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COVID-19 Vaccination and Racial/Ethnic Inequities  
in Mortality at Midlife in MinnesotaElizabeth Wrigley-Field, PhD,<sup>1,2</sup> Kaitlyn M. Berry, MPH,<sup>3</sup> Andrew C. Stokes, PhD,<sup>4</sup>  
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**Introduction:** Recent research underscores the exceptionally young age distribution of COVID-19 deaths in the U.S. compared with that of international peers. This paper characterizes how high levels of COVID-19 mortality at midlife ages (45–64 years) are deeply intertwined with continuing racial inequity in COVID-19 mortality.

**Methods:** Mortality data from Minnesota in 2020–2022 were analyzed in June 2022. Death certificate data (COVID-19 deaths N=12,771) and published vaccination rates in Minnesota allow vaccination and mortality rates to be observed with greater age and temporal precision than national data.

**Results:** Black, Hispanic, and Asian adults aged <65 years were all more highly vaccinated than White populations of the same ages during most of Minnesota's substantial and sustained Delta surge and all the subsequent Omicron surges. However, White mortality rates were lower than those of all other groups. These disparities were extreme; at midlife ages (ages 45–64 years), during the Omicron period, more highly vaccinated populations had COVID-19 mortality that was 164% (Asian-American), 115% (Hispanic), or 208% (Black) of White COVID-19 mortality at these ages. In Black, Indigenous, and People of Color populations as a whole, COVID-19 mortality at ages 55–64 years was greater than White mortality at 10 years older.

**Conclusions:** This discrepancy between vaccination and mortality patterning by race/ethnicity suggests that if the current period is a pandemic of the unvaccinated, it also remains a pandemic of the disadvantaged in ways that can decouple from vaccination rates. This result implies an urgent need to center health equity in the development of COVID-19 policy measures.

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## INTRODUCTION

The introduction of vaccines for coronavirus disease 2019 (COVID-19) in early 2021 resulted in a consensus, for a time, that future pandemic surges would lead to a pandemic of the unvaccinated.<sup>1</sup> However, limited data are available to evaluate this characterization with respect to racial inequity.<sup>2,3</sup> This study evaluated whether COVID-19 mortality reflects vaccination rates for different racial/ethnic groups in Minnesota using death certificate data on all COVID-19 deaths from March 2020 to April 2022.

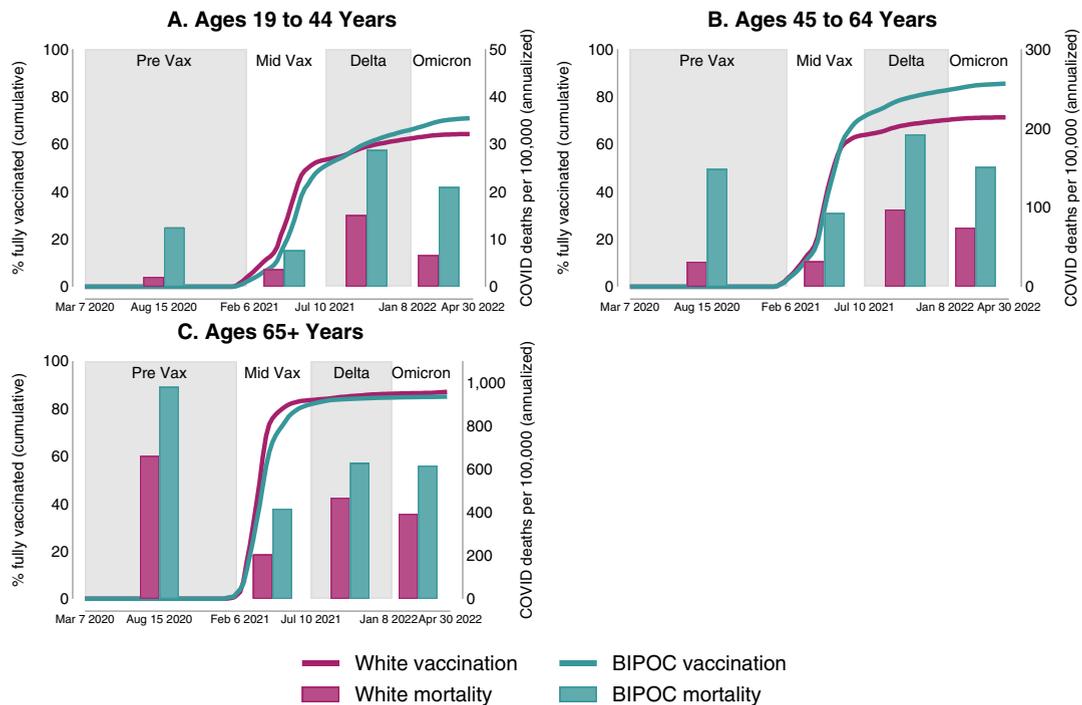
Minnesota was examined because of the unique availability of near-real-time data on both vaccination status and COVID-19 mortality that are

simultaneously separated by race/ethnicity and age. In contrast, national vaccination data that are race/ethnicity specific are not separated by age. Minnesota

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**Figure 1.** Period-specific Vax rates and COVID-19 mortality rates for White and BIPOC Minnesotans by age.

Note: The lines depict the cumulative Vax progress of each group over time as measured by the percentage of that race-specific, age-specific group that has completed their vaccine series (left axis). The bars depict the race-specific, age-specific mortality rates (right axis) during the pre-Vax period, mid-Vax period, Delta period, and Omicron period of the pandemic. Mortality rates are annualized to facilitate comparison across periods. Vax rates and mortality rates are presented for Minnesotans (A) aged 19–44 years, (B) aged 45–64 years, and (C) aged  $\geq 65$  years. Apr, April; Aug, August; BIPOC, Black, indigenous, and people of color; Feb, February; Jan, January; Jul, July; Mar, March; Vax, vaccination.

also stands out for its prolonged and deadly surge of the Delta variant, which did not end until it was supplanted by Omicron at the end of 2021.<sup>4</sup> Recent research emphasizes the exceptionally young age distribution of COVID-19 deaths in the U.S. relative to the distribution in other countries.<sup>5–7</sup> Because deaths at midlife ages drove this phenomenon<sup>7</sup> and because such deaths exhibited substantial racial/ethnic inequality before vaccines were available,<sup>8</sup> this study focuses on vaccination and mortality at these key ages.

## METHODS

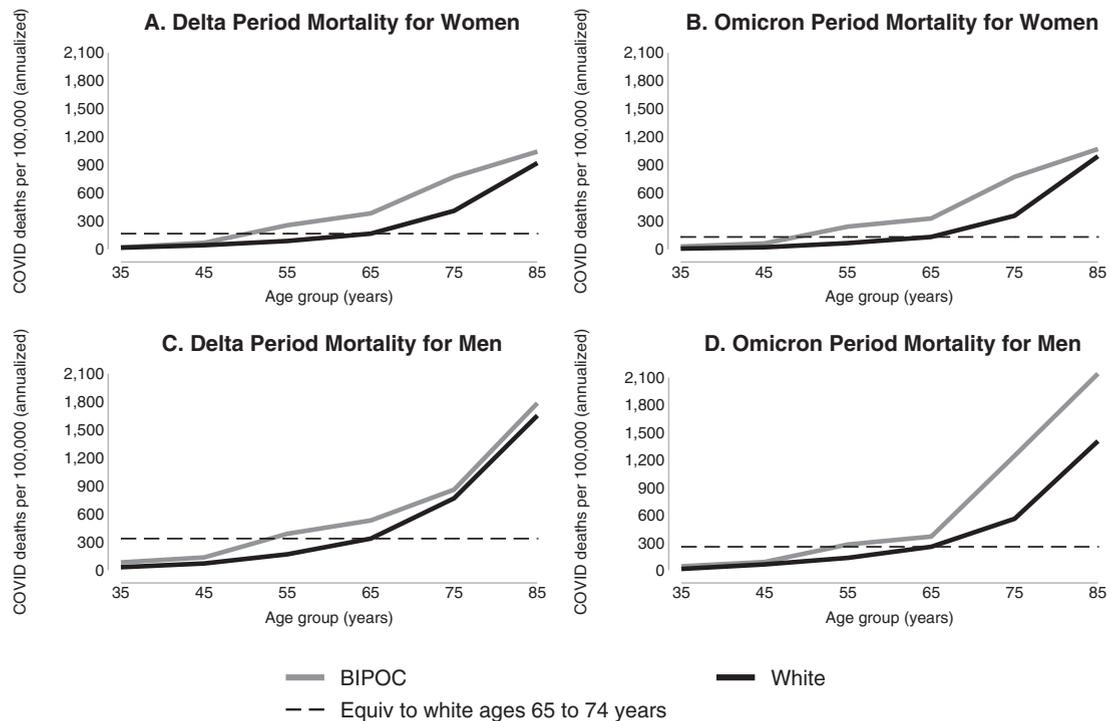
This analysis uses death certificate data from Minnesota, March 2020–April 2022; state vaccination data; and National Center for Health Statistics population distributions (Appendix Tables 1 and 2, available online). Mortality patterns were examined in specific racial/ethnic groups at midlife, with a particular focus on fall 2021 and spring 2022, periods of high mortality after widespread vaccination. Sex-specific mortality captures racial disparities independent of differences in sex composition.<sup>9</sup> COVID-19 mortality patterns in Minnesota justify the analytic grouping of the state's Black, indigenous, and

people of color (BIPOC) population, as elaborated in the Appendix (available online).

Deaths were defined as COVID-19 deaths if there was any mention of U07.1 on the death certificate. COVID-19 death and vaccination rates were examined by race/ethnicity and age for 4 pandemic periods corresponding to prevaccination (March 2020–January 2021), mid-vaccination (February 2021–June 2021), Delta-dominated (July 2021–December 2021), and Omicron-dominated (January 2022–April 2022) periods. BIPOC vaccination at elderly ages is likely underestimated in these data, as discussed in the Appendix (available online), which also presents robustness checks (Appendix Figures 1 and 2, available online).

## RESULTS

By the end of 2021 in Minnesota, vaccination among White Minnesotans was outpaced by vaccination among BIPOC Minnesotans at midlife ages (45–64 years) as well as young adult ages (19–44 years). Yet, in all age groups and in each phase of the pandemic, White mortality was substantially lower than mortality among Minnesotans of color (Figure 1).



**Figure 2.** Period-specific COVID-19 mortality rates by age for White and BIPOC men and women in Minnesota.

Note: The lines depict annualized COVID-19 death rates per 100,000 people (A–B) and during the Delta period early Omicron period, (C–D) through April 2022 by race and sex. The dashed lines in each panel show the relatively lower age at which BIPOC groups experience the same mortality rates as White groups at ages 65–74 years.

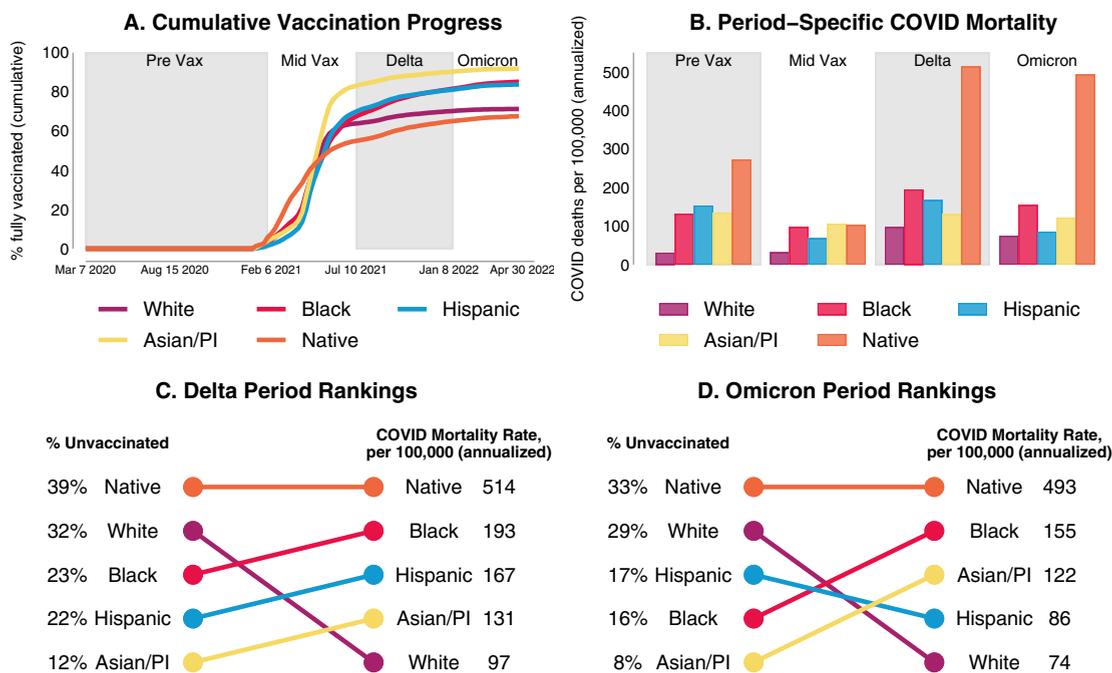
BIPOC, Black, Indigenous, and People of Color.

White undervaccination at midlife ages is pronounced: at the end of April 2022, fully vaccinated rates were 85% for BIPOC Minnesotans compared with only 71% for White Minnesotans (Figure 1B). Midlife vaccination for BIPOC Minnesotans is similar to vaccination rates for elderly (aged  $\geq 65$  years) White Minnesotans (87%) (Figure 1C). Yet, the gap in BIPOC–White mortality at those midlife ages was extreme; for example, during the Delta and Omicron periods, BIPOC mortality at ages 55–64 years was higher than White mortality at ages 65–74 years (Figure 2 and Appendix Table 3, available online). At midlife, BIPOC mortality was 4.7 times White mortality in the prevaccination period and about twice as high as White mortality in the Delta and Omicron periods; this pattern also held for Black, Hispanic, and Asian populations individually. At these ages, Minnesota’s White population is its second least vaccinated racial/ethnic group, after Native Americans (Figure 3). However, despite low vaccination rates, Minnesota’s White population aged 45–64 years has lower mortality than that of all other racial/ethnic groups, which ranged from 115% (Hispanic) to 661% (Native) of White mortality during the period dominated by the Omicron variant (Appendix Table 4, available online).

## DISCUSSION

This study found that in Minnesota, despite lower vaccination rates than all but Native Americans from autumn 2021 through April 2022, White people had lower COVID-19 mortality at midlife than Black, Hispanic, Asian, and Native people. The authors note 2 broad possible explanations for these results. One possibility is that racial inequity in COVID-19 mortality risk—owing to differential transmission, comorbidities, or unequal medical access<sup>10</sup>—among the unvaccinated, the vaccinated, or both may be so great that it overwhelms the differences in vaccination status. A second possibility is that findings may reflect vaccine differences within the fully vaccinated population, with people of color potentially less likely to have received booster vaccinations and less likely to have received mRNA vaccines in their primary series.<sup>11</sup>

Regardless of the precise mechanism, the findings suggest that the *pandemic of the unvaccinated* formulation is incomplete and that COVID-19 also remains a *pandemic of the disadvantaged*. Racial disparities in COVID-19 mortality were smaller during the Delta and Omicron waves than before vaccine availability, suggesting that the



**Figure 3.** Period-specific Vax rates and COVID-19 mortality rates at midlife (ages 45–64 years) by race/ethnicity in Minnesota. (A) The cumulative Vax progress of each racial group over time at midlife as measured by the percentage of that group who have completed their vaccine series. (B) The race-specific mortality rates at midlife during the pre-Vax period, mid-Vax period, Delta period, and Omicron period of the pandemic. (C, D) Comparison of the ranking of racial groups, from worst to best performing, by percent unvaccinated and mortality rates during the (C) Delta period and (D) Omicron period. The Vax data in C–D is from the midpoint of each period (October 2, 2021 for Delta; February 26, 2022 for Omicron) and the mortality rates cover the entire period (July 2021–December 2021 for Delta; January 2022–April 2022 for Omicron). All mortality rates are annualized to facilitate comparison across periods. Apr, April; Aug, August; Feb, February; Jan, January; Jul, July; Mar, March; PI, Pacific Islander; Vax, vaccination.

vaccination patterns documented in this study may have contributed to lessening these inequities—although declines in RRs across periods should be interpreted cautiously because they partially reflect adverse trends among White populations. Yet, if population mortality primarily reflected population vaccination rates, White communities would have a greater burden of COVID-19 mortality in midlife than communities of color. The fact that the opposite was observed indicates that structural racism, as manifested through systems and policies that affect healthcare access, occupational risk, and housing conditions, continues to fundamentally shape the risk of COVID-19 mortality even in the Delta/Omicron period.<sup>12–15</sup>

Although a *pandemic of the unvaccinated* framing may be used as a rationale for accelerating a return to normal, a *pandemic of the disadvantaged* framing emphasizes the need for sustained population-based COVID-19 prevention strategies that center on health equity. Such measures could aim to further increase vaccination with community campaigns<sup>16</sup> and might also

aim to mitigate COVID-19 spread through approaches that protect the vaccinated and unvaccinated alike, including improved ventilation in workplaces and public buildings, paid sick leave, Medicaid expansion and universal health care, economic payments to medically high-risk populations, protective equipment and increased pay for long-term care workers to reduce working multiple jobs, eviction moratoriums and housing support, mask mandates, and public funding for community testing programs and scientific research. These strategies acknowledge that even when vaccine uptake among people of color is relatively high, the mortality of the pandemic remains unequally borne. The *pandemic of the disadvantaged* framing suggests that a sole emphasis on individual behavior is inadequate for reducing health inequities.

The extent to which findings in Minnesota may resemble those of other states is unclear, particularly because state contexts affect health.<sup>17,18</sup> If vaccination rates are generally higher in metropolitan areas than in

rural areas, other states with very urban populations of color and large rural White populations may show similar vaccination disparities. At the national level, aggregated over age, the White population is vaccinated at lower rates than all but African American individuals,<sup>19</sup> and in most states, White vaccination is lower than the high average age of White populations would predict.<sup>20</sup> However, the lack of publicly available data on the age composition of vaccine status by race/ethnicity for the U.S. as a whole limits the ability to know how widespread the patterns identified in this study may be.

## CONCLUSIONS

Results highlight how distinctive risk at midlife may be intertwined with the deep inequality in U.S. COVID-19 mortality. Populations of color may be at notably high risk—even when they have greater vaccination rates than White people of the same ages.

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Elizabeth Wrigley-Field: Conceptualization, Data curation, Methodology, Software, Writing—original draft. Kaitlyn M. Berry: Conceptualization, Methodology, Software, Visualization, Writing—review and editing. Andrew C. Stokes: Conceptualization, Writing—original draft. Jonathon P. Leider: Conceptualization, Data curation, Writing—review and editing.

## SUPPLEMENTAL MATERIAL

Supplemental materials associated with this article can be found in the online version at <https://doi.org/10.1016/j.amepre.2022.08.005>.

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