



# COVID-19 Community Research Partnership (CRP):

## Breakthrough SARS-CoV-2 Infections after Vaccination in the North Carolina COVID-19 Community Research Partnership (NC-CCRP)

### Background

We characterize the overall incidence and risk factors for breakthrough infection between January 2021 and January 2022 among fully vaccinated participants in a large COVID-19 surveillance cohort – the North Carolina COVID-19 Community Research Partnership (CRP).

### Methods

Primary outcome was weeks until first self-reported infection  $\geq 14$  days after full vaccination. Cox models were used to estimate hazard rates. Time varying covariates were vaccination rate in county of residence, mask usage in the week prior, the Delta time frame, the Omicron time frame, and receipt of a vaccine booster.

### Participants

Table. Participant characteristics (N = 15,808)

<b>Age</b>	
18-44	5169 (33%)
45-64	7485 (47%)
65+	3154 (20%)
<b>Female Sex</b>	11631 (74%)
<b>Race/Ethnicity</b>	
Non-Hispanic White	14854 (94%)
Non-Hispanic Black	400 (3%)
Hispanic	165 (1%)
Non-Hispanic Other	389 (2%)
<b>Healthcare Worker Status</b>	5290 (33%)
<b>Vaccination Product</b>	
Moderna - mRNA-1273	3985 (25%)
Pfizer/BNT - BNT162b2	10999 (70%)
J&J - Ad26.COVS.2	824 (5%)
<b>County Classification</b>	
Urban	10554 (67%)
Suburban	2361 (15%)
Rural	2893 (18%)

### Results

Figure 1. Cumulative incidence of breakthrough infection overall, by vaccine brand, rurality and age

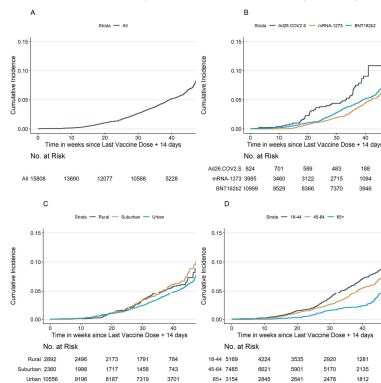
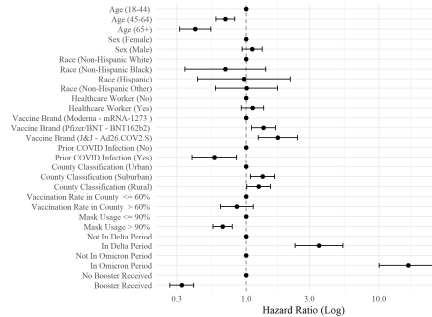


Figure 2. Predictors of breakthrough infection based on Cox proportional hazards models



### Conclusions

- 638 (4.0%) reported a positive SARS-CoV-2 test after vaccination from 01/15/2021 to 01/03/2022. Breakthrough rate increased with time from vaccination (Figure 1), with a cumulative incidence of 6.95% over 45 weeks of follow-up.
- Factors associated with a lower risk of breakthrough infection (Figure 2) included older age (HR 0.7 for participants 45-64 years and 0.41 for those > 65 years compared to those 18-44 years), prior SARS-CoV-2 infection (HR 0.58), higher rates of mask use (HR 0.66), and receipt of a booster vaccination (HR 0.33). Higher rates of breakthrough infection were reported by participants vaccinated with BNT162b2 (HR 1.35) or Ad26.COVS.2 (1.74) compared to mRNA-1273, those residing in suburban (HR 1.33) or rural (1.24) counties compared to urban counties, and during circulation of the Delta (3.54) and Omicron (16.68) variants compared to earlier time periods.
- There was no association of breakthrough infection with sex, race/ethnicity, healthcare worker status, or vaccination rate in the county of residence.

### Discussion

Our data support previous reports of superior effectiveness of Moderna mRNA-1273 relative to Pfizer/BNT BNT162b2 and even more so relative to J&J Ad26.COVS.2, and re-iterate the dramatically higher risk for breakthrough infections during the Omicron surge. The risk associated with Omicron period likely reflects several factors, including the infectivity of the Omicron variant, a higher community prevalence of infection, and waning vaccine immunity. The significantly lower rates of breakthrough associated with mask wearing and receipt of a booster highlight specific measures that may minimize the risk for COVID-19 despite prior vaccination. Similarly, higher rates among younger individuals may reflect more frequent, or higher risk exposures, including those related to childcare or to differences in occupational or social exposures.

### Limitations

The NC-CCRP is an observational cohort study assessing COVID-19 symptoms, test results, vaccination status, and risk behavior via daily email or text surveys longitudinally. As in any observational study, there are significant limitations related to reliability of self-reported results, bias or residual confounding, generalizability, and power such that results should be interpreted with caution. Nevertheless, many of our findings corroborate the work of others, supporting the validity of the data. In summary, this real-world analysis adds to the understanding of risk factors associated with breakthrough SARS-CoV-2 infections and highlights opportunities for mitigation.

### Acknowledgements and Disclosures

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Contact us:

Covid19crp\_dcc@bsc.gwu.edu

[www.covid19communitystudy.org](http://www.covid19communitystudy.org)