CORRESPONDENCE

Effectiveness of mRNA-1273 and BNT162b2 Vaccines in Qatar

TO THE EDITOR: Growing evidence suggests that coronavirus disease 2019 (Covid-19) vaccines differ in effectiveness against severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection or severe Covid-19,[1-3] but data from controlled studies that include head-to-head comparisons of the immunity induced by these vaccines are lacking. We conducted a study to compare the protection afforded by the mRNA-1273 (Moderna) vaccine with that of the BNT162b2 (Pfizer–BioNTech) vaccine in Qatar.

Using data from national Covid-19 electronic health databases, we designed two matched retrospective cohort studies to emulate a randomized, controlled trial and to assess the incidence of documented SARS-CoV-2 infection after the first and second doses of the mRNA-1273 and BNT162b2 vaccines. Both studies involved the same population of persons who had received the mRNA-1273 or BNT162b2 vaccines between December 21, 2020, and October 20, 2021 (see Section S1 in the Supplementary Appendix, available with the full text of this letter at NEJM.org). Persons were matched one to one according to calendar week of vaccination and other variables, and the matched cohorts excluded persons who had a confirmed SARS-CoV-2 infection before vaccination.

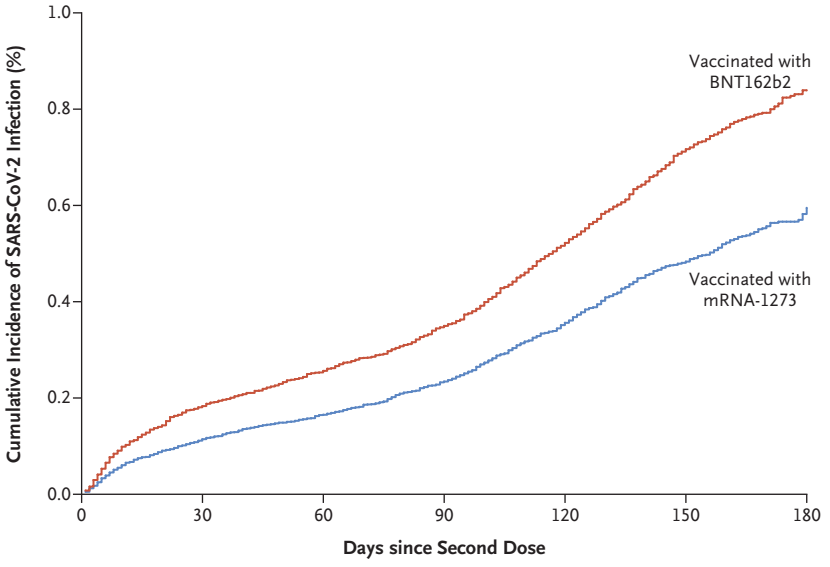
A total of 192,123 persons who had received two doses of mRNA-1273 vaccine were matched with the same number of persons who had received two doses of BNT162b2 vaccine (Fig. S1, Table S3, and Section S5). Among the mRNA-1273–vaccinated persons, 878 breakthrough infections were recorded after the second dose at a median follow-up of 89 days. Of these infections, 3 progressed to severe Covid-19 (acute-care hospitalization), but none progressed to critical disease (hospitalization in an intensive care unit) or death.

Among BNT162b2-vaccinated persons, 1262 breakthrough infections were recorded after the second dose at a median follow-up of 86 days. Of these infections, 7 progressed to severe Covid-19, none to critical disease, and 1 to death. In both vaccinated cohorts, breakthrough infections tended to occur among persons with a longer interval since the time of vaccination (Fig. 1 and Table S5).

The divergence between the two vaccine cohorts in the incidence of documented infection started during the third week after the first dose (Fig. S2). The incidences of SARS-CoV-2 infection and severe Covid-19 were lower among mRNA-1273–vaccinated persons than among BNT162b2-vaccinated persons after only one dose (Section S5). At 6 months of follow-up after the second dose, the estimated cumulative incidence of breakthrough infection was 0.59% (95% confidence interval [CI], 0.55 to 0.64) among persons who received the mRNA-1273 vaccine and 0.84% (95% CI, 0.79 to 0.89) among those who received the BNT162b2 vaccine (Fig. 1). At approximately 90 days after the second dose, during a period of a low incidence of infection in Qatar, both incidence curves started to bend upward,[2,4] which suggested progressive waning of vaccine protection.[4]

The estimated overall adjusted hazard ratio for infection after the second dose of mRNA-1273 vaccine, as compared with the second dose of BNT162b2 vaccine, was 0.69 (95% CI, 0.63 to 0.75). The adjusted hazard ratio was largely stable over time after the second dose at approximately this value (Fig. 1). The estimated overall adjusted hazard ratio for severe, critical, or fatal Covid-19 after the second dose was 0.37 (95% CI, 0.10 to 1.41).

Vaccination with mRNA-1273 was associated with a lower incidence of SARS-CoV-2 breakthrough infection than vaccination with BNT162b2; this finding is consistent with the differences in neutralizing antibody titers.[5] However, both vaccines elicited strong protection against Covid-19–related hospitalization and death. Both vaccines also had remarkably similar patterns of buildup of protection, starting from the first dose and then waning a few months after the second dose.



No. at Risk

Vaccinated with BNT162b2	192,123	191,761	181,987	169,544	146,717	113,813	23,013
Vaccinated with mRNA-1273	192,123	191,890	182,265	171,164	146,223	114,672	23,400

Month of Follow-up after Second Dose	Vaccinated with mRNA-1273		Vaccinated with BNT162b2		Absolute Difference in Cumulative Incidence (95% CI)	Unadjusted Hazard Ratio for Breakthrough Infection (95% CI)	Adjusted Hazard Ratio for Breakthrough Infection (95% CI)
	No. of persons	Cumulative incidence (95% CI)	No. of persons	Cumulative incidence (95% CI)	Percentage points		
1	191,890	0.11 (0.10–0.13)	191,761	0.18 (0.16–0.20)	0.07 (0.04–0.10)	0.62 (0.52–0.73)	0.62 (0.52–0.73)
2	182,265	0.17 (0.15–0.18)	181,987	0.26 (0.23–0.28)	0.09 (0.06–0.12)	0.73 (0.57–0.95)	0.73 (0.57–0.95)
3	171,164	0.23 (0.21–0.26)	169,544	0.35 (0.32–0.38)	0.12 (0.09–0.15)	0.72 (0.57–0.91)	0.72 (0.57–0.91)
4	146,223	0.36 (0.33–0.38)	146,717	0.52 (0.49–0.56)	0.16 (0.12–0.20)	0.70 (0.58–0.85)	0.70 (0.58–0.85)
5	114,672	0.48 (0.45–0.52)	113,813	0.72 (0.68–0.76)	0.24 (0.18–0.30)	0.67 (0.55–0.81)	0.67 (0.55–0.81)
6	23,400	0.59 (0.55–0.64)	23,013	0.84 (0.79–0.89)	0.25 (0.18–0.32)	0.81 (0.59–1.10)	0.82 (0.60–1.12)

Figure 1. Breakthrough Infections after the Second Dose of mRNA-1273 and BNT162b2 Vaccines.

The cumulative incidence of breakthrough infections after the second dose in matched cohorts of mRNA-1273–vaccinated and BNT162b2-vaccinated persons is shown. CI denotes confidence interval, and SARS-CoV-2 severe acute respiratory syndrome coronavirus 2.

The nature of vaccine immunity that builds after vaccination and wanes over time appeared to be similar with both vaccines.

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Supported by the Biomedical Research Program and the Biostatistics, Epidemiology, and Biomathematics Research Core at Weill Cornell Medicine–Qatar, the Qatar Ministry of Public Health, Hamad Medical, and Sidra Medicine. The Qatar Genome Program and Qatar University Biomedical Research Center provided the reagents for the viral genome sequencing.

Disclosure forms provided by the authors are available with the full text of this letter at NEJM.org.

This letter was published on January 19, 2022, at NEJM.org.

1. International Vaccine Access Center. VIEW-hub: Covid-19 data, vaccine studies, effectiveness studies. 2021 (https://view-hub.org/covid-19/effectiveness-studies/).

2. Abu-Raddad LJ, Chemaitelly H, Ayoub HH, et al. Association of prior SARS-CoV-2 infection with risk of breakthrough infection following mRNA vaccination in Qatar. JAMA 2021;326:1930-9.
3. Rotshild V, Hirsh-Raccah B, Miskin I, Muszkat M, Matok I. Comparing the clinical efficacy of COVID-19 vaccines: a systematic review and network meta-analysis. Sci Rep 2021;11:22777.
4. Chemaitelly H, Tang P, Hasan MR, et al. Waning of BNT162b2 vaccine protection against SARS-CoV-2 infection in Qatar. N Engl J Med 2021;385(24):e83.
5. Khoury DS, Cromer D, Reynaldi A, et al. Neutralizing antibody levels are highly predictive of immune protection from symptomatic SARS-CoV-2 infection. Nat Med 2021;27:1205-11.

DOI: 10.1056/NEJMc2117933
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