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## Research Brief

# mRNA vaccine effectiveness against asymptomatic severe acute respiratory coronavirus virus 2 (SARS-CoV-2) infection over seven months

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Coronavirus disease 2019 (COVID-19) mRNA vaccines are remarkably effective[1], including against symptomatic disease caused by the B.1.1.7 or α variant of concern (VOC).[2] Early studies of COVID-19 vaccines showed effectiveness against asymptomatic infection.[3,4] Vaccine effectiveness against asymptomatic COVID-19 has not been recently assessed as the frequency of α and B.1.617.2 or δ VOC infections have increased and other mitigation efforts, such as masking and social distancing, have decreased. Therefore, we investigated the observed mRNA vaccine effectiveness against asymptomatic severe acute respiratory coronavirus virus 2 (SARS-CoV-2) infection between April–August 2021 compared to January–March 2021.

## Methods

This retrospective point-prevalence study included all consecutive, preprocedural and surgical adult patients (aged ≥18 years) residing in Minnesota who received a SARS-CoV-2 molecular screening test between January 1, 2021, and August 15, 2021, at Mayo Clinic in Rochester, Minnesota. The testing approach and data sources have been described previously.[3] Patients with COVID-19 symptoms or a known exposure and patients with a prior positive polymerase chain reaction (PCR) or antigen test were excluded from this analysis. This study was deemed exempt by the Mayo Clinic Institutional Review Board.

Primary exposure was vaccination with at least 1 dose of the BNT162b2 (Pfizer) SARS-CoV-2 vaccine or the mRNA-1273 (Moderna) SARS-CoV-2 vaccine prior to molecular screening. Vaccination status was determined from Mayo Clinic records and the Minnesota immunization system. Individuals whose state vaccination registry was not queried on the day of preprocedural molecular screening test or later were excluded. Vaccine status at the time of testing was categorized as (1) unvaccinated, (2) early partially vaccinated (1–20 days after first vaccine), (3) late partially vaccinated or missed their second dose (>20 days after first vaccine until considered fully vaccinated), or (4) fully vaccinated (>14 days after second dose).

The outcome was relative risk of a positive preprocedural COVID-19 molecular screening test. Percent positivity levels of molecular screening by vaccination status were calculated. The unadjusted relative risk (RR) and 95% confidence interval (CI) were compared using unvaccinated as the reference. Adjusted vaccine effectiveness (1 relative risk) levels were calculated using mixed-effects modeling to adjust for age, sex, race or ethnicity, calendar time (January–March 2021 vs April–May 2021 vs June–August 15, 2021), repeated patient screenings, and an interaction term between calendar time and vaccination status.

## Results

Overall, 56,917 molecular screening tests were performed among 46,008 unique patients (Table 1). The positivity rate among fully vaccinated individuals was 0.30% compared to 1.23% among unvaccinated individuals (unadjusted RR, 0.25; 95% CI, 0.19–0.32). The adjusted effectiveness level of full vaccination against asymptomatic infection was 71% (95% CI, 61%–78%) for the entire study period. The adjusted effectiveness level of full vaccination from January to March was 91% (95% CI, 72%–98%), which was not significantly different than the adjusted effectiveness level (71%; 95% CI, 53%–83%) during April–May ($P = .13$) or June–August 15 (63%; 95% CI, 44%–76%; $P = .07$). We detected no significant difference in the adjusted effectiveness of partial vaccination among the 3 periods.

## Discussion

In this observational study of individuals without COVID-19 symptoms undergoing SARS-CoV-2 molecular screening prior to a medical procedure or surgery, the adjusted effectiveness levels of full and partial vaccination against asymptomatic infection were similar in April–May and June–August 15 compared to that observed in January–March. We observed a trend toward a

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**Table 1.** Preprocedure Screenings (N = 56,917) by Period

| Characteristic | Period 1 Jan 1–Mar 31, 2021 (n = 24,162, 42.5%), No. (%) | Period 2 Apr 1–May 31, 2021 (n = 14,791, 26.0%), No. (%) | Period 3 Jun 1–Aug15, 2021 (n = 17,964, 31.6%), No. (%) | *P* Value (Comparing Periods 1 and 2) | *P* Value (Comparing Periods 1 and 3) |
|---|---|---|---|---|---|
| **Vaccination status** | | | | <.0001 | <.0001 |
| Unvaccinated | 17,764 (73.5) | 4,720 (31.9) | 7,057 (39.3) | | |
| Early (partially) vaccinated | 2,730 (11.3) | 769 (5.2) | 84 (0.5) | | |
| Late (partially) vaccinated | 1,720 (7.1) | 1,551 (10.5) | 272 (1.5) | | |
| Fully vaccinated | 1,948 (8.1) | 7,751 (52.4) | 10,551 (58.7) | | |
| Age, y | 58.6 (17.6) | 60.7 (17.1) | 60.1 (17.4) | <.0001 | <.0001 |
| **Sex** | | | | .08 | <.01 |
| Male | 11,630 (48.1) | 6,986 (47.2) | 8,368 (46.6) | | |
| Female | 12,532 (51.9) | 7,805 (52.7) | 9,596 (53.4) | | |
| **Race or ethnicity** | | | | <.001 | <.01 |
| White | 21,944 (90.8) | 13,528 (91.5) | 16,286 (90.7) | | |
| Black | 502 (2.1) | 292 (2.0) | 396 (2.2) | | |
| Asian | 455 (1.9) | 302 (2.0) | 399 (2.2) | | |
| Hispanic of any race | 653 (2.7) | 401 (2.7) | 476 (2.7) | | |
| Other/Unknown | 608 (2.5) | 268 (1.8) | 407 (2.3) | | |
| **Vaccine manufacturer** | | | | <.0001 | <.0001 |
| Pfizer | 3,761 (58.8) | 5,562 (55.2) | 6,129 (56.2) | | |
| Moderna | 1,955 (30.6) | 3,265 (32.4) | 3,825 (35.1) | | |
| Unknown mRNA | 682 (10.7) | 1,244 (12.4) | 953 (8.7) | | |
| **Patient lives in health referral region** | | | | <.0001 | <.0001 |
| Yes | 17,904 (74.1) | 10,408 (70.4) | 12,650 (70.4) | | |
| No | 6,258 (25.9) | 4,348 (29.6) | 5,314 (29.6) | | |
| **Unadjusted positivity** | | | | | |
| Unvaccinated | 222/17,764 (1.2) | 62/4,720 (1.3) | 78/7,057 (1.1) | | |
| Early (partially) vaccinated | 24/2,730 (0.9) | 10/769 (1.3) | 0/84 (0.0) | | |
| Late (partially) vaccinated | 10/1,720 (0.6) | 10/1,551 (0.7) | 1/272 (0.4) | | |
| Fully vaccinated | 2/1,948 (0.1) | 23/7,751 (0.3) | 36/10,551 (0.3) | | |
| **Adjusted effectiveness (1-RR)**[a] | | | | $P_{interaction}$[c] | $P_{interaction}$[c] |
| Unvaccinated | Reference | Reference | Reference | | |
| Early (partially) vaccinated | 16% (−29% to +45%) | 5% (−88% to +51%) | N/A[b] | .75 | .99 |
| Late (partially) vaccinated | 44% (−6% to +71%) | 46% (−7% to +73%) | 65% (−170% to +95%) | .96 | .65 |
| Fully vaccinated | 91% (+72% to +98%) | 71% (+53% to +83%) | 63% (+44% to +76%) | .13 | .07 |

Note. RR, relative risk; N/A, not applicable.
[a]Mixed-effects model with fixed effects for age, sex, race or ethnicity, patient residence in health referral region, and random effect for patient.
[b]0 cases, effectiveness estimate did not converge for early partial vaccination from June–August 15.
[c]Interaction term for (calendar month × vaccination status) compared to January–March.

decrease in effectiveness of full vaccination in the latter period compared to January–March, but the difference was not statistically significant. Our baseline adjusted effectiveness level (91%) of full vaccination in January–March was similar to the effectiveness levels in other reports of 90%[4] and 91.5%[5] against asymptomatic infection from the same period. This agreement supports the generalizability of our study design. Our findings support the sustained effectiveness of mRNA vaccines against COVID-19, despite the increasing proportion of SARS-CoV-2 α and δ VOCs in the United States and changes in behavior and mitigation measures over this time.[6] The limitations of our study include an insufficient sample size to determine the impact of timing from vaccination on effectiveness and lack of assessment for viable virus or determination of viral variants. Also, we did not assess vaccine effectiveness against severe disease or death. Nevertheless, the nonsignificant trend toward lower effectiveness underscores the need to monitor clinical vaccine effectiveness against asymptomatic infection, given the proportion of individuals who remain unvaccinated and at risk for transmission from individuals with asymptomatic infection.

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## References

1. Swift MD, Breeher LE, Tande AJ, *et al.* Effectiveness of mRNA COVID-19 vaccines against SARS-CoV-2 infection in a cohort of healthcare personnel. *Clin Infect Dis* 2021. doi: 10.1093/cid/ciab361.
2. Abu-Raddad LJ, Chemaitelly H, Butt AA, National study group for C-V. Effectiveness of the BNT162b2 COVID-19 vaccine against the B.1.1.7 and B.1.351 variants. *N Engl J Med* 2021;385:187–189.
3. Tande AJ, Pollock BD, Shah ND, *et al.* Impact of the COVID-19 vaccine on asymptomatic infection among patients undergoing preprocedural COVID-19 molecular screening. *Clin Infect Dis* 2021. doi: 10.1093/cid/ciab229.
4. Tang L, Hijano DR, Gaur AH, *et al.* Asymptomatic and symptomatic SARS-CoV-2 infections after BNT162b2 vaccination in a routinely screened workforce. *JAMA* 2021;325:2500–2502.
5. Haas EJ, Angulo FJ, McLaughlin JM, *et al.* Impact and effectiveness of mRNA BNT162b2 vaccine against SARS-CoV-2 infections and COVID-19 cases, hospitalisations, and deaths following a nationwide vaccination campaign in Israel: an observational study using national surveillance data. *Lancet* 2021;397:1819–1829.
6. CDC COVID data tracker variant proportions. Centers for Disease Control and Prevention website. https://covid.cdc.gov/covid-data-tracker/#variant-proportions. Published 2021. Accessed June 10, 2021.