department of Global Health and Social Medicine, Harvard Medical School, Boston, MA, USA
8 Partners In Health, Boston, MA, USA

Corresponding author: Marco Tovar, M.D.
Jr. Puno 279 Cercado de Lima, Lima, Peru
E-mail: mtovar_ses@pih.org Phone: +51 1 6125200
ABSTRACT

We report SARS-CoV-2 antibody positivity among market and city bus depot workers in Lima, Peru. Among 1,285 vendors from eight markets, prevalence ranged from 27-73%. Among 488 workers from three city bus depots, prevalence ranged from 11-47%. Self-reported symptoms were infrequent.

Keywords: frontline worker, essential work, COVID-19
INTRODUCTION

Essential service workers perform functions that are critical to maintaining infrastructure. They include first responders and individuals working in healthcare, education, food and agriculture, and public transit. In the context of the SARS-CoV-2 pandemic, particular attention has been paid to healthcare workers who, by nature of their jobs, face an increased risk of exposure to the virus. While studies have documented frequent SARS-CoV-2 antibody positivity among healthcare workers globally,[1–4] this risk can be reduced with appropriate personal protective equipment (PPE) and infection control practices.[5]

Few studies have examined SARS-CoV-2 antibody prevalence among frontline essential service workers who are not healthcare workers or first responders. These workers may face an elevated risk of SARS-CoV-2 exposure through public-facing jobs that cannot be performed from home. These same jobs may not be prioritized for, or have access to, PPE to the same extent as healthcare workers or first responders. And, lower-wage frontline workers may face financial constraints in purchasing PPE and tend to rely on public transportation for commuting, further increasing risk. One U.S.-based study found that frontline workers (most of whom were not healthcare workers) had six-times the risk of SARS-CoV-2 antibody positivity as compared to those who did not conduct frontline work.[6]

Despite an elevated risk of occupational exposure, low-wage workers with essential frontline jobs may be unable to afford to stay home when ill in the absence of paid sick leave.

As part of the regional response to SARS-CoV-2, the Peru Ministry of Health and the NGO Socios En Salud conducted SARS-CoV-2 antibody testing among groups at high risk of workplace exposure. We report the frequency of antibody positivity among market and city bus depot workers, two sectors of understudied frontline essential service workers with potential for high exposure.
METHODS

Study setting

Peru, a nation of 31 million inhabitants, is highly affected by SARS-CoV-2. As of January 31, 2021, more than 1.1 million reported cases and >40,000 deaths were reported, with metropolitan Lima disproportionately affected.\textsuperscript{[7]} Nationwide, the case-fatality rate is 3.5%\textsuperscript{[7]}. Through November 2020, SARS-CoV-2 rapid antibody testing was the predominant testing modality; rapid antigen and reverse transcription polymerase chain reaction (RT-PCR) testing were rarely available. The present work took place in the northern Lima health jurisdiction, which includes urban and peri-urban areas and informal human settlements; it is characterized by high rates of poverty.

Study procedures

Day-long SARS-CoV-2 testing campaigns were conducted at eight markets and three bus depots from June 5 to July 18, 2020, during which time the reported number of cases in Peru rose from 191,758 to 349,500.\textsuperscript{[7]} Bus depots served metropolitan Lima and were operated by the primary bus company in the catchment area; markets constituted the zone’s main markets. During the study period, businesses and markets routinely implemented infection control protocols, including hand sanitizing, temperature checks, social distancing and mandatory masks.

Prior to campaign implementation at each locale, Socios En Salud staff coordinated with site leadership, who provided a roster of workers and served as communication liaisons. On the day of testing, health personnel invited workers to participate in voluntary testing. Among those who agreed, the team conducted rapid SARS-CoV-2 antibody testing using the Standard Q COVID-19 IgG/IgM Duo (SD Biosensor, Suwon, Korea). Workers completed a survey regarding symptoms within the past two weeks and relevant co-morbidities.\textsuperscript{[8]} Testing occurred in a well-ventilated area with tables and chairs spaced at least 2 meters apart. After a finger prick, a drop of blood was deposited on the test device. Results were read after 15 minutes and communicated to the individual. If the result was indeterminate, a
second and final test was conducted. Those with a reactive result (IgG, IgM or IgG-IgM) were managed according to national guidelines, which included isolation, virtual clinical follow-up, tracing of contacts, and provision of social support as needed.

**Statistical analyses**

We report the prevalence of antibody positivity (combined IgG/IgM) by site. Among bus depot workers, we stratify by role.

**Research ethics**

Data were collected as part of public health response activities. Workers did not provide informed consent to participate in research. The Ethics Committee of the NGO Asociación Benéfica PRISMA approved use of the data for research purposes.

**RESULTS**

94% and 90% of listed market and bus depot workers, respectively, were tested for SARS-CoV-2 antibodies. Among them were 1,285 vendors (55% female, median age: 40 years; IQR: 30-51) from eight markets and 488 workers (15% female, median age: 39 years; IQR: 32-48) from three bus depots (including drivers (n=329), administrative (n=62), maintenance (n=34) and security personnel (n=25), cooks (n=11) and cleaners (n=16)).

Frequency of antibody positivity ranged from 27% to 73% in market workers (Figure 1, Panel A) and was 11%, 32%, and 47% at the bus depots. Prevalence tended to be lower in drivers relative to other jobs (Figure 1, Panel B). Overall, 44% of market workers and 29% of bus depot workers had a reactive result. Of those, 13% (76/563) of market workers and 21% (29/141) of bus depot workers reported COVID-19 symptoms within two weeks, including cough, sore throat, nasal congestion, difficulty breathing, fever, diarrhea/vomiting, headache, diarrhea or malaise.

The prevalence of self-reported co-morbidities was 5.9% (76/1285) in market workers, with obesity (n=33), diabetes (n=14), and cardiovascular disease (n=17) most common. Among bus depot workers, the prevalence of self-reported comorbidities was 7.2% (35/488), with obesity (n=13), diabetes (n=10) and cardiovascular disease (n=5) most common.
DISCUSSION

We found frequent SARS-CoV-2 seropositivity among market and bus depot workers in urban Peru during the “first wave” of infections, highlighting the need for an urgent occupational and public health response to provide protections for these and other frontline essential workers who may be highly exposed. The risk of SARS-CoV-2 infection to frontline essential workers with direct contact with the public can be reduced with appropriate PPE and infection control, but in Peru, where the majority of employment is informal, this responsibility often falls to the individual worker. The workers included in this report were independent contractors, earning daily wages, without guaranteed salary or paid sick time. Thus, purchase of appropriate PPE and the decision to stay home when sick directly compete with earnings.

Given the frequency of asymptomatic and pre-symptomatic SARS-CoV-2 infection, strengthening infection control measures (e.g., enabling hand-sanitization and social distancing; improving ventilation and airflow; reinforcing adherence to mask requirements for the public) and provision of appropriate PPE for frontline public-facing workers are critical measures for protecting workers and curtailing transmission of SARS-CoV-2. Elevating the priority level of these frontline workers for COVID-19 vaccination would align with the National Vaccination Plan[9], which seeks to ensure the continuity of basic services, and could have important public health implications given their constrained agency to exercise other measures that would protect their contacts. Studies have shown high secondary infection rates in household contacts of frontline essential workers.[10] In Peru, independent day labor is a marker of socioeconomic precariousness; the introduction of SARS-CoV-2 to a vulnerable household may fuel a vicious cycle of household and community-based transmission in which overcrowding, poor ventilation and/or inability to effectively isolate result in ongoing transmission to other household members who, likewise, must leave the home for income generation.
Early on in the pandemic, antibody testing was used for clinical management and contact tracing because tests that directly detect the virus (i.e., rapid antigen and RT-PCR) were not in sufficient supply to meet testing demands in this setting. This approach is not recommended because it fails to detect those cases that are infectious and causes socioeconomic harm through unnecessary isolation of individuals who are no longer infectious. On the other hand, these data demonstrate that rapid antibody testing can be useful for identifying populations at high risk of infection, and in whom more intensive rapid antigen or RT-PCR testing and additional protections are warranted.

The high participation rate was likely driven by a high demand for testing among workers which was intensified by a lack of broadscale access. While high testing coverage minimizes potential selection bias; the antibody prevalences reported here may still be underestimates. First, although assay specificity is high, nearing 99%, sensitivity is around 90% after two weeks.[11] Second, sampling from the workplace can introduce healthy worker bias -- if sick workers commonly stayed home or had died of COVID-19, the observed antibody prevalence estimates would underestimate the proportion of workers with past (or current) SARS-CoV-2 infection. Similarly, if workers commonly had early-stage infection, the positive antibody prevalence would underestimate this quantity. While the SARS-CoV-2 antibody prevalences are specific to each locale and somewhat variable, the overall message that these public-facing frontline essential service workers outside of the healthcare industry are at high risk of SARS-CoV-2 infection is broadly generalizable to settings with a high incidence of SARS-CoV-2 and where there is a lack of formalized protections for independent or informal workers.

In conclusion, we found a high prevalence of SARS-CoV-2 infection in independent frontline essential workers who lack social and material protections. Policies that implement and reinforce social safety nets and prioritize vaccination for these workers may prove to be critical for control of SARS-CoV-2, particularly during the current devastating “second wave” of infections in Peru.
ACKNOWLEDGEMENTS

We are grateful to the COVID-19 Rapid Response Teams of DIRIS Lima Norte and Socios En Salud and to the frontline essential workers in Peru.

DISCLAIMER

The contents of this manuscript are solely the responsibility of the authors and do not necessarily represent the official views of the U.S. National Institutes of Health. The funding source had no role in the study design; in the collection, analysis, or interpretation of data; in the writing of the report; or in the decision to submit the report for publication.

FUNDING

Public health response activities were financed by Peruvian Ministry of Health, Partners In Health and the United States Agency for International Development. GEV received funding from the National Institute of Allergy and Infectious Diseases at the U.S. National Institutes of Health [grant number K08 AI141740], paid to their institution; the Dr. Lynne Reid/Drs. Eleanor and Miles Shore Fellowship at Harvard Medical School [grant number not provided], paid to their institution; the Burke Global Health Fellowship at the Harvard Global Health Institute [grant number not provided], paid to their institution; the Harvard University Center for AIDS Research [grant number P30 AI060354], paid to their institution, during the conduct of the study; and salary support from Unitaid for their role as co-investigator of the endTB-Q clinical trial (NCT03896685), payments made to their institution, in the past 36 months.

The authors report no conflicts of interest.
REFERENCES

1. Psichogiou M, Karabinis A, Pavlopoulou ID, et al. Antibodies against SARS-CoV-2 among health care workers in a country with low burden of COVID-19. PLoS One 2020; 15.

2. Olayanju O, Bamidele O, Edem F, et al. SARS-CoV-2 Seropositivity in Asymptomatic Frontline Health Workers in Ibadan, Nigeria. Am J Trop Med Hyg 2021; 104:91–94.

3. Chen Y, Tong X, Wang J, et al. High SARS-CoV-2 antibody prevalence among healthcare workers exposed to COVID-19 patients. J Infect 2020; 81:420–426.

4. Houlihan CF, Vora N, Byrne T, et al. Pandemic peak SARS-CoV-2 infection and seroconversion rates in London frontline health-care workers. Lancet. 2020; 396:e6–e7.

5. Self WH, Tenforde MW, Stubblefield WB, et al. Seroprevalence of SARS-CoV-2 Among Frontline Health Care Personnel in a Multistate Hospital Network — 13 Academic Medical Centers, April–June 2020. MMWR Morb Mortal Wkly Rep 2020; 69:1221–1226.

6. Chamie G, Marquez C, Crawford E, et al. Community Transmission of Severe Acute Respiratory Syndrome Coronavirus 2 Disproportionately Affects the Latinx Population During Shelter-in-Place in San Francisco. Clin Infect Dis 2020.

7. Peru Ministry of Health. Sala Situacional COVID-19. 2021. Available at: https://covid19.minsa.gob.pe/sala_situacional.asp. Accessed 2 February 2021.

8. Certain Medical Conditions and Risk for Severe COVID-19 Illness | CDC. Available at: https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/people-with-medical-conditions.html. Accessed 10 March 2021.

9. Plan Nacional de Vacunación contra la COVID-19 | Gobierno del Perú. Available at: https://www.gob.pe/11796-plan-nacional-de-vacunacion-contra-la-covid-19. Accessed 10
McDade TW, McNally EM, Zelikovich AS, et al. High seroprevalence for SARS-CoV-2 among household members of essential workers detected using a dried blood spot assay. PLoS One 2020; 15.

FIND Evaluation of SARS-CoV-2 Antibody Detection Tests. 2021. Available at: https://www.finddx.org/wp-content/uploads/2020/11/Av-eval-results20201127.jpg. Accessed 30 March 2021.
Figure 1. SARS-CoV-2 antibody prevalence among essential frontline workers in northern Lima, Peru, June-July, 2020. Panel B excludes 11 individuals whose professional role was not classifiable into one of these categories.
A. Select markets (N=1,285)

- A: 39% (N=214)
- B: 58% (N=150)
- C: 50% (N=181)
- D: 39% (N=168)
- E: 73% (N=111)
- F: 40% (N=178)
- G: 27% (N=158)
- H: 34% (N=125)

B. Select bus depots, stratified by professional role (N=477)

- A (N=169):
  - Admin: 21% (N=19)
  - Driver: 27% (N=119)
  - Cook / Cleaner / Security: 43% (N=14)
- B (N=175):
  - Admin: 13% (N=23)
  - Driver: 8% (N=117)
  - Cook / Cleaner / Security: 24% (N=17)
  - Maintenance: 22% (N=18)
- C (N=133):
  - Admin: 65% (N=20)
  - Driver: 42% (N=93)
  - Cook / Cleaner / Security: 56% (N=18)
  - Maintenance: 50% (N=2)