Summary line: In epidemiological surveillance, prevalence of current SARS-CoV-2 infection by nucleic acid detection was 27.7% and 7.2% among farmworkers in Monterey County, California, with and without potential COVID-19 symptoms, underscoring high risk of infection in this essential workforce population.

Short title: SARS-CoV-2 infection among farmworkers

Keywords: COVID-19; SARS-CoV-2; farmworkers; infection prevalence; sero-survey; essential workers

Title: Prevalence and clinical profile of SARS-CoV-2 infection among farmworkers in Monterey County, California: June-November, 2020

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ABSTRACT—148 words

As essential personnel, United States farmworkers have continued working in-person throughout the COVID-19 pandemic. We undertook prospective surveillance of SARS-CoV-2 infection and antibody prevalence among farmworkers in California's Salinas Valley from 15 June to 30 November, 2020. Over this period, we observed 22.1% (1514/6864) positivity for current SARS-CoV-2 by nucleic acid detection among farmworkers tested at federally-qualified migrant and community health clinics, as compared to 17.2% (1255/7305) among other adults from the same communities (risk ratio, 1.29; 95% confidence interval, 1.20-1.37). In a nested study enrolling 1,115 farmworkers, prevalence of current infection was 27.7% among farmworkers reporting ≥1 potential COVID-19 symptom, and 7.2% among farmworkers without symptoms (adjusted odds ratio 4.16; 2.85-6.06). Prevalence of anti-SARS-CoV-2 IgG antibodies increased from 10.5% (6.0-18.4%) between 16 July-31 August to 21.2% (16.6-27.4%) between 1-30 November. The

high observed prevalence of infection among farmworkers underscores the need for vaccination and other preventive interventions.

MAIN TEXT—3,395 words

INTRODUCTION

In response to the ongoing coronavirus disease 2019 (COVID-19) pandemic, the United States and other countries have implemented broad interventions aiming to mitigate community transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) (*1*). Workers in food production and other industries deemed essential to continuity of public health and safety have continued in-person work (*2*). While COVID-19 outbreaks have been reported among various essential workforce groups, including employees in food processing facilities (*3, 4*), to date no studies have prospectively assessed risk of infection among essential workers involved in food production.

Agriculture and related food production industries comprise one of the lowest-paid sectors of the US economy, with 29% of full-time workers earning an annual income below $12,760 as individuals or $26,200 for a family of four (*5*). Agriculture in particular draws on a predominantly Latino immigrant workforce (*6*), who in comparison to their US-born counterparts work longer hours, receive lower wages, and experience higher levels of household poverty (*7*). An estimated 54% of immigrant farmworkers are undocumented, and thus have reduced access to federal benefits under the Coronavirus Aid, Relief, and Economic Security Act (*8*). These circumstances have compounded pre-existing legal and economic challenges faced by farmworkers during the COVID-19 pandemic (*9, 10*).

We initiated surveillance of SARS-CoV-2 infection among farmworkers in California's Salinas Valley to monitor the epidemic. We have previously described impacts of the pandemic on economic well-being, mental health, and food insecurity within this population (*11*). Here we report on the prevalence of SARS-CoV-2 infection among farmworkers tested from June to November, 2020, as well as symptoms and antibody responses within a subset of these farmworkers enrolled in a cross-sectional study.

METHODS

Study setting

The Salinas Valley is a 90-mile stretch of agricultural land within Monterey County, California; prominent farmed crops include leafy greens, berries, broccoli, artichokes, and wine grapes. The agricultural workforce comprises ~50,000 resident farmworkers, with an additional 40,000 seasonal workers supporting the peak summer and fall seasons (*12*). The population is 75% Latino, and 30-60% of workers are believed to be undocumented (*13*). Severe overcrowding and household disrepair are common among farmworkers (*14*), with many living in multi-generational households (*15*) as well as labor camps, vehicles, and informal dwellings (*16*). Many farmworkers travel long distances to work, often in shared trucks or buses, and may work in close proximity to one another. These circumstances have led to concern about difficulty preventing SARS-CoV-2 transmission among farmworkers and in their communities (*17*).

We undertook this study in partnership with Clínica de Salud del Valle de Salinas (CSVS), a federally-qualified community and migrant health center in Monterey County. As the main healthcare provider for the region's farmworkers and their families, CSVS operates a

network of 12 comprehensive primary care centers serving 52,000 low-income, primarily Spanish-speaking patients.

SARS-CoV-2 testing

Testing for SARS-CoV-2 infection at CSVS clinics began 15 June, 2020, and was offered to all individuals at clinics during weekday business hours. Medical personnel collected oropharyngeal specimens for detection of SARS-CoV-2 RNA via the qualitative Hologic (Marlborough, Massachusetts) Aptima nucleic acid transcription-mediated amplification (TMA) assay (analytical sensitivity: 62.5 RNA transcript copies/mL (*18*); clinical specificity: 99.9% (*19*)). All patients receiving care from CSVS for any reason were encouraged by their healthcare providers to receive SARS-CoV-2 testing, regardless of symptoms; testing was also made available to individuals who were not CSVS patients. No-cost testing for individuals without insurance was supported by funding from the Health Resources and Services Administration. Additionally, CSVS conducted outreach testing via mobile testing facilities at community sites including low-income and employer-provided housing, agricultural fields, homeless shelters, food banks, and CSVS-run health fairs where free SARS-CoV-2 testing was offered alongside seasonal influenza vaccination and food donations.

Clinical surveillance study

As part of routine clinical intake, all patients ages ≥18 years were asked about employment. We considered farmworkers to include all persons engaged in work in agriculture, including but not limited to crop, nursery, and greenhouse laborers; agricultural equipment

operators; workers in packing sheds and other food processing facilities; and farm and ranch animal workers and breeders.

Cross-sectional study

Enrollment: To better understand the distribution, dynamics, and clinical profile of infection in among farmworkers, we invited farmworkers who were receiving a SARS-CoV-2 TMA test at CSVS to participate in a more in-depth cross-sectional study further entailing anti-SARS-CoV-2 antibody testing and a detailed questionnaire. To advertise the cross-sectional study, Spanish- and English-language fliers were distributed in the community and to area growers and were hung in clinics describing the opportunity to receive free SARS-CoV-2 testing from CSVS and participate in the study. The study team was stationed at CSVS testing facilities and aimed to approach all patients receiving SARS-CoV-2 TMA tests to screen for study eligibility and invite participation in the cross-sectional study. When time allowed, study personnel called patients with scheduled SARS-CoV-2 testing appointments at CSVS on the day before their visit to advertise the study and screen for eligibility. Participants in an ongoing longitudinal study of farmworker families (*13*) and those living in housing for farmworkers were also invited to participate and to bring other farmworkers.

Eligible participants were non-pregnant adult farmworkers ages ≥18 years receiving SARS-CoV-2 TMA testing at CSVS who had conducted farm work ≤14 days before their testing date, who had not previously participated, and who spoke sufficient English or Spanish to give consent and complete study procedures. To accommodate the end of the growing season, from 5 October onward we enrolled individuals who had engaged in farm work any time since March 2020.

Study procedures: The study team obtained a blood sample by venipuncture and measured participants' height and weight using large-print tape measures adhered to a post or wall and digital scales. Within 48 hours before (for pre-consented participants) or after the enrollment visit, and before SARS-CoV-2 testing results were available, the study team administered a 45-minute computer-guided questionnaire by telephone in Spanish or English. Questionnaire items addressed participant demographics, socio-economic status, symptoms since December 2019 and in the two weeks preceding enrollment, COVID-19 risk factors and exposures, and impacts of the pandemic on daily life and wellbeing (*11, 20*). Following completion of all components of the study, the study team loaded a $50 incentive onto VISA gift cards handed out to participants at the enrollment visit.

Blood specimens were stored immediately at 4-7ºC and centrifuged ≤48 hours after collection. Following separation, plasma aliquots were heat-inactivated at 56°C for 30 minutes and stored at –80ºC, then used for assessment of immunoglobulin G (IgG) reactivity against the SARS-CoV-2 spike protein via in-house enzyme linked immunosorbent assays (ELISAs) (*21*). Briefly, recombinant full-length SARS-CoV-2 spike protein (John Pak, Chan Zuckerberg Biohub) was coated on Nunc Maxisorp ELISA plates (Themofisher) at 1.5µg/mL. Plates were blocked with 2.5% non-fat dry milk in 1X phosphate-buffered saline (PBS) for 2 hours at 37°C. Plates were then washed 3 times in 1X PBS. Plasma samples, diluted 1:100 in 1% non-fat dry milk in 1X PBS, were added to the plate in duplicate wells. After a 1-hour incubation at 37°C, plates were washed 5 times in 1X PBS + 0.05% Tween-20. Bound anti-spike IgG was detected using horseradish peroxidase-conjugated goat-anti-human IgG antibody (Fisher Scientific). The plate was developed using a 3,3′,5,5′-Tetramethylbenzidine (TMB) solution, and the reaction was stopped with 2M H_2SO_4 after 6 minutes. Prior assay validation was performed using

convalescent (≥8 days post-onset) serum samples from 60 hospitalized, PCR-confirmed COVID-19 cases; 57 mild or subclinical PCR-confirmed COVID-19 cases; and 131 unexposed individuals (pre-2020 serum samples). Specimens were considered to be positive for anti-SARS-CoV-2 spike IgG if the ELISA optical density (OD) value was >0.096. This cutoff maximized area under the receiver operating characteristic curve, yielding 94.0% sensitivity and 98.5% specificity. All specimens were processed in duplicate; reflex testing was conducted if ≥1 OD measurement fell in the borderline range of 0.07-0.3 or if the coefficient of variation between replicates was ≥30% and ≥1 OD measure was ≥0.07. All specimens considered positive by the spike ELISA were confirmed by presence of IgG against the receptor binding domain (RBD) of SARS-CoV-2 spike protein (John Pak, Chan-Zuckerberg Biohub), using the protocol described above, substituting the coating antigen with RBD at 3ug/mL. Specimens were considered positive if RBD ELISA OD values were >0.205, determined via a similar validation process as described above for spike protein.

Statistical analyses

Clinical surveillance study: Results for all patients tested at CSVS from 15 June through 30 November, 2020 were tabulated by age, sex, and farmworker status. We also computed 2-week moving averages in the daily proportion of tests yielding positive results as well as estimates of the final proportion of tests yielding positive results by patient age, sex, and farmworker status. We used the Beta distribution to define 2.5% and 97.5% quantiles for the proportion positive.

Cross-sectional study: We computed adjusted odds ratios (aORs) using logistic regression models accounting for age, sex, and venue to determine the association of symptoms (experienced in the last two weeks) with a positive test result. We used the same logistic

regression framework to estimate aORs for the association of each symptom (experienced in the prior two weeks or at any time since December, 2019) with anti-SARS-CoV-2 antibody OD measures (continuous).

We computed stabilized sampling weights (*22*) to correct for differences in the population enrolled in the study over time when estimating prevalence of infection. To generate weights for each recruitment period (16 July-31 August, 1-30 September, 1-31 October, or 1-30 November), we fit a multinomial logistic regression model which included all exposures listed in **Table 1**, the number of symptoms participants reported in the preceding two weeks, and the recruitment venue as predictors.

We estimated period-specific prevalence of SARS-CoV-2 infection and of seropositivity, accounting for inverse sampling weights, using a generalized linear model with a log-binomial link function. Models accounted for the four recruitment periods above, presence of any symptoms, and recruitment venue. We used the model parameter estimates to summarize period-specific prevalence of TMA-positive and seropositive status for individuals with and without symptoms, whom we would have expected to reach via community outreach. To account for missing data (1.1% of observations across all outcome and predictor variables), we sampled estimates from five independent iterations of the analysis carried out on multiply-imputed datasets. Analyses were conducted in R (version 4.0.3); we used the Amelia II package (*23*) for multiple imputation and fit the multinomial logistic model using the nnet package (*24*).

RESULTS

Clinical surveillance study

Between 15 June and 30 November, CSVS administered 14,169 SARS-CoV-2 TMA tests to adults, including 6,864 tests among farmworkers and 7,305 among other adults living in the same communities (**Figure 1A**). In total, 1,514 tests among farmworkers (22.1%) had positive results, as compared to 1,255 (17.2%) among other adults, corresponding to a 28.5% (95% confidence interval: 20.1-37.4%) higher probability of positive test results among farmworkers (**Figure 1B-C**). The test-positive fraction was similarly higher among men than among women both among farmworkers (23.7%, men vs. 20.5%, women; risk ratio: 1.16, 1.06-1.27) and non-farmworkers (21.7%, men vs. 18.8%, women; risk ratio: 1.15, 1.09-1.23). Point estimates of the test-positive fraction were consistent with equal or higher prevalence of infection among farmworkers across all age and sex strata (**Figure 1D-E**).

Among farmworkers, multiple peaks in the proportion of TMA tests yielding positive results were evident, with the moving average of the test-positive fraction reaching 32.0% (27.2-37.0%) and 30.4% (27.0-34.0%) over the two-week periods surrounding 30 June and 14 August, respectively (**Figure 1C**). After declining from mid-September to early October, both the number of tests and the proportion yielding positive results increased through the remainder of the study period; from 10 October to 23 November, the two-week moving average of the number of tests conducted daily increased from 35.5 to 69.5 among farmworkers and from 38.7 to 104.5 among other adults; the proportion positive increased from 15.4% (12.2-18.8%) to 22.7% (20.0-25.5%) among farmworkers and from 12.1% (9.4-15.1%) to 19.9% (17.9-22.1%) among other adults. This increase in case volume among non-farmworker adults in November, without a commensurate rise among farmworkers, coincided with the annual migration of many Salinas Valley farmworkers to Yuma, Arizona and elsewhere (*25*).

Cross-sectional study

Our cross-sectional study recruited 1,115 farmworkers, including 565 who were tested at clinics and 550 tested via outreach (**Figure 2**). SARS-CoV-2 TMA test results were obtained for 1,111 (99.6%) of these individuals, and ELISAs were conducted for 1,058 (94.9%; **Table 1**). Most of the farmworkers in this study were born in Mexico, spoke Spanish at home, had primary school-level education or less, earned <$25,000 per year, and worked in the fields; 36.3% lived in crowded housing. Most (81.8%) were overweight or obese, and only 4.4% were current smokers. In comparison to farmworkers recruited via outreach, farmworkers recruited at clinics had lower levels of educational attainment and a shorter length of stay in the US; a higher proportion spoke indigenous languages at home (14.9% vs. 4.7%) and reported contact with an individual experiencing respiratory symptoms (17.9% vs. 3.3%).

Overall, 27.2% of participants reported symptoms potentially related to COVID-19 in the last two weeks and 41.2% reported symptoms since the start of the pandemic. A higher proportion of farmworkers recruited at clinics compared to those recruited via outreach reported at least one symptom potentially attributable to COVID-19 in either the two weeks before testing (35.8% vs. 18.4%; **Table 1**) or the period since December 2019 (47.7% vs. 34.7%). A total of 12.7% of all farmworkers tested TMA-positive for current SARS-CoV-2 infection, including 18.7% of farmworkers tested at clinics and 6.6% of those tested via outreach (**Table 1**). In contrast, 19.0% of farmworkers tested via ELISA were found to have antibody evidence of prior infection, with similar prevalence among those tested in the clinics (18.4%) and via outreach (19.4%).

Of all farmworkers who tested TMA-positive, 58.9% reported symptoms in the preceding two weeks, including 64.8% among those recruited from the clinic and 41.7% of those recruited

via outreach (**Table 2**). Overall, 27.2% of those who had any potential COVID-19 symptoms in the two weeks prior to enrollment had current TMA-positive SARS-CoV-2 infection. Prevalence of current infection among farmworkers recruited in the clinic was 34.2% and 10.1% for those reporting any symptoms and no symptoms, respectively. Among farmworkers recruited from outreach testing, current TMA-positive SARS-CoV-2 infection was detected in 14.9% and 4.7% of those reporting any symptoms and no symptoms, respectively. Following adjustment for age, sex, and recruitment setting, the adjusted odds ratio (aOR) of a TMA-positive SARS-CoV-2 test result was 4.16 (2.85-6.06) among farmworkers reporting any of the solicited symptoms in the past two weeks versus those reporting no symptoms (**Figure 3**). Symptoms most strongly associated with current SARS-CoV-2 infection included shortness of breath (aOR: 26.86; 8.78-83.31), loss of smell (aOR: 14.06; 6.37-31.15), loss of taste (aOR: 11.62; 5.52-24.77), and self-reported fever (aOR: 9.06; 5.02-16.39). Each of these symptoms, however, was reported by <25% of individuals with current SARS-CoV-2 infection. The most commonly reported symptoms among individuals testing positive, headache (33.0%) and myalgia (31.6%), were associated with 3.52 (2.31-5.33) and 6.13 (3.83-9.77) fold higher adjusted odds of SARS-CoV-2 RNA detection, respectively.

Individuals who recalled experiencing a blocked nose, sweating, chills, headache, a tickling sensation in the throat, a feeling of pain or pressure in the sinuses, loss of appetite, shortness of breath, fatigue, a loss of taste, a loss of smell since December 2019 had higher antibody reactivity, on average, than individuals who did not recall experiencing such symptoms (**Figure 4A**). We also identified higher antibody reactivity among individuals experiencing wheeze or loss of taste in the preceding two weeks, as well as suggestive associations of higher antibody measurements with chest pain and loss of smell in the preceding two weeks (**Figure**

4B). Quantitative antibody reactivity measures were not found to differ significantly among individuals who were or were not currently infected with SARS-CoV-2 (*p*=0.3), suggesting associations of antibody reactivity with recent symptoms were not attributable to current infection; 30 of 129 TMA-positive individuals (18%) and 168 of 925 TMA-negative individuals (23%) met the threshold for IgG seropositivity.

Reweighting the sample to adjust for differences among individuals tested over time, we estimated the prevalence of current, TMA-positive SARS-CoV-2 infection within the population reached by outreach testing was 5.6% (2.9-10.6%), 7.4% (4.4-12.4%), 4.5% (2.6-7.5%), and 8.0% (5.5-11.7%) over the periods of 16 July to 31 August, 1-30 September, 1-31 October, and 1-30 November, respectively (**Figure 5A**). These results closely tracked patterns in the proportion of tests yielding positive results among all farmworkers tested by CSVS (**Figure 1C**). Over this period, we estimated between 2.0% (0.9-4.4%) and 6.4% (4.0-10.2%) prevalence of current SARS-CoV-2 infection among asymptomatic persons, and between 7.7% (3.7-15.8%) and 17.4% (10.4-29.3%) prevalence of current SARS-CoV-2 infection among individuals experiencing ≥1 symptom. Estimated seroprevalence increased from 10.5% (6.0-18.4%) to 21.2% (16.6-27.4%) over the duration of the study, with similar results among symptomatic and asymptomatic individuals during each period (**Figure 5B**).

DISCUSSION

Among all adults tested for SARS-CoV-2 infection by clinics serving the Monterey County farmworker population, test positivity was 28% higher for farmworkers than for non-farmworkers from the same communities. In comparison to the 6.1% overall test-positive fraction observed in Monterey County over the same period (*26*), test-positivity was 22.1%

among farmworkers tested by CSVS. Within the cross-sectional study subpopulation, we identified sustained, high prevalence of infection, with TMA-positive results among 6.6% of individuals tested in the community and 18.7% of those tested in clinics. We estimated that roughly 10% of the farmworker population became infected over a 3-month period during the study, yielding ~21% seroprevalence by November, 2020. This seroprevalence is well above the 5% seroprevalence noted among California adults in a large-scale assessment of blood specimens submitted for routine clinical screening or clinical management in September (27). A previous study in San Francisco likewise identified elevated infection risk in an urban, low-income and predominantly Latino population, with 6.0% prevalence of current infection among frontline workers and. 7.7% seroprevalence as of late April (28). Our findings demonstrate high infection risk among farmworkers during the ongoing pandemic.

We identified a diverse array of symptoms, including gastrointestinal and other non-respiratory symptoms, associated with SARS-CoV-2 infection. Among individuals found to be TMA-positive for current SARS-CoV-2 infection in our study, 41% did not report experiencing any symptoms in the two weeks preceding their test. Similar results have been reported in other studies (29). Importantly, individuals could have been pre-symptomatic at the time of their interview; additionally, asymptomatic individuals who seek testing may not represent the broader community, for instance if testing is triggered by known exposure SARS-CoV-2 exposure. The estimated 2-6% prevalence of infection among individuals without symptoms in the community suggests substantial risk of exposure to clinically-inapparent cases. Guidance issued for growers to screen farmworkers for fever or other COVID-19 symptoms is thus likely inadequate to prevent workplace infections (30). We also identified associations of higher antibody reactivity with current symptoms including loss of taste and smell, chest pain, and wheeze. Participants in

our study likely experienced these symptoms in a persisting manner beyond the acute infectious stage, as seroconversion typically occurs 8-14 days following initial symptoms (*31*). While the clinical profile of "long COVID" remains to be fully clarified, these same symptoms have been identified as prominent complaints in prior studies along with fatigue, joint pain, and headache (*32–34*).

Our study has limitations. We cannot verify how well our sample represents the farmworker population, many of whom are "hidden" from population statistical measures (*35*); our findings should be taken to represent individuals reached by testing. As we excluded individuals who did not speak Spanish or English sufficiently well to participate in the cross-sectional study, our study likely under-represents indigenous populations (estimated at 13% of Salinas Valley farmworkers (*12*)). Roughly half of our cross-sectional study participants were enrolled in clinic-based testing, among whom infection prevalence was higher. For this reason, our statistical framework accounted for differences between clinic-based and outreach samples. Last, waning antibody titers from infections acquired early in the pandemic may have contributed to under-estimation of seroprevalence, in particular for individuals who experienced mild or asymptomatic infection (*36*).

While Phase 1 vaccination programs have prioritized residents of long-term care facilities and healthcare workers, at the recommendation of the Advisory Committee on Immunization Practices (*37*), prioritization of differing essential workforce groups among Phase 2 recipients will be determined by states. Our study demonstrates high risk of SARS-CoV-2 infection and both acute and persisting symptoms of COVID-19 among farmworkers in California's Salinas Valley, underscoring the urgency of preventive interventions for this population.

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REFERENCES

1. Lewnard JA, Lo NC. Scientific and ethical basis for social-distancing interventions against COVID-19. Lancet Infect Dis. 2020; doi:10.1016/S1473-3099(20)30190-0.

2.	The President's Coronavirus Guidelines for America: 30 days to slow the spread. 2020; available from: https://www.whitehouse.gov/wp-content/uploads/2020/03/03.16.20_coronavirus-guidance_8.5x11_315PM.pdf.

3.	Dyal JW, Grant MP, Broadwater K, Bjork A, Waltenburg MA, Gibbins JD, et al. COVID-19 among workers in meat and poultry processing facilities - 19 states, April 2020. MMWR. 2020; doi:10.15585/mmwr.mm6918e3.

4.	Steinberg J, Kennedy ED, Basler C, Grant MP, Jacobs JR, Ortbahn D, et al. COVID-19 outbreak among employees at a meat processing facility — South Dakota, March–April 2020. MMWR. 2020; doi:10.15585/mmwr.mm6931a2.

5.	Stephenson J. COVID-19 Outbreaks among food production workers may intensify pandemic's disproportionate effects on people of color. JAMA Heal. Forum. 2020; doi:10.1001/jamahealthforum.2020.0783.

6.	Martin P. Immigration and Farm Labor: From Unauthorized to H-2A for Some?. Migration Policy Institute. 2017; available from https://www.migrationpolicy.org/research/immigration-and-farm-labor-unauthorized-h-2a-some.

7.	Barham BL, Melo A, Hertz T. Earnings, wages, and poverty outcomes of US farm and low-skill workers. Appl Econ Perspect Policy. 2020; 307–334..

8.	Kerwin D, Warren R. US Foreign-born workers in the global pandemic: essential and marginalized. J Migr Hum Secur. 2020;8:282–300.

9.	Becot F, Inwood S, Bendixsen C, Henning-Smith C. Health Care and health insurance access for farm families in the United States during COVID-19: essential workers without essential resources? J Agromedicine. 2020; doi:10.1080/1059924X.2020.1814924.

10. Carlisle-Cummins I. COVID-19 farmworker study (COFS): Historic pandemic worsens vulnerability of essential workers who feed us all. 2020; available from: http://covid19farmworkerstudy.org/preliminary-data/.

11. Mora AM, Lewnard JA, Kogut K, Rauch S, Morga N, Jewell N, et al. Impact of the COVID-19 pandemic and vaccine hesitancy among farmworkers from Monterey County, California. medRxiv. 2020; doi:10.1101/2020.12.18.20248518.

12. Villarejo D, Wadsworth G. Farmworker housing study and action plan for Salinas Valley and. Pajaro Valley, April 2018. California Institute for Rural Studies. 2018; available from: https://www.co.monterey.ca.us/home/showdocument?id=63729.

13. Eskenazi B, Bradman A, Gladstone EA, Jaramillo S, Birch K, Holland N. CHAMACOS, a longitudinal birth cohort study: Lessons from the fields. J Child Heal. 2003; doi:10.3109/713610244.

14. Bradman A, Chevrier J, Tager I, Lipsett M, Sedgwick J, Macher J, et al. Association of housing disrepair indicators with cockroach and rodent infestations in a cohort of pregnant Latina women and their children. Environ Health Perspect. 2005; doi:10.1289/ehp.7588.

15. Goldman L, Eskenazi B, Bradman A, Jewell NP. Risk behaviors for pesticide exposure among pregnant women living in farmworker households in Salinas, California. Am J Ind Med. 2004; doi:10.1002/ajim.20012.

16. Villarejo D. California's hired farm workers move to the cities: the outsourcing of responsibility for farm labor housing. California Rural Legal Assistance Priorities Conference. 2014; available from: https://www.crla.org/sites/all/files/u6/2014/rju0214/VillarejoFrmLbrHsngHlth_CRLA_012414.pdf.

17.   Flocks J. The potential impact of COVID-19 on H-2A agricultural workers. J
        Agromedicine. 2020; doi:10.1080/1059924X.2020.1814922.

18.   Smith E, Zhen W, Manji R, Duong S, Berry GH. Analytical and clinical comparison of
        three nucleic acid amplification tests for SARS-CoV-2 detection. J Clin Microbiol. 2020;
        doi:10.1128/JCM.01134-20.

19.   Skittrall JP, Wilson M, Smielewska AA, Parmar S, Fortune MD, Sparkes D, et al.
        Specificity and positive predictive value of SARS-CoV-2 nucleic acid amplification
        testing in a low-prevalence setting. Clin Microbiol Infect. 2020;
        doi:10.1016/j.cmi.2020.10.003.

20.   Mora AM, Lewnard JA, Kogut K, Rauch SA, Morga N, Hernandez S, et al. Risk factors
        for SARS-CoV-2 infection among farmworkers in Monterey County, California.
        medRxiv. 2021; doi:10.1101/2021.02.01.21250963.

21.   Amanat F, Stadlbauer D, Strohmeier S, Nguyen THO, Chromikova V, McMahon M, et al.
        A serological assay to detect SARS-CoV-2 seroconversion in humans. Nat Med. 2020;
        doi:10.1038/s41591-020-0913-5.

22.   Cole SR, Hernán MA. Constructing inverse probability weights for marginal structural
        models. Am J Epidemiol. 2008; doi:10.1093/aje/kwn164.

23.   Honaker J, King G, Blackwell M. Amelia II: A program for missing data. J Stat Softw.
        2011; doi:10.18637/jss.v045.i07.

24.   Ripley B, Venables W, Ripley MP. Package 'nnet.' 2016; available from: https://cran.r-
        project.org/web/packages/nnet/nnet.pdf.

25.   Matthews J. Salinas and Yuma share a common (salad) bowl. 2018; available from:
        https://www.sfchronicle.com/opinion/article/Salinas-and-Yuma-share-a-common-salad-

bowl-13319515.php.

26. E Moreno. COVID-19 data, metrics and updates. Monterey County Health Department, Public Health Bureau. 2020; available from: https://www.co.monterey.ca.us/home/showdocument?id=96259.

27. Havers FP, Reed C, Lim T, Montgomery JM, Klena JD, Hall AJ, et al. Seroprevalence of antibodies to SARS-CoV-2 in 10 sites in the United States, March 23-May 12, 2020. JAMA Intern Med. 2020; doi:10.1001/jamainternmed.2020.4130.

28. Chamie G, Marquez C, Crawford E, Peng J, Petersen M, Schwab D, 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; doi:10.1093/cid/ciaa1234

29. Buitrago-Garcia D, Egli-Gany D, Counotte MJ, Hossmann S, Imeri H, Ipekci AM, et al. Occurrence and transmission potential of asymptomatic and presymptomatic SARS-CoV-2 infections: A living systematic review and meta-analysis. PLoS Med. 2020; doi:10.1371/journal.pmed.1003346.

30. Advisory for agricultural worker protection during COVID-19 crisis on the Central Coast of California. Monterey County Health Department. 2020; available from: https://www.co.monterey.ca.us/home/showdocument?id=88063.

31. Long QX, Liu BZ, Deng HJ, Wu GC, Deng K, Chen YK, et al. Antibody responses to SARS-CoV-2 in patients with COVID-19. Nat Med. 2020; doi:10.1038/s41591-020-0897-1.

32. Mandal S, Barnett J, Brill SE, Brown JS, Denneny EK, Hare SS, et al. "Long-COVID": A cross-sectional study of persisting symptoms, biomarker and imaging abnormalities

following hospitalisation for COVID-19. Thorax. 2020; doi:10.1136/thoraxjnl-2020-215818.

33.   Carfi A, Bernabei R, Landi F. Persistent symptoms in patients after acute COVID-19. JAMA. 2020; doi:10.1001/jama.2020.12603.

34.   Sudre CH, Murray B, Varsavsky T, Graham MS, Penfold RS, Bowyer RC, et al. Attributes and predictors of Long-COVID: analysis of COVID cases and their symptoms collected by the Covid Symptoms Study. medRxiv. 2020; doi:10.1101/2020.10.19.20214494

35.   Bail MK, Foster J, Dalmida SG, Kelly U, Howett M, Ferranti EP, et al. The impact of invisibility on the health of migrant farmworkers in the southeastern United States: A case study from Georgia. Nurs Res Pract. 2012; doi:10.1155/2012/760418.

36.   Choe PG, Kang CK, Suh HJ, Jung J, Song KH, Bang JH, et al. Waning antibody responses in asymptomatic and symptomatic SARS-CoV-2 infection. Emerg Infect Dis. 2021; doi:10.3201/eid2701.203515.

37.   ACIP COVID-19 Vaccines Work Group. Phased allocation of COVID-19 vaccines. 2020; available from: https://www.cdc.gov/vaccines/acip/meetings/downloads/slides-2020-12/COVID-02-Dooling.pdf).

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Table 1: Characteristics of the study population, by recruitment setting, Monterey County farmworkers cross-sectional study, July 16 to November 30 2020, *N*=1115.

Attribute		All enrolled *n* (%)[1]	Clinic *n* (%)[1]	Outreach *n* (%)[1]
		N=1,115	*N*=565	*N*=550
Age				
	18-29	277 (24.8)	140 (24.7)	137 (24.9)
	30-39	274 (24.6)	136 (24.0)	138 (25.1)
	40-49	298 (26.7)	163 (28.8)	135 (24.5)
	50-59	200 (17.9)	90 (15.9)	110 (20.0)
	≥60	66 (5.9)	36 (6.4)	30 (5.5)
Sex				
	Female	586 (52.6)	302 (53.5)	284 (51.6)
	Male	529 (47.4)	263 (46.5)	266 (48.4)
Country of birth				
	Mexico	929 (83.3)	486 (86.0)	443 (80.5)
	US	142 (12.7)	49 (8.7)	93 (16.9)
	Other	44 (3.9)	30 (5.3)	14 (2.5)
Language spoken at home				
	Spanish	948 (85.0)	460 (81.4)	488 (88.7)
	English	57 (5.1)	21 (3.7)	36 (6.5)
	Indigenous language	110 (9.9)	84 (14.9)	26 (4.7)
Education				
	Never attended	62 (5.6)	48 (8.5)	14 (2.5)
	Some primary school	430 (38.6)	229 (40.5)	201 (36.5)
	Primary school complete	238 (21.3)	119 (21.1)	119 (21.6)
	Some high school	142 (12.7)	68 (12.0)	74 (13.5)
	High school complete	242 (21.7)	100 (17.7)	142 (25.8)
	No response	1	1	0
Family income				
	<$25,000	560 (52.8)	291 (54.3)	269 (51.4)
	$25,000-34,999	260 (24.6)	112 (20.9)	148 (28.3)
	$35,000-49,999	162 (15.3)	86 (16.0)	76 (14.5)
	≥$50,000	77 (7.3)	47 (8.8)	30 (5.7)
	No response	56	29	27
Years in US				
	<15	262 (26.9)	157 (30.4)	105 (23.0)
	15-19	194 (19.9)	110 (21.3)	84 (18.4)
	20-29	299 (30.7)	141 (27.3)	158 (34.6)
	≥30	217 (22.3)	107 (20.7)	110 (24.1)
	No answer	1 (0.1)	1 (0.2)	0 (0.0)
H2A visa holder				
	Holds H2A visa	65 (6.8)	20 (4.0)	45 (10.0)
	No response	155	56	99
Community				
	Salinas	492 (44.1)	263 (46.5)	229 (41.6)
	Northern Monterey County	73 (6.5)	18 (3.2)	55 (10.0)
	Southern Monterey County	539 (48.3)	284 (50.3)	255 (46.4)
	Outside Monterey County	11 (1.0)	0 (0.0)	11
Household size				
	0 others	12 (1.1)	8 (1.4)	4 (0.7)
	1-3 others	399 (35.8)	187 (33.1)	212 (38.6)
	4-6 others	515 (46.2)	259 (45.8)	256 (46.5)
	≥7 others	189 (17.0)	111 (19.7)	78 (14.2)
Children in household				
	Any children	836 (75.0)	440 (77.9)	396 (72.1)
	No response	1	0	1
Children attending school/daycare				
	Any children	85 (7.7)	57 (10.1)	28 (5.1)
	No response	4	3	1
Residential overcrowding				
	<2 persons/bedroom	490 (44.0)	224 (39.7)	266 (48.4)
	≥2 to <4 persons/bedroom	510 (45.7)	289 (51.2)	221 (40.2)
	≥4 persons/bedroom	115 (10.3)	52 (9.2)	63 (11.5)
Ability to isolate at home if infected				
	Live alone or have >1 bedroom and bathroom	643 (57.7)	330 (58.4)	313 (56.9)

Size of company				
	<25 workers	108 (11.5)	49 (10.1)	59 (12.9)
	25-49 workers	132 (14.1)	67 (13.9)	65 (14.3)
	50-499 workers	447 (47.6)	229 (47.4)	218 (47.8)
	≥500 workers	252 (26.8)	138 (28.9)	114 (25.0)
	No answer	176	82	94
Work setting				
	Indoors only	192 (17.2)	103 (18.3)	89 (16.2)
	Outdoors only	849 (76.2)	425 (75.4)	424 (77.1)
	Indoor/outdoor	73 (6.6)	36 (6.4)	37 (6.7)
	No response	1	1	0
Type of agricultural work				
	Working in the fields	830 (74.4)	416 (73.6)	414 (75.3)
	Packing shed	133 (11.9)	65 (11.5)	68 (12.4)
	Processing facility	64 (5.74)	34 (6.0)	30 (5.5)
	Nursery	40 (3.6)	18 (3.2)	22 (4.0)
	Truck driver	38 (3.4)	19 (3.4)	19 (3.5)
	Packing truck	22 (1.97)	15 (2.7)	7 (1.3)
	Other	21 (1.88)	12 (2.1)	9 (1.6)
	No response	10 (0.9)	10 (1.8)	0 (0.0)
Commute to work				
	Alone/with household members only	714 (65.6)	341 (61.6)	373 (69.9)
	With non-household members	374 (34.4)	213 (38.4)	161 (30.1)
	No response	27	11	16
Body mass index				
	<18.5 (underweight0	4 (0.4)	2 (0.4)	2 (0.4)
	18.5-24.9 (normal)	194 (17.8)	106 (19.4)	88 (16.2)
	25-29.9 (overweight)	423 (38.9)	212 (38.9)	211 (38.9)
	≥30 (obese)	466 (42.9)	225 (41.3)	241 (44.5)
	Not collected	28	20	8
Smoking				
	Never smoked	907 (81.4)	460 (81.6)	447 (81.3)
	Former smoker	158 (14.2)	86 (15.2)	72 (13.1)
	Current smoker	49 (4.4)	18 (3.2)	31 (5.6)
	No response	1	1	0
Contact with ARI cases				
	None	971 (89.3)	449 (82.1)	522 (96.7)
	At work only	66 (6.1)	54 (9.9)	12 (2.2)
	At home only	44 (4.0)	38 (6.9)	6 (1.1)
	At home and work	6 (0.6)	6 (1.1)	0 (0.0)
	No response	28	18	10
Attended gatherings				
	Attended in preceding 2 weeks	113 (10.2)	50 (8.9)	63 (11.5)
	No response	2	1	1
Recent COVID-19 symptoms				
	Symptoms in preceding 2 weeks	301 (27.2)	200 (35.8)	101 (18.4)
	No response	7	0	7
History of COVID-19 symptoms				
	Symptoms since pandemic started	457 (41.2)	266 (47.7)	191 (34.7)
	No response	7	7	0
SARS-CoV-2 infection				
	Positive TMA result	141 (12.7)	105 (18.7)	36 (6.6)
	TMA result not available	4	2	2
Prior SARS-CoV-2 infection				
	Positive antibody result	201 (19.0)	97 (18.4)	104 (19.5)
	Antibody result not available	57	39	18

Values in parentheses are the proportion, calculated excluding persons for whom data were not available. Clinic participants are those recruited on clinic premises, where they may have been seeking care for COVID-19 or any other cause. Outreach participants are those recruited at mobile testing operations in the community, who were not seeking medical care.

Table 2: Prevalence of SARS-CoV-2 infection by transcription-mediated amplification assay, symptoms, and recruitment setting.

Symptom	Frequency of symptoms among all participants and test positivity among individuals with listed symptoms, n (%)					
	All participants		*Clinic participants*		*Outreach participants*	
	Frequency[1]	Infected[2]	Frequency[1]	Infected[2]	Frequency[1]	Infected[2]
	N=1,108		*N*=558		*N*=550	
Non-productive cough	68 (6.1)	31 (45.6)	47 (8.4)	26 (55.3)	21 (3.8)	5 (23.8)
Productive cough	68 (6.1)	25 (37.3)	51 (9.1)	21 (42.0)	17 (3.1)	4 (23.5)
Pain or pressure in the ears	24 (2.2)	10 (41.7)	19 (3.4)	10 (52.6)	5 (0.9)	0 (0.0)
Blocked nose	62 (5.6)	22 (36.1)	50 (9.0)	19 (38.8)	12 (2.2)	3 (25.0)
Runny nose	78 (7.0)	24 (31.2)	56 (10.0)	18 (32.7)	22 (4.0)	6 (27.3)
Sneezing	95 (8.6)	21 (22.3)	61 (10.9)	16 (26.7)	34 (6.2)	5 (14.7)
Watery eyes	57 (5.1)	14 (25.0)	48 (8.6)	14 (29.8)	9 (1.6)	0 (0.0)
Hoarseness	49 (4.4)	19 (38.8)	42 (7.5)	17 (40.5)	7 (1.3)	2 (28.6)
Self-reported fever[3]	56 (5.1)	33 (58.9)	47 (8.4)	29 (61.7)	9 (1.6)	4 (44.4)
Sweating	48 (4.3)	22 (45.8)	40 (7.2)	20 (50.0)	8 (1.5)	2 (25.0)
Chills	74 (6.7)	35 (47.3)	63 (11.3)	33 (52.4)	11 (2.0)	2 (18.2)
Headache	147 (13.3)	46 (31.5)	100 (17.9)	39 (39.4)	47 (8.5)	7 (14.9)
Tickle in throat	49 (4.4)	17 (34.7)	36 (6.5)	15 (41.7)	13 (2.4)	2 (15.4)
Sore throat	103 (9.3)	32 (31.1)	78 (14.0)	29 (37.2)	25 (4.5)	3 (12.0)
Myalgia	97 (8.8)	44 (45.8)	79 (14.2)	40 (51.3)	18 (3.3)	4 (22.2)
Chest pain	26 (2.3)	11 (42.3)	21 (3.8)	10 (47.6)	5 (0.9)	1 (20.0)
Sinus pain	17 (1.5)	7 (41.2)	14 (2.5)	7 (50.0)	3 (0.5)	0 (0.0)
Swollen glands	18 (1.6)	5 (27.8)	11 (2.0)	5 (45.5)	7 (1.3)	0 (0.0)
Loss of appetite	38 (3.4)	21 (55.3)	32 (5.7)	18 (56.2)	6 (1.1)	3 (50.0)
Difficulty breathing	34 (3.1)	18 (52.9)	27 (4.8)	16 (59.3)	7 (1.3)	2 (28.6)
Wheezing	15 (1.4)	6 (40.0)	12 (2.2)	6 (50.0)	3 (0.5)	0 (0.0)
Shortness of breath	22 (2.0)	18 (81.8)	19 (3.4)	16 (84.2)	3 (0.5)	2 (66.7)
Diarrhea	40 (3.6)	15 (37.5)	33 (5.9)	14 (42.4)	7 (1.3)	1 (14.3)
Nausea	39 (3.5)	13 (33.3)	32 (5.7)	13 (40.6)	7 (1.3)	0 (0.0)
Stomach pain	47 (4.2)	15 (31.9)	34 (6.1)	12 (35.3)	13 (2.4)	3 (23.1)
Trouble thinking	18 (1.6)	5 (27.8)	10 (1.8)	5 (50.0)	8 (1.5)	0 (0.0)
Fatigue	94 (8.5)	33 (35.5)	70 (12.5)	31 (44.9)	24 (4.4)	2 (8.3)
Loss of sense of taste	33 (3.0)	22 (66.7)	26 (4.7)	18 (69.2)	7 (1.3)	4 (57.1)
Loss of sense of smell	32 (2.9)	22 (68.8)	25 (4.5)	19 (76.0)	7 (1.3)	3 (42.9)
Pain or pressure in the eyes	25 (2.3)	6 (24.0)	16 (2.9)	6 (37.5)	9 (1.6)	0 (0.0)
No response	7		7		0	
Any symptom	301 (27.2)	83 (27.7)	200 (35.8)	68 (34.2)	101 (18.4)	15 (14.9)
No symptoms	807 (72.8)	57 (7.1)	358 (64.2)	36 (10.1)	449 (81.6)	21 (4.7)

Values in parentheses are the proportion, calculated excluding persons for whom data were not available. Clinic participants are those recruited on clinic premises, where they may have been seeking care for COVID-19 or any other cause. Outreach participants are those recruited at mobile testing operations in the community, who were not seeking medical care.

[1]Proportions are computed among all tested

[2]Proportions indicate the prevalence of current, TMA-positive infection among those with the indicated symptom(s) in the last two weeks.

[3]Participants were not asked to verify whether they recorded their body temperature.

Figure 1: SARS-CoV-2 diagnoses at CSVS. We plot two-week moving averages of the (**A**) number of patients tested by CSVS; (**B**) the number of SARS-CoV-2 infection diagnoses; and (**C**) the proportion of tests yielding positive results, with shading for 95% confidence intervals. Below, we plot age- and sex- stratified test-positive fractions for (**D**) female and (**E**) male patients. Vertical lines in panels **A-C** indicate the date of initiation of the cross-sectional study (July 16, 2020).
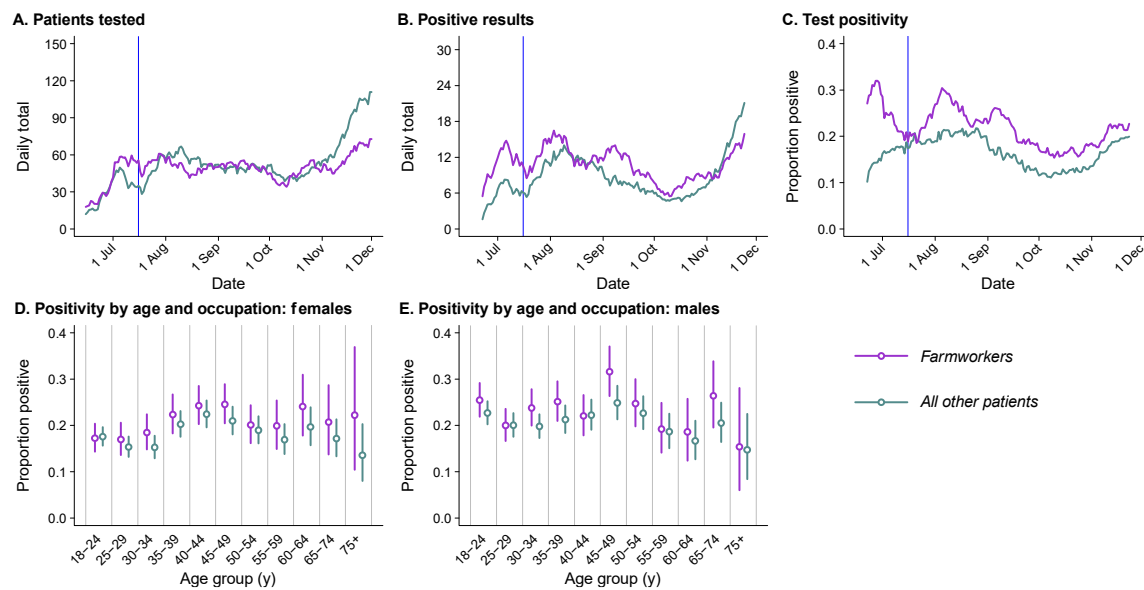
Figure 2: Participants recruited into the cross-sectional study. We indicate the number of patients recruited at each participating CSVS clinic as well as the outreach venues where participants were recruited in the community. We indicate the number and proportion of participants reporting symptoms or exposure to a known or suspected COVID-19 case in the prior two weeks for both the clinic-based and outreach samples.

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┌─────────────────────────────────┐        ┌──────────────────────────────────────────────────────────────────┐
│ 565 recruited at CSVS clinics   │        │ 67 (12%) symptomatic with known or suspected exposure              │
│ 239 (42%) Sanborn               │        │ 128 (23%) symptomatic without known or suspected exposure          │
│ 244 (43%) Greenfield            │───────▶│ 89 (16%) asymptomatic with known or suspected exposure             │
│ 1 (<1%) King City               │        │ 263 (47%) asymptomatic without known or suspected exposure         │
│ 19 (3%) Soledad                 │        │ 18 (3%) missing symptom or exposure data                           │
│ 23 (4%) Circle                  │        └──────────────────────────────────────────────────────────────────┘
│ 27 (5%) North Main              │
│ 12 (2%) Castroville             │
└─────────────────────────────────┘


┌─────────────────────────────────┐        ┌──────────────────────────────────────────────────────────────────┐
│ 550 recruited via outreach testing│      │ 30 (5%) symptomatic with known or suspected exposure               │
│ 108 (20%) Clinic-based health fair│      │ 65 (12%) symptomatic without known or suspected exposure           │
│ 260 (47%) Farmworker housing visits│────▶│ 36 (7%) asymptomatic with known or suspected exposure              │
│ 51 (9%) Agriculture employer visits│     │ 401 (73%) asymptomatic without known or suspected exposure         │
│ 131 (24%) Other recruitment     │        │ 18 (3%) missing symptom or exposure data                           │
└─────────────────────────────────┘        └──────────────────────────────────────────────────────────────────┘
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Figure 3: Association of symptoms with current TMA-positive infection. We illustrate the prevalence of each symptom in the two weeks preceding testing among individuals who tested positive and negative for SARS-CoV-2 infection via TMA, as well as the adjusted odds ratio (aOR) conveying the association of each symptom wi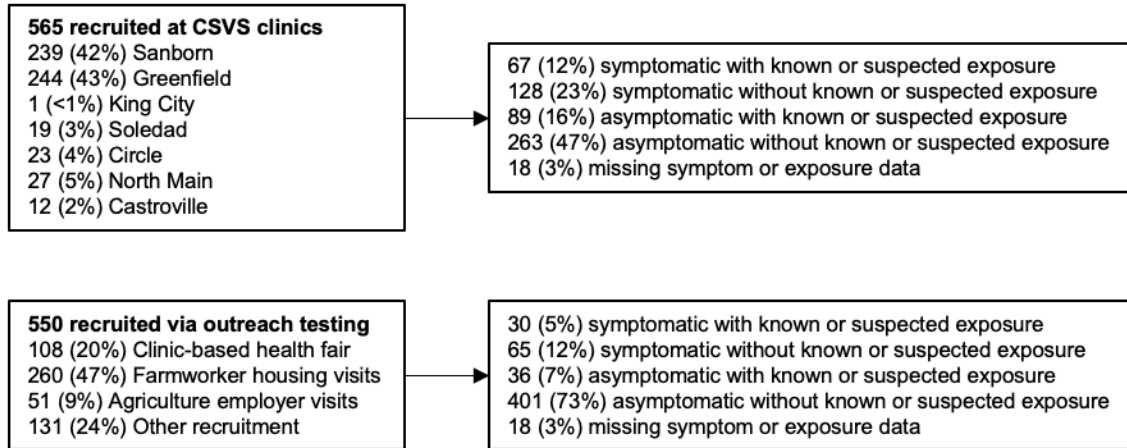th current infection. We obtain aORs via logistic regression, controlling for age group, sex, and recruitment venue (clinic-based or outreach sample). Lines denote 95% confidence intervals around point estimates.

Symptom	TMA negative	TMA positive	aOR (95% CI)
Non-productive cough	3.8	21.8	5.99 (3.51–10.23)
Productive cough	4.5	18.1	3.96 (2.26–6.87)
Pain or pressure in the ears	1.5	7.1	3.90 (1.64–9.26)
Blocked nose	4.2	15.8	3.20 (1.81–5.66)
Runny nose	5.6	17.4	3.00 (1.76–5.14)
Sneezing	7.7	15.2	1.96 (1.15–3.38)
Watery eyes	4.5	10.3	1.70 (0.88–3.23)
Hoarseness	3.1	13.4	3.40 (1.83–6.33)
Self-reported fever	2.5	23.4	9.06 (5.02–16.39)
Sweating	2.7	15.7	4.94 (2.66–9.17)
Chills	4.0	24.8	5.95 (3.53–9.97)
Headache	10.5	33.0	3.52 (2.31–5.33)
Tickle in the throat	3.4	12.0	3.15 (1.67–5.94)
Sore throat	7.4	23.0	2.98 (1.83–4.83)
Myalgia	5.5	31.6	6.13 (3.83–9.77)
Chest pain	1.6	7.7	3.84 (1.69–8.79)
Sinus pain	1.0	5.1	4.02 (1.47–10.81)
Swollen grands	1.4	3.5	2.38 (0.80–7.16)
Loss of appetite	1.8	15.0	7.26 (3.66–14.34)
Difficulty breathing	1.7	12.7	6.60 (3.21–13.63)
Wheezing	0.9	4.2	3.66 (1.24–10.87)
Shortness of breath	0.4	12.8	26.86 (8.78–83.31)
Diarrhea	2.7	10.7	3.35 (1.70–6.61)
Nausea	2.7	9.3	2.84 (1.39–5.76)
Stomach pain	3.4	10.8	2.72 (1.40–5.20)
Trouble thinking	1.3	3.5	2.56 (0.85–7.64)
Fatique	6.3	23.7	3.67 (2.25–5.95)
Loss of sense of taste	1.3	15.6	11.62 (5.52–24.77)
Loss of sense of smell	1.1	15.7	14.06 (6.37–31.15)
Pain or pressure in the eyes	2.0	4.2	1.93 (0.74–5.08)
Any symptom	22.9	59.5	4.16 (2.85–6.06)

TMA negative
TMA positive
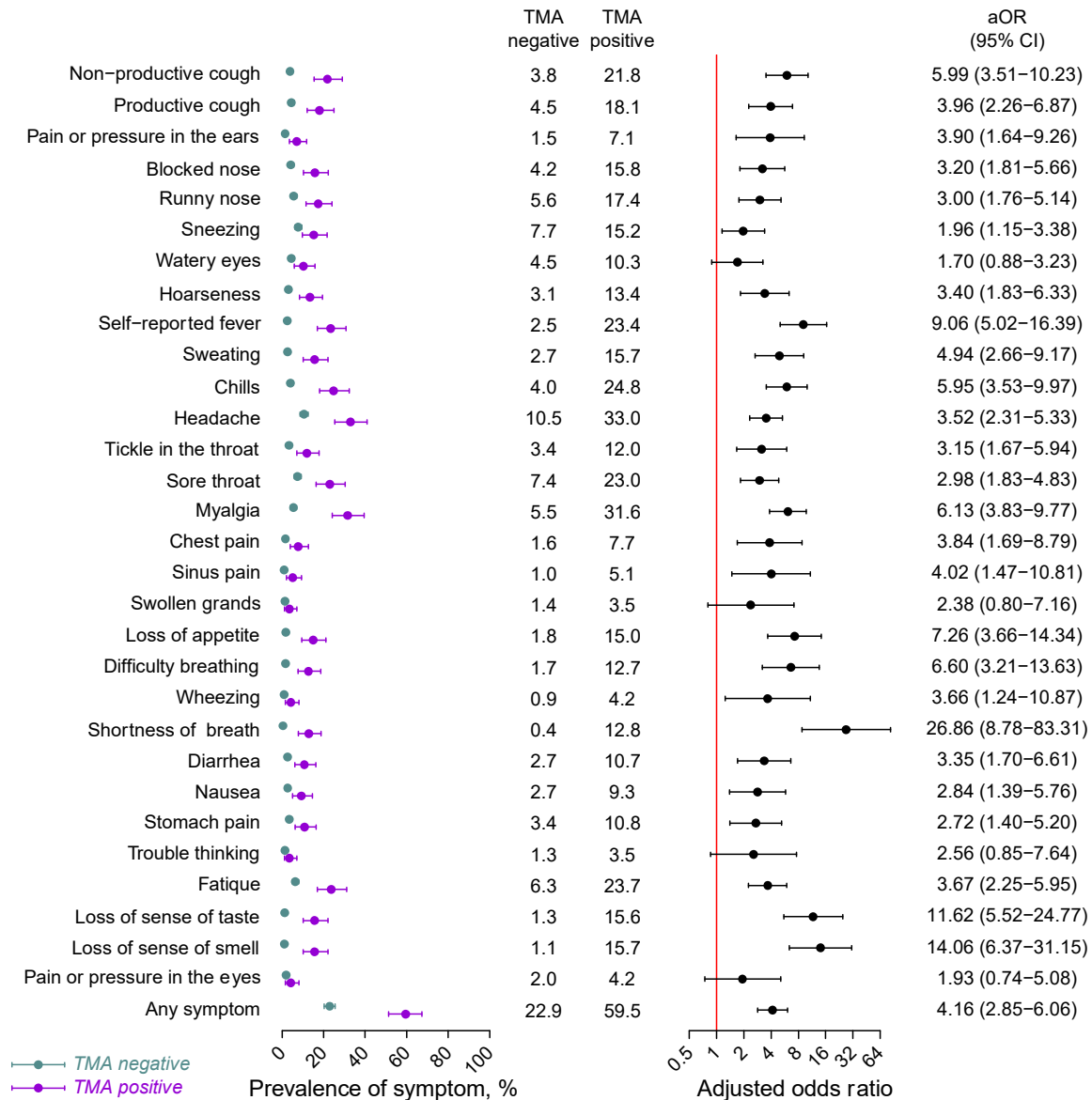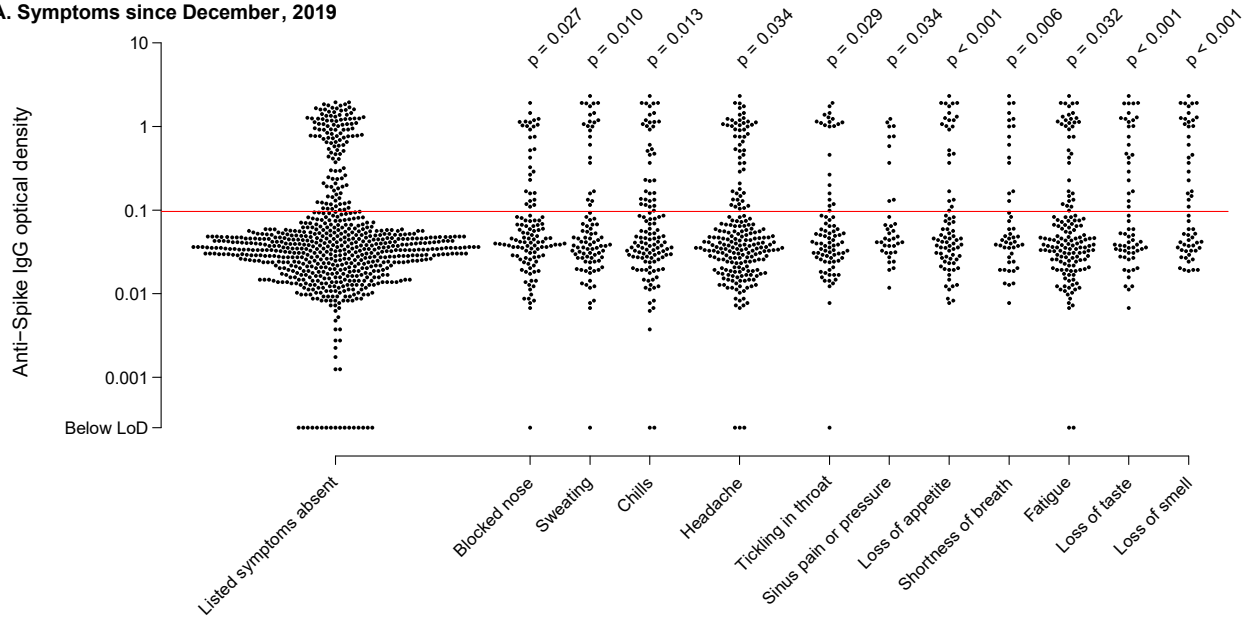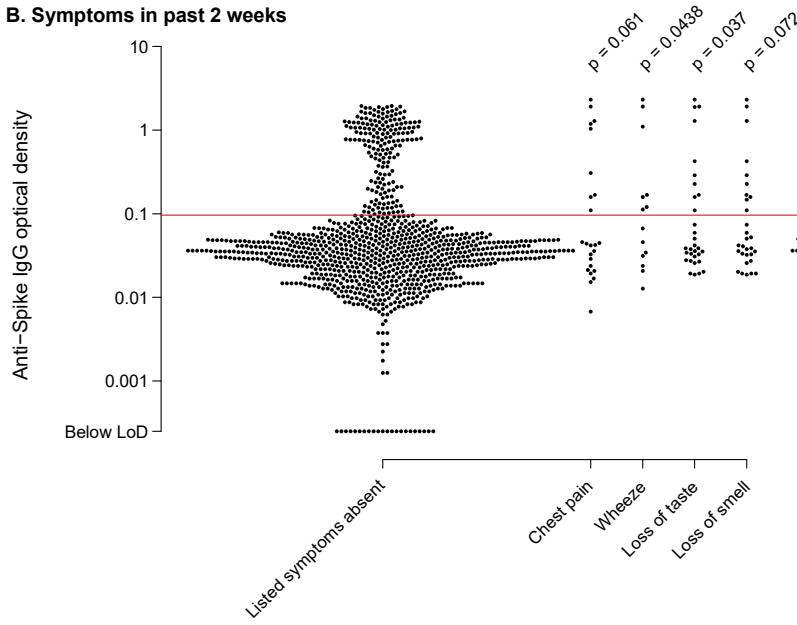Prevalence of symptom, %
Adjusted odds ratio

Figure 4: Anti-spike IgG antibody reactivity and association with recalled symptoms. We plot distributions of antibody reactivity (optical density, OD) among individuals who (**A**) reported experiencing or did not report experiencing various symptoms potentially associated with COVID-19 since December, 2019; (**B**) reported experiencing or did not report experiencing various symptoms in the two weeks before enrollment (data not shown for symptoms with $p>0.1$); and (**C**) had a positive or negative SARS-CoV-2 TMA test result at the enrollment visit. Reported p-values are measured in logistic regression models with the occurrence of each symptom as the outcome and antibody ELISA OD values (log-transformed) as predictors, with adjustment for age group and sex.

A. Symptoms since December, 2019

Anti–Spike IgG optical density

p = 0.027 p = 0.010 p = 0.013 p = 0.034 p = 0.029 p = 0.034 p < 0.001 p = 0.006 p = 0.032 p < 0.001 p < 0.001

10
1
0.1
0.01
0.001
Below LoD

Listed symptoms absent, Blocked nose, Sweating, Chills, Headache, Tickling in throat, Sinus pain or pressure, Loss of appetite, Shortness of breath, Fatigue, Loss of taste, Loss of smell

B. Symptoms in past 2 weeks

Anti–Spike IgG optical density

p = 0.061 p = 0.0438 p = 0.037 p = 0.072

10
1
0.1
0.01
0.001
Below LoD

Listed symptoms absent, Chest pain, Wheeze, Loss of taste, Loss of smell

C. Current infection

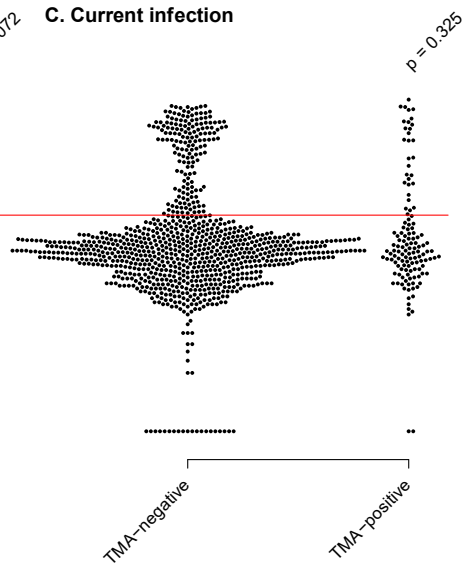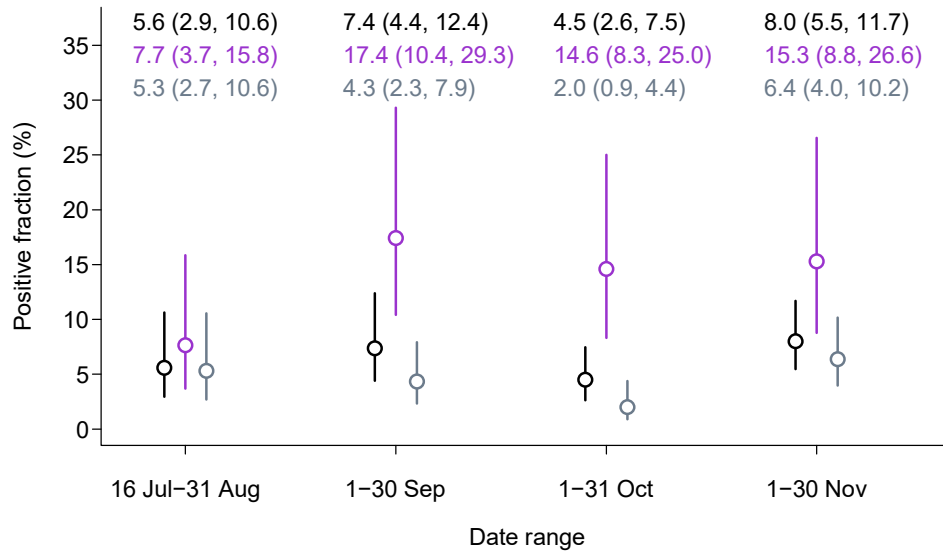p = 0.325

TMA–negative, TMA–positive

Figure 5: Community prevalence of SARS-CoV-2 positivity by TMA and seropositivity over time. We plot estimated prevalence of SARS-CoV-2 infection and seropositivity in samples reweighted to correct for differences in the population seeking testing over the course of the study. Lines delineate 95% confidence intervals around point estimates.