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Incidence of SARS-CoV-2 infection among previously infected or vaccinated employees

N. Kojima[1,*], A. Roshani[2], M. Brobeck[2], A. Baca[2], J.D. Klausner[3]

[1] Department of Medicine, University of California Los Angeles, Los Angeles, 90095
[2] Curative Inc., San Dimas, CA
[3] Departments of Population and Public Health Sciences, Medicine, and the COVID-19 Pandemic Research Center, University of Southern California, Keck School of Medicine, Los Angeles, 90033

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ABSTRACT

Introduction: We aimed to determine the incidence of SARS-CoV-2 infection among individuals with a previous SARS-CoV-2 infection versus vaccinated individuals.
Methods: In March 2020, a SARS-CoV-2 testing company began routinely screening its workforce for SARS-CoV-2 with a PCR test. On December 15, 2020, vaccination with either the BNT162b2 or mRNA-1273 vaccines became available. Routine screening has continued through July 2021. We compared the incidence of SARS-CoV-2 infection between people who were SARS-CoV-2 naïve and unvaccinated, people with prior COVID-19 without vaccination, and people vaccinated without prior COVID-19. Incidence in 100 person-years with 95% confidence intervals (95% CIs) was calculated with the Poisson Exact equation. The incidence rate ratio (IRR), the ratio of confirmed COVID-19 cases per 100 person-years of follow-up with 95% CIs, was used as a measure of association between groups. Analyses were performed on StataSE.
Results: The median age of employees was 29.0 years (interquartile range: 23.6, 39.9). During the observation period, 258 SARS-CoV-2 incident infections were identified. The naïve, unvaccinated group had a SARS-CoV-2 incidence of 25.9 per 100 person-years (95% CI: 22.8-29.3). The previously infected, unvaccinated group had an incidence of 0 per 100 person-years (95% CI: 0-5.0). The vaccinated group had an incidence of 1.6 per 100 person-years (95% CI: 0.04-4.2).
Conclusion: We found a strong association between prior SARS-CoV-2 infection and/or vaccination for SARS-CoV-2 with either the BNT162b2 or mRNA-1273 vaccines and the reduced incidence of SARS-CoV-2 infection when compared with those naïve and/or unvaccinated to SARS-CoV-2.

Introduction

Prior reports have found lower rates of SARS-CoV-2 infections among those vaccinated against SARS-CoV-2 or with a prior SARS-CoV-2 infection (Dagan et al., 2021; Qureshi et al., 2021). Although an association between vaccination and reduction of SARS-CoV-2 incidence has been well described, it remains unclear how the incidence among individuals with a previous infection compares to vaccinated individuals.

Methods

In March 2020, Curative, a SARS-CoV-2 testing company, began routinely screening its workforce with a Food and Drug Administration-authorized SARS-CoV-2 PCR-based test (Kojima et al., 2020). The workforce was screened daily. Those with a positive test were retested to ensure they were truly positive. A standardized employee-testing database was implemented on May 8, 2020. Vaccination with either the BNT162b2 or mRNA-1273 vaccines became available on December 15, 2020. Routine screening has continued through July 2021.

The SARS-CoV-2 naïve, unvaccinated group was defined as any employee without previous infection that tested negative from May 8, 2020, up to December 15, 2020 (when vaccination became available). The previously infected, unvaccinated group was defined as any employee with documented previous SARS-CoV-2 infection

* Corresponding author: Department of Medicine at UCLA, 10833 Le Conte Ave, Los Angeles, CA 90095.
E-mail address: nkojima@ucla.edu (N. Kojima).

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Table
Incidence of SARS-CoV-2 infection among employees listed as SARS-CoV-2 naïve, previously infected or vaccinated in a clinical laboratory workforce, during 2020-2021

SARS-CoV-2 Status	Cohort size	Number of infections	Follow-up time (PY)	Incidence per 100 PY (95% CI)*
Naïve	4313	254	979.7	25.9 (22.8-29.3)
Previously Infected	254	0	74.4	0 (0-5.0)
Fully Vaccinated	739	4	244.5	1.6 (0.04-4.2)

* PY = person-years, 95% Confidence Interval by Poisson Exact test

(at least 2 positive PCR tests) between May 8, 2020, and December 15, 2020. The vaccinated group was defined as any employee with documented completion of vaccination through July 1, 2021.

Person-days were measured from the first test date to the last test date up to December 15, 2020, for groups 1 and 2 and up to July 1, 2021, for group 3. We defined SARS-CoV-2 infection as 2 positive PCR tests in a 30-day period. Individuals with fewer than 14 days of follow-up were excluded. Incidence in 100 person-years with 95% confidence intervals (95% CIs) was calculated with the Poisson Exact equation. The incidence rate ratio (IRR), the ratio of confirmed COVID-19 cases per 100 person-years of follow-up with 95% CIs, was used as a measure of association between groups. Analyses were performed on StataSE (StataCorp, College Station, Texas).

The study of de-identified electronic medical record data was determined by the Advarra Institutional Review Board (Pro00054560) to be exempt from review. All research was performed in accordance with relevant regulations in accordance with the Declaration of Helsinki.

Results

We identified 4313, 254, and 739 employee records for the naïve and unvaccinated group (group 1), the previously infected and unvaccinated group (group 2), and the vaccinated without previous infection group (group 3), respectively. The median age of employees was 29.0 years (interquartile range: 23.6, 39.9). During the observation period, 254, 0, and 4 SARS-CoV-2 incident infections were identified among groups 1, 2, and 3, respectively (Table).

The naïve, unvaccinated group had a SARS-CoV-2 incidence of 25.9 per 100 person-years (95% CI: 22.8-29.3). The previously infected, unvaccinated group had an incidence of 0 per 100 person-years (95% CI: 0-5.0). The vaccinated group had an incidence of 1.6 per 100 person-years (95% CI: 0.04-4.2). The IRR of reinfection among those with previous SARS-CoV-2 infection compared with those who are SARS-CoV-2 naïve was 0 (95% CI: 0-0.19). The IRR of those vaccinated compared with those who are SARS-CoV-2 naïve was 0.06 (95% CI: 0.02-0.16). The IRR of those previously infected compared with those vaccinated was 0 (95% CI: 0-4.98).

Discussion

In the workplace setting, we observed a lower incidence of SARS-CoV-2 infection among those with a previous SARS-CoV-2 infection or SARS-CoV-2 vaccination with either the BNT162b2 or mRNA-1273 vaccines. A prior infection or vaccination was associated with a dramatic decrease in the risk for infection or reinfection with SARS-CoV-2 during the study period. There was no difference in the incidence of SARS-CoV-2 infection or reinfection between individuals who were vaccinated and individuals with a prior SARS-CoV-2 infection.

Our findings are similar to other studies that compared the incidence of SARS-CoV-2 infection among those with a prior SARS-CoV-2 infection and completed vaccination to unvaccinated antibody seronegative individuals. In a study conducted in Oxfordshire, United Kingdom, among a cohort of 13,109 healthcare workers, researchers reported that they found no differences in immunity induced by natural infection and vaccination with the BNT162b2 or ChAdOx1 nCOV-19 vaccines (Lumley et al., 2021). Another group of researchers studying a group of 52,238 employees of the Cleveland Clinic Health System found that those with previous SARS-CoV-2 infection and those who were vaccinated had lower rates of SARS-CoV-2 infection compared with those who were SARS-CoV-2 naïve and unvaccinated (Shrestha et al., 2021).

After vaccination or natural infection, many mechanisms of immunity exist including humoral and cellular immunity (Doshi, 2020, Le Bert et al., 2020, Shrotri et al., 2021). It is known that SARS-CoV-2 infection induces specific and durable T cell immunity against multiple SARS-CoV-2 spike (S) protein targets (or epitopes) and recognizes other SARS-CoV-2 proteins. The broad diversity of T cell viral recognition serves to enhance protection against SARS-CoV-2 variants (Le Bert et al., 2020), with recognition of at least 3 SARS-CoV-2 variants (B.1.1.7 [U.K.], B.1.351 [South Africa], and B.1.1.248 [Brazil]) (Redd et al., 2021). In addition, a memory B cell response to SARS-CoV-2 evolves between 1.3 and 6.2 months after infection that is consistent with durable immunity (Gaebler et al., 2021).

Our findings were limited by the observational nature of the study. It is possible, but unlikely, that employees could have tested positive outside of the employee-testing program. In addition, because allocation to each exposure group was not random, there might be differences between groups in the risk of repeat exposure over time. Given that the study periods did not overlap for the assessment of those with and without vaccination, the risk of infection might vary between study periods. This study was conducted before the detection of the Omicron variant of SARS-CoV-2 and the extrapolation of our findings to the period of Omicron variant transmisison should be done with caution. The study was strengthened by the high incidence of COVID-19 infections among those naïve and unvaccinated, the large sample size and the large number of person-years of follow-up in each group.

Conclusion

We found a strong association between prior SARS-CoV-2 infection and vaccination against SARS-CoV-2 with either the BNT162b2 or mRNA-1273 vaccine, and the reduced incidence of SARS-CoV-2 when compared with those naïve and unvaccinated against SARS-CoV-2. There was no difference in the incidence of SARS-CoV-2 between individuals who were vaccinated and individuals with a prior SARS-CoV-2 infection. Combined with prior studies, our findings provide increased confidence that those previously infected were at very low risk for repeat infection, prior to the introduction of the Omicron varant.

Declaration of competing interest

NK is a consultant for Curative. AR, MB, and AB are employed by Curative. JDK serves as a consultant and independent Medical Director of Curative.

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Ethical Approval

The Advarra institutional review board (Pro00054560) determined the study of de-identified electronic medical record data to be exempt from review. All research was performed in accordance with relevant regulations in accordance with the Declaration of Helsinki.

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