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BRIEF REPORT

US County-Level COVID-19 Vaccine Uptake and Rates of Omicron Cases and Deaths

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The population-level impact of vaccination on Omicron-related disease is not well described. We fit negative binomial models to estimate the relationship between US county-level vaccine coverage and rates of coronavirus disease 2019. Increased booster dose uptake was associated with lower rates of Omicron cases and deaths and is critical to combat future severe acute respiratory syndrome coronavirus 2 waves.

Keywords. Omicron; county; uptake; coverage; impact.

The Omicron variant has >30 mutations in its spike glycoprotein, some associated with increased transmissibility and neutralizing antibody escape [1]. Although protection against Omicron-related severe disease appears relatively intact for currently available vaccines [2–6], Omicron led to a surge in infections that surpassed all previous US pandemic peaks. Beyond the unvaccinated, the fully vaccinated, boosted, and previously infected all seemed susceptible to Omicron infection. Thus, outlining the population-level impact of vaccination on Omicron-related disease is critical for maintaining public trust in coronavirus disease 2019 (COVID-19) vaccines.

METHODS

We obtained county-level numbers of COVID-19 cases and deaths from January 9 through January 25, 2022, from Johns Hopkins University [7]—a period when >95% of incident US COVID-19 cases were Omicron [8]. Vaccine coverage based on Centers for Disease Control and Prevention (CDC) definitions of *fully vaccinated* and *boosted* was obtained from the CDC COVID Data Tracker. Similar to our previous analyses [9, 10], we fit negative binomial models to estimate the relationship between county-level vaccine coverage (all manufacturers; >95% mRNA vaccines [11]) and rates of COVID-19 cases and deaths, controlling for important potentially confounding county-level characteristics, including differential COVID-19 testing rates. More detailed methodology is outlined in the Supplementary Data.

RESULTS

US COVID-19 vaccine uptake varied across counties (Supplementary Figures 1 and 2, Supplementary Tables 1 and 2). In contrast with our findings in previous waves [10], in adjusted models, there was no relationship between percentage of residents ≥5 years of age who were fully vaccinated and rates of Omicron cases. However, counties with higher percentages of fully vaccinated individuals had lower Omicron-related mortality. Compared with counties with <50% fully vaccinated, those with ≥80% had 47% (95% CI, 37%−56%) lower rates of

Table 1. Risk Ratios Comparing the Relationship Between County-Level COVID-19 Vaccine Uptake and Rates of Omicron-Related Cases and Deaths, January 9–January 25, 2022

	Omicron Cases	Omicron-Related Deaths
County-Level Vaccine Coverage	Adjusted[a] Risk Ratio (95% CI)	
% of residents ≥5 years of age who were fully vaccinated[b]		
<50	1.00 (reference)	1.00 (reference)
50–59	1.05 (0.99–1.12)	0.88 (0.78–0.99)
60–69	1.04 (0.95–1.13)	0.83 (0.69–0.98)
70–79	1.02 (0.92–1.13)	0.76 (0.63–0.92)
≥80	1.06 (0.97–1.16)	0.53 (0.44–0.63)
% of booster-eligible residents ≥18 years of age who were boosted[c]		
<20	1.00 (reference)	1.00 (reference)
20–29	0.89 (0.86–0.92)	0.91 (0.72–1.15)
30–39	0.73 (0.67–0.81)	0.75 (0.54–1.04)
40–49	0.62 (0.56–0.68)	0.62 (0.41–0.93)
≥50	0.62 (0.57–0.67)	0.43 (0.28–0.66)

Abbreviations: CDC, Centers for Disease Control and Prevention; COVID-19, coronavirus disease 2019.

[a]Risk ratio estimates are from a county-level negative binomial regression model adjusted for environmental factors including urbanicity (urban vs rural), population density, residential crowding, and air pollution; sociodemographic and economic variables including gender, age, race/ethnicity, a residential housing segregation index, high school education status, unemployment status, median household income, and income inequality ratio; health status–related variables included prevalence of diabetes, obesity, smoking, and rates of sexually transmitted infections; disease activity before the study period; percent change in county-level travel to nonresidential locations; county-level rates of COVID-19 cases and deaths during previous waves; county-level testing rates during the Omicron period; and Health and Human Services region. Details about how these variables were categorized or transformed are listed in the Supplementary Data. Analyses were conducted from January 9 through January 25, 2022, when >95% of all incident COVID-19 cases in the United States were caused by the Omicron variant.

[b]*Fully vaccinated* was defined based on CDC definitions as having received 2 doses of mRNA vaccine (Pfizer-BioNTech or Moderna) or 1 dose of Ad26.COV2.S (Janssen).

[c]*Boosted* was defined based on CDC definitions as being fully vaccinated and subsequently receiving an additional dose of COVID-19 vaccine.

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Omicron-related death—a finding that showed dose response. Booster dose uptake was associated with lower rates of both Omicron cases and deaths. Compared with counties where <20% of the booster-eligible adult population was boosted, those with ≥50% had 38% (33%–43%) and 57% (34%–72%) lower rates of Omicron cases and deaths, respectively—also with dose response (Table 1; Supplementary Tables 3–6).

DISCUSSION

Our ecological data suggest that, at a community level, high vaccine coverage likely saved numerous lives during the Omicron surge. Booster uptake, on top of reducing deaths, likely also blunted the trajectory of local Omicron waves. US booster uptake, however, has lagged [12]—potentially harmed by early mixed messaging about their utility [13]—and was <50% among all booster-eligible US adults at the end of January 2022 [14]. Although we did not observe a significant relationship between increasing the proportion of fully vaccinated individuals and a reduction in COVID-19 cases, this was not completely unexpected. It has become clear that current (wild-type) COVID-19 vaccines cannot prevent all Omicron infections and that booster doses substantially improve neutralizing activity and protection against Omicron infection or symptomatic disease [4, 6, 15, 16]. Thus, our findings reiterate the importance of booster doses in the context of Omicron.

Our study was ecological, and the potential for unmeasured confounding exists. For example, we did not have county-level data about nonpharmaceutical interventions. However, we controlled for county-level data describing mobility during the pandemic, which is a proxy for social distancing measures [17]. We also controlled for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) testing rates and a wealth of other county-level variables. We did not have vaccine coverage data for all counties. However, we had coverage data (ie, ≥80% reporting completeness) for 95% of all US counties, which represented 97% of the US population. Finally, our findings were not vaccine specific. Based on CDC data through the end of the study period, of the roughly 536 million COVID-19 vaccine doses distributed in the United States, 59% were BNT162b2, 38% were mRNA-1273, and 3% were Ad26.COV2.S [18]. Thus, our results largely reflect the impact of mRNA vaccine.

Our findings underscore the importance of improving community vaccination rates—despite widespread dissemination of Omicron—and reiterate that boosters are urgently needed to help combat Omicron and future variants likely to emerge in subsequent SARS-CoV-2 waves.

Supplementary Data

Supplementary materials are available at *Open Forum Infectious Diseases* online. Consisting of data provided by the authors to benefit the reader, the posted materials are not copyedited and are the sole responsibility of the authors, so questions or comments should be addressed to the corresponding author.

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Patient consent. This study does not include factors necessitating patient consent.

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