Infect Dis Ther
https://doi.org/10.1007/s40121-024-00923-4

BRIEF REPORT

Longitudinal Molecular and Serological Evidence of SARS-CoV-2 Infections and Vaccination Status: Community-Based Surveillance Study (CONTACT)

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Received: August 23, 2023 / Accepted: January 12, 2024

ABSTRACT

Introduction: This prospective, longitudinal, community-based study, EpidemiologiCal POpulatioN STudy of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in Lake CounTy, Illinois (CONTACT), investigated coronavirus disease 2019 (COVID-19) immunity, occupational risks related to SARS-CoV-2 exposure, and long-term immunoglobulin G (IgG) seroconversion kinetics.
Methods: At baseline and follow up (3, 6, and 9 months), non-hospitalized adult participants provided nasal and blood serum specimens for molecular [reverse transcription polymerase chain reaction (RT-PCR)] and serological (IgG) testing (4 November 2020–30 October 2021).
Results: At baseline, 6.4% (65/1008) had evidence of current/prior SARS-CoV-2 infection. At 3, 6, and 9 months, positive PCR tests were obtained from 0.4% (3/781), 0.4% (3/733), and 0% (0/673) of participants, respectively. Positive IgG occurred at baseline and 3, 6, and 9 months in 4.5% (45/1008), 6.0% (48/799), 5.4% (39/733), and 2.8% (19/673) of participants, respectively. Of participants positive for IgG at baseline, 28 had a negative IgG test at a follow-up visit; of those 28, 21 had their first negative IgG test within 6 months. Participants were more likely to retain positive IgG if they were 18–29 years of age, were male, or had medium-high/high-risk occupations. A high vaccination

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s40121-024-00923-4.

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Published online: 10 March 2024

rate (70% received ≥ 1 dose by 9 months) was observed. Influence of occupational status or characteristics on transmission and IgG, and COVID-19 vaccination trends, are shown.
Conclusions: This study expands on prior studies assessing COVID-19 immunity and IgG seroconversion by including both RT-PCR and serologic testing and longitudinal follow-up of study participants. We observed decreased infection rates over the 9 month follow-up period as well as a decline in IgG persistency after 6 months. The findings from this community-based study regarding vaccinate rates, infection rates by PCR, and IgG persistency over time can help improve our understanding of COVID-19 immunity, occupational risks related to SARS-CoV-2 exposure, and the kinetics of long-term IgG seroconversion, which is important to help guide local and national mitigation strategies.
Clinical Trial Registration: NCT04611230.

Keywords: SARS-CoV-2; COVID-19; Epidemiology; Community-based research

Key Summary Points

Why carry out this study?

Our understanding of COVID-19 transmission dynamics and immunity continues to evolve.

Furthering knowledge on how population-level factors may impact transmission over time and characterizing the persistence of IgG response with infection may provide valuable insight into potential mitigation strategies.

We conducted a unique, prospective, longitudinal, community-based study that investigated COVID-19 immunity, occupational risks related to SARS-CoV-2 exposure, and long-term IgG seroconversion kinetics.

What has been learned from the study?

Approximately 6.4% of participants had evidence of current or prior SARS-CoV-2 infection at baseline, with 0.4%, 0.4%, and 0% (i.e., no new infections) having positive PCR tests and 4.5%, 5.4%, and 2.8% IgG having positive tests at 3,6, and 9 months, respectively.

Participants aged 18–29 years, of male sex, or in medium-high/high-risk occupations were more likely to have positive IgG status.

Our study is one of a few studies that includes longitudinal follow-up with IgG evidence and prospectively combines molecular and serological testing with high-quality specimen collection during the height of the COVID-19 pandemic, which can inform population-level transmission and IgG seroconversion kinetics

INTRODUCTION

After first being identified in China in December 2019, coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) spread at an unprecedented rate, leading to the World Health Organization declaring a global pandemic (March 2020) [1, 2]. Susceptibility and disease severity differ according to patient demographics and occupation-related factors [3–7]. Although COVID-19 risk factors are better known than at the start of the pandemic [8], most evidence has emerged from cross-sectional studies. Understanding how population-level factors impact transmission over time and how the IgG response with infection persists would provide insight into potential mitigation strategies.

To address these evidence gaps and improve our understanding of COVID-19 immunity on a long-term basis, we conducted the epidemiological study titled, EpidemiologiCal POpulatioN STudy of SARS-CoV-2 in Lake CounTy, Illinois (CONTACT); it was a prospective, longitudinal, community-based study. Here we present the epidemiology of SARS-CoV-2 infection as shown by reverse transcriptase polymerase chain reaction (RT-PCR) and immunoglobulin G (IgG) persistency against the SARS-CoV-2 nucleoprotein (N protein) over time in participants with varying occupational risk exposure for COVID-19.

METHODS

Study Design and Sample Collection

The full CONTACT methodology has been previously published [9]. Briefly, CONTACT was an observational, direct-to-participant, community-based prospective epidemiological study of adult participants who were currently living or employed in Lake County, IL, between 4 November 2020 and 30 October 2021; current employment was not a requirement for participation. Enrollees were followed longitudinally for a 9-month period (± 2 weeks) with self-reported study data from questionnaires collected every 2 weeks via a web-based study portal (Fig. S1). Self-reported study data included reporting on vaccination status, once vaccines became available, and was collected from 3 months through the duration of the study. Participants were asked whether they had received a vaccine, and the date of vaccination if yes, and whether they had received a second vaccination dose, and if not, whether they intended to receive a second dose. Data on type or supplier of vaccination were not collected. Nasal and serum specimens were taken by trained healthcare personnel at one of three sites located in Lake County, IL, for molecular (RT-PCR) testing and serological (IgG) testing against the SARS-CoV-2 N protein at baseline and at 3, 6, and 9 months [9]. RT-PCR was conducted according to manufacturer's instructions, which include positive and negative controls [Roche Cobas® (Roche Diagnostics, Basel, Switzerland)]. The full analysis set contained all enrolled participants who completed baseline questionnaires and baseline SARS-CoV-2 PCR and IgG testing. Participants were stratified into one of four groups on the basis of occupational risk: low risk (jobs that do not require close contact with the general public or coworkers); low-to-medium risk (infrequent contact with the general public or coworkers); medium-to-high risk (jobs requiring frequent contact with the general public or coworkers); and high risk (jobs requiring frequent and/or close contact with individuals with high potential risk for exposure to known or suspected cases of COVID-19) [10]. Attempts were made to over-recruit those in higher-risk occupations. Participants were compensated a fair market value per visit for time and travel to the sample collection center. This compensation amount was approved by the institutional review board.

Ethical Approval

The protocol, informed consent form, and all communications to study participants including advertising pieces were reviewed and approved by an institutional review board (Advarra, Inc). All participants provided informed consent prior to completion of questionnaires and specimen collection.

Study Objectives

The study objectives presented here include (1) SARS-CoV-2 infection at baseline and at 3, 6, and 9 months; (2) IgG persistence; (3) association between IgG persistency/testing and variables of interest (i.e., baseline characteristics and occupational exposure); and when vaccination became available in Lake County, IL, an objective to describe (4) COVID-19 vaccination rates over time was added.

Statistical Analysis

Proportions were estimated overall by sample proportion and subgroups of interest at baseline

and at 3, 6, and 9 months. Time to first infection was summarized using Kaplan–Meier curves by occupation risk group. This study was descriptive and exploratory in nature, and no formal hypotheses were tested. Data were analyzed using Statistical Analysis System (SAS)® version 9.4 (SAS Institute, Cary, NC, USA).

Quality Assurance

Steps taken to minimize bias have been previously reported (e.g., collection of self-reported data prior to each specimen sampling and remote monitoring of testing collection sites) [9]. Assays with high specificity were used as previously described [9]. The same assays were used for the full study duration.

RESULTS

Study Cohort

In total, 1267 eligible participants completed the baseline questionnaire and were enrolled (November 2020 to January 2021). Of these, 1008 (79.6%) completed baseline SARS-CoV-2 molecular and serological testing (Fig. S2; Table 1). As noted in the previous study publication, the proportions of patients in each workplace exposure risk group was highest in the low-risk group, followed by the medium-to-low-risk and medium-to-high-risk groups, and lowest in the high-risk group [9].

Longitudinal Molecular and Serological Testing of Study Population

Overall, at baseline, 6.4% (65/1008) had evidence of current (i.e., positive PCR test) or prior (i.e., IgG positive) SARS-CoV-2 infection. Of those who provided nasal samples and tested positive for SARS-CoV-2 infection via PCR test, 70.0% (14/20) were symptomatic (Table 2). Of those who provided nasal samples for PCR testing during follow-up visits, 0.4% (3/781) tested positive at month 3, 0.4% (3/733) tested positive at month 6, and 0% (0/673) tested positive at month 9.

At baseline, 4.5% (45/1008) of participants who provided blood specimens for IgG testing tested positive for prior SARS-CoV-2 infection (Table 2), of whom, 28 (62.2%) had a negative IgG at one of the follow-up visits. Of those 28, 7 were IgG-negative for the first time at month 3 (25.0%), 14 at month 6 (50.0%), and 7 at month 9 (25.0%). At baseline, 95.5% (963/1008) of participants had negative IgG tests. Of those, 41 (4.3%) had a positive subsequent test. Of those 41, positive tests occurred for 26 (63.4%) at month 3, 12 (29.3%) at month 6, and 3 (7.3%) participants at month 9. Of the 26 participants who had negative baseline IgG and positive IgG at month 3, 18 (69.2%) had a subsequent negative test at one of the follow-up visits. Of those 18, 9 (50%) tested negative at month 6, and 9 (50%) tested negative at month 9. Of those who tested negative at baseline but positive at month 6 (n = 12), 54.6% (n = 6) tested negative at month 9 (Table 2).

Persistence of IgG Seropositivity by Subgroup

IgG against N protein was detected in a total of 86 participants at one point during the duration of the study including baseline, among whom 52 subsequently demonstrated antibody waning below detectable level (Table 3). Persistency of IgG seropositivity by subgroup was also reported; however, no statistical comparisons were made. Participants in medium-to-high- and high-risk groups were numerically more likely to retain IgG positivity at a subsequent visit (12 of 22 and 8 of 15, respectively) than those in low- and medium-to-low-risk groups (7 of 29 and 7 of 20, respectively). Those aged 18–29 years were more likely to retain IgG positivity (5 out of 8) than other age groups, and those between ages 40 and 49 years were least likely (12 of 14 participants had subsequent negative tests). In terms of sex, women had a greater likelihood than men to have a subsequent negative result after testing IgG-positive (40 versus 19 participants for females; 12 versus 15 participants for males; Table 3).

Table 1 Participant baseline demographics and clinical characteristics

Characteristic	Baseline (N = 1008)
State of residence,[a] *n* (%)	
Illinois	992 (98.4)
Indiana	16 (1.6)
Age at baseline (years)[b]	
Mean ± SD	51.4 ± 13.8
Age group (years), *n* (%)	
18–29 years	78 (7.7)
30–39 years	147 (14.6)
40–49 years	173 (17.2)
50–64 years	451 (44.7)
65–74 years	140 (13.9)
75–84 years	15 (1.5)
85+ years	4 (0.4)
Sex, *n* (%)	
Female	713 (70.7)
Male	293 (29.1)
Other	2 (0.2)
Race, *n* (%)	
White	924 (91.7)
Asian	40 (4.0)
Other	28 (2.8)
Black or African American	10 (1.0)
American Indian or Alaska Native	4 (0.4)
Native Hawaiian or other Pacific Islander	2 (0.2)
Ethnic origin, *n* (%)	
Not Hispanic or Latino	954 (94.6)
Hispanic or Latino	53 (5.3)
Prefer not to say	1 (< 0.1)
BMI (kg/m^2) at baseline[c]	
Mean ± SD	28.4 ± 6.2
Vaccination against COVID-19, *n* (%)	
Yes	7 (0.7)
No	968 (96.0)
I do not know	33 (3.3)
Participating in another COVID-19 study, *n* (%)	11 (1.1)
Smoking status, *n* (%)	
Never smoked	703 (69.7)
Past smoker	267 (26.5)
Current smoker	38 (3.8)
Participants with acute or previous SARS-CoV-2 infection at baseline	
Overall	
Tested positive as part of the study	56 (5.6)
Positive qualitative RT-PCR test	20 (2.0)
Positive IgG test	45 (4.5)

BMI body mass index, *COVID-19* coronavirus disease 2019, *IgG* immunoglobulin G, *RT-PCR* reverse transcriptase polymerase chain reaction, *SARS-CoV-2* severe acute respiratory syndrome coronavirus 2, *SD* standard deviation

[a]No participants enrolled from Wisconsin

[b]Age at baseline = (2020 − year of birth)

[c]BMI = (weight (kg)/height (m)^2)

Agreement Between Self-Report and PCR Results versus IgG Results for SARS-CoV-2 Infections

IgG against N protein was detected at the subsequent scheduled follow-up visit (i.e., not the same visit) among 37.6% (38/101) of those who self-reported having COVID-19 and 50.0% (13/26) of those who had a positive PCR test at either baseline, 3, or 6 months. IgG against N protein was detected at a subsequent scheduled follow up visit among only 3.0% of those who self-reported not having COVID-19 and 2.6% of those who had a negative PCR test (Table 4).

Table 2 SARS-CoV-2 molecular and serological testing at baseline and across follow-ups—full analysis set[a]

Characteristic	Baseline (*N* = 1008)	3 months (*N* = 799)	6 months (*N* = 733)	9 months (*N* = 673)
Nasal sample obtained for SARS-CoV-2 qualitative PCR test, *n* (%)	1008 (100.0)	781 (97.7)	733 (100.0)	673 (100.0)
Positive SARS-CoV-2 qualitative PCR test, *n* (%)	20 (2.0)	3 (0.4)	3 (0.4)	0 (0.0)
Symptomatic among positive participants, *n* (%)	14 (70.0)	3 (100.0)	3 (100.0)	N/A
Blood specimen collected for SARS-CoV-2 qualitative IgG test, *n* (%)	1008 (100.0)	797 (99.7)	725 (98.9)	671 (99.7)
Positive SARS-CoV-2 qualitative IgG test, *n* (%)[b]	45 (4.5)	48 (6.0)	39 (5.4)	19 (2.8)
Number and percentage of participants who were IgG-positive among those who were IgG-negative at baseline, *n/N* (%)[c]	NA	26/41 (63.4)	12/41 (29.3)	3/41 (7.3)
Number and percentage of participants who were IgG negative among patients who were IgG-negative at baseline, but IgG-positive at visit 3, *n/N* (%)[d]	NA	NA	9/18 (50.0)	9/18 (50.0)
Proportion IgG negative among patients who were IgG negative at baseline, but IgG positive at visit 6, *n/N* (%)[e]	NA	NA	NA	6/11 (54.6)
Proportion IgG-negative among those who were IgG-positive at baseline, *n/N* (%)[f]	NA	7/28 (25.0)	14/28 (50.0)	7/28 (25.0)

IgG immunoglobulin G, *N/A* not applicable, *PCR* polymerase chain reaction, *SARS-CoV-2* severe acute respiratory syndrome coronavirus 2

[a]The full analysis set contained all enrolled participants who completed the baseline questionnaires and the baseline SARS-CoV-2 molecular and serological testing

[b]Those with a positive IgG test had evidence of prior infection

[c]Out of 963 participants with a negative baseline IgG test, 41 had a positive IgG at one of the follow-up visits. Of those 41, the number and percentage of participants who had their first positive test at each visit is shown

[d]Of the 26 participants with a negative baseline IgG and their first positive IgG at month 3, 18 had a negative IgG at one of the follow-up visits. Of those 18, the number and percentage of participants who had their first positive test at each visit is shown

[e]Of the 11 participants with a negative baseline IgG and their first positive IgG at month 6, the number and percentage of participants who had their first positive test at month 9 is shown

[f]Out of 45 participants with a positive baseline IgG test, 28 had a negative IgG at one of the follow-up visits. Of those 28 participants, the number and percentage of participants who had their first negative test at each visit is shown

Among 36 participants who were negative for PCR and positive for IgG at baseline, 24 (66.7%) provided a blood specimen/sample at a subsequent visit at month 3, among whom 79.1% (19/24) maintained a detectable IgG level. Among 43 participants who tested negative for PCR and positive for IgG at month 3, 38 (88.4%) attended the subsequent visit at month 6, among whom 47.4% (18/38) maintained a detectable IgG level. Among the 37 participants who tested negative for PCR and positive for IgG at month 6, 34 (91.9%) returned for a subsequent visit at 9 months and among whom 41.2% (14/34) had a detectable IgG level. Out of 20 participants who tested positive for PCR at baseline, 2 participants (20%) never had a detectable level of IgG when tested across visits (baseline or months 3, 6, or 9).

Table 3 SARS-CoV-2 IgG testing according to occupational risk of exposure to SARS-CoV-2 and demographics

Characteristic	No positive IgG results (N = 800)	At least one positive IgG result (N = 86)	At least one positive IgG result and no subsequent negative results (n = 34)	At least one positive IgG result and a subsequent negative result (n = 52)
Level of exposure risk to SARS-CoV-2 by occupation				
Low risk	353 (44.1)	29 (33.7)	7 (20.6)	22 (42.3)
Medium-to-low risk	189 (23.6)	20 (23.3)	7 (20.6)	13 (25.0)
Medium-to-high risk	179 (22.4)	22 (25.6)	12 (35.3)	10 (19.2)
High risk	79 (9.9)	15 (17.4)	8 (23.5)	7 (13.5)
Demographics				
Age				
18–29 years	51 (6.4)	8 (9.3)	5 (14.7)	3 (5.8)
30–39 years	104 (13.0)	18 (20.9)	7 (20.6)	11 (21.2)
40–49 years	141 (17.6)	14 (16.3)	2 (5.9)	12 (23.1)
50–64 years	367 (45.9)	32 (37.2)	14 (41.2)	18 (34.6)
65+ years	137 (17.1)	14 (16.3)	6 (17.6)	8 (15.4)
Sex				
Female	577 (72.1)	59 (68.6)	19 (55.9)	40 (76.9)
Male	222 (27.8)	27 (31.4)	15 (44.1)	12 (23.1)
Other	1 (0.1)	0	0	0
Race				
American Indian or Alaska Native	4 (0.5)	0	0	0
Asian	31 (3.9)	6 (7.0)	2 (5.9)	4 (7.7)
Black or African American	8 (1.0)	1 (1.2)	1 (2.9)	0
Native Hawaiian or other Pacific Islander	1 (0.1)	0	0	0
White	741 (92.6)	71 (82.6)	25 (73.5)	46 (88.5)
Other	13 (1.6)	7 (8.1)	6 (17.6)	1 (1.9)
Prefer not to say	2 (0.3)	1 (1.2)	0	1 (1.9)

Results reported as n (%)
IgG immunoglobulin G, *SARS-CoV-2* severe acute respiratory syndrome coronavirus 2

Table 4 SARS-CoV-2 IgG testing after either a self-report COVID-19 infection or positive PCR test according to occupation risk of exposure to SARS-CoV-2 and demographics throughout study

Characteristic	Positive IgG at subsequent scheduled visit after self-report of COVID-19 (*n* = 38)	Positive IgG at subsequent scheduled visit after no self-report of COVID-19 (*n* = 85)	Positive IgG at subsequent scheduled visit after PCR positive for COVID-19 (*n* = 13)	Positive IgG at subsequent scheduled visit after PCR negative for COVID-19 (*n* = 81)
Level of exposure risk to SARS-CoV-2 in occupation				
Low Risk	11 (28.9)	25 (29.4)	5 (38.5)	22 (27.2)
Medium–low risk	12 (31.6)	23 (27.1)	5 (38.5)	24 (29.6)
Medium–high risk	7 (18.4)	23 (27.1)	3 (23.1)	21 (25.9)
High risk	8 (21.1)	14 (16.5)	0	14 (17.3)
Demographics				
Age				
18–29 years	3 (7.9)	3 (3.5)	0	6 (7.4)
30–39 years	6 (15.8)	17 (20.0)	1 (7.7)	16 (19.8)
40–49 years	7 (18.4)	14 (16.5)	4 (30.8)	13 (16.0)
50–64 years	16 (42.1)	34 (40.0)	5 (38.5)	31 (38.3)
65+ years	6 (15.8)	17 (20.0)	3 (23.1)	15 (18.5)
Sex				
Female	25 (65.8)	55 (64.7)	9 (69.2)	50 (61.7)
Male	13 (34.2)	30 (35.3)	4 (30.8)	31 (38.3)
Race				
American Indian or Alaska Native	0	0	0	0
Asian	3 (7.9)	1 (1.2)	0	4 (4.9)
Black or African American	2 (5.3)	2 (2.4)	0	2 (2.5)
Native Hawaiian or other Pacific Islander	0	0	0	0
White	31 (81.6)	77 (90.6)	12 (92.3)	72 (88.9)
Other	2 (5.3)	4 (4.7)	1 (7.7)	2 (2.5)

Table 4 continued

Characteristic	Positive IgG at subsequent scheduled visit after self-report of COVID-19(n = 38)	Positive IgG at subsequent scheduled visit after no self-report of COVID-19(n = 85)	Positive IgG at subsequent scheduled visit after PCR positive for COVID-19(n = 13)	Positive IgG at subsequent scheduled visit after PCR negative for COVID-19(n = 81)
Prefer not to say	0	1 (1.2)	0	1 (1.2)

Results reported as n (%)
COVID-19 coronavirus disease 2019, *IgG* immunoglobulin G, *PCR* polymerase chain reaction, *SARS-CoV-2* severe acute respiratory syndrome coronavirus 2

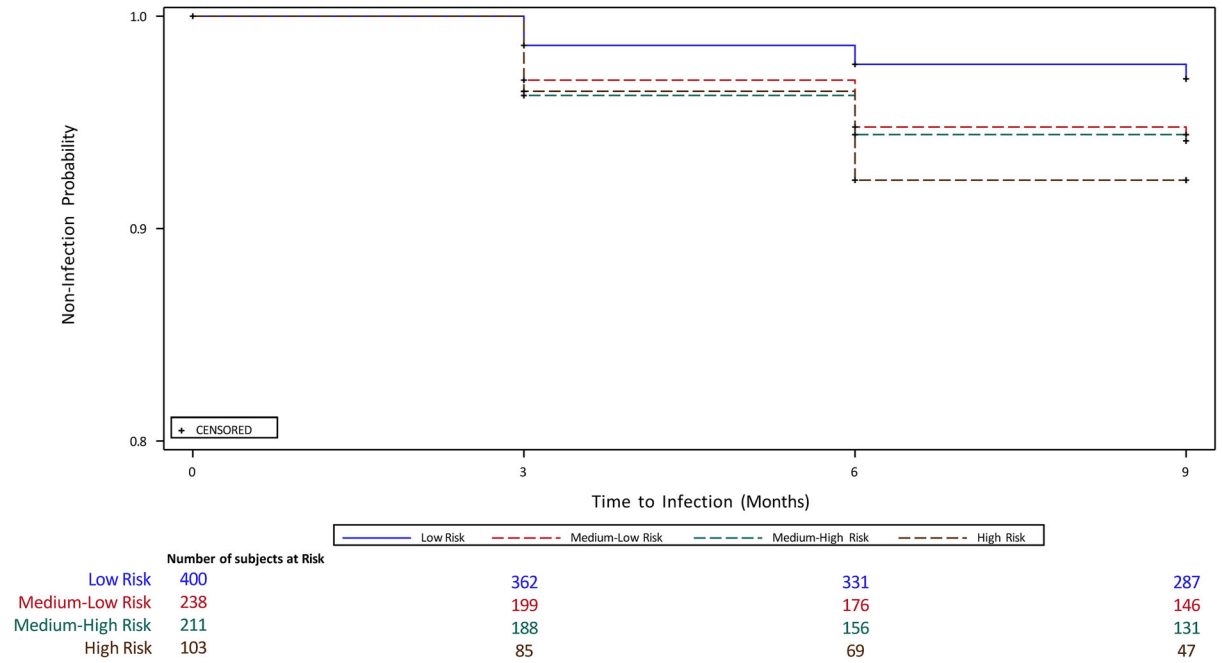

Fig. 1 Kaplan–Meier curves of time to first infection by level of risk to SARS-CoV-2 in occupation—full analysis set *SARS-CoV-2* severe acute respiratory syndrome coronavirus 2

Time to First Infection

Participants in the high-risk occupation subgroup had a greater likelihood of infection as compared with participants in low-, medium-to-low-, or medium-to-high-risk subgroups based on the time to first infection event for each group (Fig. 1). The likelihood of an infection event was greater for those at high risk of SARS-COV-2 infection in their occupational environment.

Vaccination Status

At baseline, 0.7% (7/1008) of participants had received a first dose of vaccine against SARS-CoV-2. At 9 months, 73.2% (630/861) and

70.0% (603/861) received a first or second SARS-CoV-2 vaccination dose, respectively.

DISCUSSION

While, at baseline, the proportion of the study cohort who contracted SARS-CoV-2 infection (2.0% positive for PCR and 4.5% with detectable IgG) was greater than observed rates in Lake County, IL [9], during the 9-month study period, the trend of decreased infection rate was similar to that of Lake County (January–September 2021) [11]—a reduction that coincided with an increase in SARS-CoV-2 vaccinations (0.7% at baseline to 70.0% at 9 months). In our study, the zero current infections reported at 9 months via PCR suggests a positive impact of public health measures to stop the spread of COVID-19 and population immunity acquired via vaccination.

However, the potential of protection via an acquired infection as measured by IgG is not clear and results are descriptive in nature, thus limiting the interpretation of any association between IgG response and patient demographics. While the IgG response was more likely to persist in those who work in medium-to-high- or high-risk occupations, for those who were in the 18–29-year age group, or for those who were male, the other cohorts more frequently did not test positive for IgG response against the N protein at various time points. Further, seroconversion rates may indicate the possibility of a rapid waning of IgG response within a 3-month time frame (i.e., at a subsequent visit) in some who are without current infection at the initial testing (i.e., PCR negative). In patients who were IgG-positive at baseline, only 7 of 28 maintained detectable levels of IgG through 3-month and 6-month visits and had the first IgG-negative test after 9 months of follow up, with 14 of 28 without detectable levels of IgG by the 6-month visit. The rapid seroconversion rates from IgG-positive to IgG-negative found in some participants over 3 months in the absence of current infection are in line with previous findings that IgG response wanes quickly and that infection boosts IgG response [12–14].

In general, participants working in high-SARS-CoV-2-risk environments tended to have a greater likelihood of infection versus those in low-risk environments, similar to what has been found in previous studies [15]. The greater likelihood of infection in those with high-risk occupations may potentially be owing to changes in workplace policies/procedures and reduction of preventative measures over time, as well as continuous exposure to the virus and immune system stimulation [16]. Regardless of occupational risk, by month 9, the rate of current infection was 0%, which may suggest, as mentioned previously, the potential positive impact of COVID-19 vaccines in this community-based sample that had a high vaccination rate.

This is one of the few studies that includes longitudinal follow-up with IgG evidence, and also that prospectively combines the molecular and serological testing with high-quality specimen collection during the height of the COVID-19 pandemic. In addition, this is one of the first studies to evaluate the epidemiology of COVID-19 by occupational risk. Another key strength was the use of stratified sampling for participants across occupational exposure risk groups as defined by the modified Occupational Safety and Health Administration guidelines [10]. Validated tools with high sensitivity and specificity were used for prospective data collection on serological and molecular testing of SARS-CoV-2.

There were several limitations. Participants were volunteers and may have been healthier and at lower risk of SARS-CoV-2 than those who did not enroll. Convenience sampling was used to select the study sample in Lake County, IL. Hence, the study sample may not be representative of nor generalizable to the Lake County population in Illinois, but rather considered to inform relative risks between groups within the sample and trends within the timeframe of the study conduct. This study did not report on the type or supplier of vaccines; however, there were no restrictions, and all vaccines that were approved during the study time frame were available to individuals living in Lake County, IL. Our study did not distinguish the variants of COVID-19 that were present when determining

infection and IgG immunity statuses; however, the PCR and IgG assays utilized would have identified current or evidence of prior infection regardless of variant, and currently there are no approved diagnostics tests designed to specifically detect variants [17].

CONCLUSIONS

The unique, prospective, longitudinal, community-based design of this study as well as the inclusion of both RT-PCR and serological assessments to follow both infection as well as IgG positivity over time and stratification by occupational risk can help improve our understanding of COVID-19 immunity and occupational risks related to SARS-CoV-2 exposure, as well as the kinetics of long-term IgG seroconversion. Our study demonstrated a high rate of vaccine uptake (70%) during the specific study time frame as well as a decrease in infection rate, as measured by PCR tests, during this time (November 2020 through October 2021). The seroconversion rates observed may indicate the possibility of a rapid waning of IgG response within a 3-month time frame (i.e., at a subsequent visit) in some who are without current infection at the initial testing (i.e., PCR negative). Although this study predates the emergence of COVID-19 variants, such as the Omicron variant, the use of PCR and IgG assays that indirectly detect all variants and that are the same assays still in use [17] may allow for the findings to be extrapolated to national and local communities. Future studies are warranted to assess changes in transmission of SARS-CoV-2 as well as kinetics of long-term IgG as novel variants continue to circulate.

ACKNOWLEDGEMENTS

The authors would like to express their gratitude to the people who participated in this study and their families as well as the study investigators and coordinators of the study.

Authorship All named authors meet the International Committee of Medical Journal Editors (ICMJE) criteria for authorship for this article, take responsibility for the integrity of the work as a whole, and have given their approval for this version to be published.

Medical Writing, Editorial, and Other assistance Medical writing support was provided by Caryne Craige, Ph.D., and Brandy Menges, Ph.D., of Fishawack Facilitate Ltd., a member of Avalere Health, and funded by AbbVie.

Author Contributions. Ryan D. Kilpatrick, Olga Sánchez-Soliño, Yixin Fang, Whitney S. Krueger, Yizhou Ye, Negar Niki Alami, and Christopher Johnson contributed to the conception and design of the study and analysis of data. All authors (Ryan D. Kilpatrick, Olga Sánchez-Soliño, Negar Niki Alami, Christopher Johnson, Yixin Fang, Katarzyna Zarish, Whitney S. Krueger, Yizhou Ye, Nancy Dreyer, and Gregory C. Gray) contributed to the interpretation of data and critical revision of the manuscript, agree to be accountable for ensuring the integrity and accuracy of the work, and approved the final version of the manuscript.

Funding. This work/study as well as the journal's Rapid Service Fee were funded by AbbVie Inc. AbbVie participated in the study design, research, data collection, analysis and interpretation of data, writing, reviewing, and approving the publication. All authors had access to the data results and participated in the development, review, and approval of this manuscript. No honoraria or payments were made for authorship.

Data Availability. The datasets generated during and/or analyzed during the current study are available from the corresponding author upon request.

Declarations

Conflict of interest. Ryan D. Kilpatrick, Olga Sánchez-Soliño, Yixin Fang, Katarzyna Zarish, Whitney S. Krueger, and Yizhou Ye are employees of AbbVie and may hold stock

options. Nancy Dreyer was a full-time employee of IQVIA during the design and conduct of this study and now works as an independent consultant through Dreyer Strategies LLC. Gregory C. Gray previously served as a paid consultant to AbbVie, Inc., and is currently employed at the University of Texas Medical Branch, Galveston, Texas. Negar Niki Alami was an employee of AbbVie and is currently employed by Pfizer. Christopher Johnson was an employee of AbbVie at the time of study and is currently employed by Amgen.

Ethical Approval. The protocol, informed consent form, and all communications to study participants including advertising pieces were reviewed and approved by an institutional review board (Advarra, Inc). All participants provided informed consent prior to completion of questionnaires and specimen collection.

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