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DOI: 10.1377/hlthaff.2020.02142
HEALTH AFFAIRS 40,
NO. 2 (2021): 307–316

Racial Disparities In Excess All-Cause Mortality During The Early COVID-19 Pandemic Varied Substantially Across States

ABSTRACT **The impact of the coronavirus disease 2019 (COVID-19) pandemic has been starkly unequal across race and ethnicity. We examined the geographic variation in excess all-cause mortality by race and ethnicity to better understand the impact of the pandemic. We used individual-level administrative data on the US population between January 2011 and April 2020 to estimate the geographic variation in excess all-cause mortality by race and Hispanic origin. All-cause mortality allows a better understanding of the overall impact of the pandemic than mortality attributable to COVID-19 directly. Nationwide, adjusted excess all-cause mortality during that period was 6.8 per 10,000 for Black people, 4.3 for Hispanic people, 2.7 for Asian people, and 1.5 for White people. Nationwide averages mask substantial geographic variation. For example, despite similar excess White mortality, Michigan and Louisiana had markedly different excess Black mortality, as did Pennsylvania compared with Rhode Island. Wisconsin experienced no significant White excess mortality but had significant Black excess mortality. Further work understanding the causes of geographic variation in racial and ethnic disparities—the relevant roles of social and environmental factors relative to comorbidities and of the direct and indirect health effects of the pandemic—is crucial for effective policy making.**

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The coronavirus disease 2019 (COVID-19) pandemic in the United States has led to a sharp rise in all-cause mortality nationwide, starting in March 2020 and continuing in the subsequent months. Excess deaths stem from a combination of the direct effects of viral infections with severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) and the indirect effects of wide-reaching societal changes associated with the pandemic.[1–5]

Many observers have emphasized the large differences in the impact of the pandemic across demographic and socioeconomic groups.[6–9] Although some differences such as the age gradient have clear explanations based on biological pathways, the reasons for other gaps warrant further examination. This is particularly true of racial/ethnic disparities in the pandemic's impact. Nationwide, there are stark differences in excess all-cause mortality by race and ethnicity, as well as in case fatality rates for COVID-19 infections.[10–14]

The reasons for these racial/ethnic disparities are poorly delineated, making it hard to formulate evidence-based mitigation policies. One crucial question that policy makers face in this context is whether racial/ethnic disparities in all-cause mortality stem predominantly from disparities in the direct effects of SARS-CoV-2 infections, such as higher infection rates or higher

case fatality rates, or, alternatively, whether the disparities are driven by the indirect effects of the pandemic, such as disparities in the effects of the pandemic on livelihoods and associated excess morbidity and mortality.

An important first input into this discussion is a measurement of the overall effect of the pandemic on different demographic groups, both nationally as well as across different geographies. Although national and geographic variation in mortality associated with COVID-19 directly has been widely reported,[1–11,13] less evidence has been available on the pandemic's differential impact on all-cause mortality across both demographic groups and geographies.

To fill this gap, we drew on individual-level administrative data covering the near universe of the US population from January 2011 through April 2020. This provided demographic information on age, race and Hispanic origin, sex, state of residence, and date of death (if any). We used these data to estimate excess all-cause mortality (hereafter "excess mortality") separately for seven racial/ethnic groups during April 2020, the first full month of the COVID-19 pandemic. We report estimates both for the whole nation and separately by state. We report unadjusted estimates as well as estimates adjusted to a standardized population by demographics.

Study Data And Methods

DATA We used the Census Bureau's version of the Social Security Administration's Numerical Identification (Numident) database covering the US population and deaths from January 2011 to April 2020 (inclusive) to measure the all-cause monthly mortality rate. To our knowledge, this represents one of the first studies to use the Census Numident database to assess the ongoing mortality effects of the pandemic. The Census Numident data cover all people with a Social Security number regardless of their geographic location. The data set is cumulative, adding people as they receive Social Security numbers on birth or arrival to the US. People are not removed from the data after death. For each person, we observed a date of birth. For deceased people, we observed a date of death. The date of death is recorded regardless of whether the person died inside or outside the United States. The version of the Census Numident available to us was released August 27, 2020, and included deaths through May 2020. The last month of death records in each release of the Census Numident data tend to be incomplete because of the delays in the reporting of deaths. Our analysis thus included deaths only through April 2020. Sections 1.1 and 1.2 of the online appendix describe our data sources in more detail.[15]

Death counts in the Social Security Administration Numident, the main source for the Census Numident, differ from those in another major source of US vital statistics: data released by the National Center for Health Statistics of the Centers for Disease Control and Prevention (CDC). However, that source provided three distinct advantages for our purposes. First, the Numident data provided an internally consistent numerator and denominator for measuring mortality, as they record not only deceased but also living people at any given moment; this denominator is not available in the CDC vital statistics measure. Second, we were able to link mortality records at the individual level to other demographic information about individuals, allowing us to estimate excess mortality by race/ethnicity and to adjust these estimates to a standardized distribution of demographics by race/ethnicity, both nationally and by state, as discussed below. Third, we were able to use a self-reported record of race or Hispanic origin, potentially improving on CDC vital statistics office data that use proxy race/ethnicity reports from funeral directors.[16]

As has previously been documented in the literature, estimates of death counts and characteristics of the deceased, such as race/ethnicity, differ between the Social Security Administration Numident and the CDC data because of different underlying reporting mechanisms.[17] In addition, the CDC counts all deaths that occurred on US territory regardless of nationality or immigration status; its data do not cover deaths of US persons outside of the US. Section 1.3 of the appendix discusses the April 2020 difference in death counts by race/ethnicity and state between our baseline analytic data set and CDC vital statistics.[15]

We measured people's sexes and ages (based on date of birth) in the Census Numident data. The Census Bureau's annual address database, the Master Address File Auxiliary Reference File, was used to attach a county and state of residence to each individual-month observation when available. The appendix discusses, in more detail, the use of Master Address File Auxiliary Reference File and when the address records were available.[15]

Self-reported race/ethnicity information was drawn primarily from the 2010 decennial census. When no record of race or Hispanic origin was available from that source, we used the race variable recorded in the Census Bureau's 2010 Modeled Race File. We analyzed the following seven categories: Hispanic origin, White, Black, Asian, American Indian and Alaska Native, Native Hawaiian and Other Pacific Islander (all non-Hispanic), and non-Hispanic people of

Several states that experienced virtually no White excess mortality in April 2020 exhibited substantial Black excess mortality.

some other race or two or more races.

The monthly mortality rate for each demographic group of interest was defined as the ratio of the count of people whose death dates fell within that month divided by the count of people who were alive at the beginning of the month.

Institutional Review Board determination was obtained through Stanford University; this research was determined to not involve human subjects as defined in 45 CFR 46. The analysis used preexisting deidentified data.

STATISTICAL ANALYSIS Data were collapsed into counts of living and deceased people by sex, age, race/ethnicity, county, month, and year. Monthly mortality rates from January 2011 through April 2020 were computed for each sex, age, race/ethnicity, county, and month-year combination.

Predicted and excess unadjusted all-cause mortality were computed on the basis of a linear regression model. The outcome variable was the monthly mortality rate by demographic group. The right-hand side variables were a linear annual time trend to capture secular trends; indicator variables for each calendar month to nonparametrically capture seasonal variation; and indicator variables for January, February, March, and April 2020 to capture deviations from historical trend, if any, during the first four months of 2020. All slopes and intercepts were allowed to be race specific. Section 2 of the appendix shows the regression equation and provides more information about our specifications.[15]

Regression coefficients on the interaction between race/ethnicity indicators and the indicator for April 2020 directly measured the difference in excess mortality between racial/ethnic groups. The level of excess mortality for each race/ethnicity (relative to a race-specific historical trend) was obtained from combining these regression coefficients with the other race-specific parameters of the regression model.

To adjust our estimates of excess mortality across races and Hispanic origin to a standardized distribution of demographics, we first estimated an augmented version of our baseline regression model that included differential intercepts and differential deviations from historical trends in January, February, March, and April 2020 for specific demographics: sex, individual state, or five-year age group and those three metrics combined. We also estimated the demographically augmented model separately by state. The coefficients on the demographic variables were then used to obtain national estimates of adjusted excess mortality for each race or ethnicity for a standardized population that had the same distribution of sex, age (in five-year age groups), and states of residence as the full baseline analytic data set in April 2020. In other words, each race-specific estimate was adjusted to match the national distribution of age, sex, and state in April 2020. State-specific adjusted estimates of excess mortality were obtained for the same standardized distribution of sex and age.

All regressions were estimated using Stata, version 16.1, on data collapsed by sex, age, race/ethnicity, county, month, and year and were weighted by the number of people who were alive at the beginning of the month in each data cell. The 95% confidence intervals for the levels and gaps in excess all-cause mortality by race/ethnicity were computed using heteroskedasticity-robust standard errors and the delta method.

LIMITATIONS The main limitation of our analysis was that information on the date of birth, date of death, race/ethnicity, sex, and geographic location were not available for some people residing in the US. Also, race/ethnicity information was not available for people born after 2010; our analysis therefore excluded children ages ten and younger. As the mortality rate is very low in this population, omitting children was unlikely to have substantially affected our main results. Race/ethnicity data from a combination of administrative records, survey, and census data were used in our baseline analysis. As we show in the appendix, our results were similar when limiting our analysis only to people for whom we observed race or Hispanic origin recorded in the 2010 decennial census.[15]

Our baseline analysis was limited to people for whom a state record was observed and who resided in the fifty US states or Washington, D.C. As we show in the appendix, our unadjusted estimates of excess mortality were unaffected when we included people who resided outside of the fifty states or Washington, D.C., or for

whom no geographic record was observed.[15] As the Census Numident database is based on the records of the Social Security Administration, mortality for people living in the US but not captured in the Social Security Administration records (for example, people without Social Security numbers) was not measured.

Finally, some people were missed in our analysis because of a lack of valid linkage keys. A unique individual-level anonymous identifier common across all data sources was used to link the Census Numident to other data sources. The linkage keys were created using personally identifiable information and probabilistic record linkage. Prior literature shows that linkage key assignment may be nonrandom, as immigrants, young people, and minorities are less likely to receive these keys.[18] Our analysis required people to have valid linkage keys.

Study Results

BASELINE ANALYTIC DATA SET The data set included 27 billion person-month observations and 22.4 million deaths for people ages 11–99 (inclusive) between January 1, 2011, and April 30, 2020. The mean age in the full data set was forty-four years, and 51 percent were female. The data set was 67 percent White, 14 percent Hispanic origin, 12 percent Black, 5 percent Asian, 0.9 percent American Indian or Alaska Native, 0.2 percent Native Hawaiian or Pacific Islander, and 0.4 percent reporting two or more races or other race. The April 2020 data included 241.5 million people ages 11–99 and 276,000 deaths. The distribution of age, sex, and geographic location in April 2020 was similar to that for the complete time range (exhibit 1).

NATIONAL ALL-CAUSE EXCESS MORTALITY BY RACE/ETHNICITY Exhibit 2 shows raw monthly all-cause mortality for April of each year separately for three race/ethnicity categories (results for Native Hawaiian and Pacific Islander people, American Indian and Alaska Native people, Asian people, and people who reported having "Other and two or more races" are in appendix section 3.1).[15] It also superimposes the regression fit from the historical April mortality trend for each race and Hispanic origin. Two clear facts emerge. First, for all races and Hispanic origin, historical April mortality has followed a stable, close to linear, slightly upward trend during the past decade. Second, for all three groups there is a pronounced upward deviation from this trend in April 2020. The difference between the observed and predicted values in April 2020 measures national race-specific excess all-cause mortality in April 2020.

These estimates are reported in exhibit 3, which shows excess mortality per 10,000 people by race and Hispanic origin; all racial/ethnic groups exhibited excess mortality ($p < 0.05$ for two-sided null hypothesis of zero excess mortality). Native Hawaiian and Pacific Islander unadjusted excess mortality was the lowest observed of any group, at 1.3 excess deaths per 10,000 people, which is a 22 percent increase relative to the predicted rate for April 2020 of 5.9 deaths (data not shown). Black unadjusted excess mortality was the highest observed, at 6.1 excess deaths per 10,000, which is a 79 percent increase relative to the predicted rate of 7.7 deaths per 10,000. Unadjusted excess mortality was 2.1 per 10,000 among White people (a 21 percent increase from the predicted rate of 10.2 deaths), 2.7 among Hispanic people (a 64 percent increase), 2.9 among Asian people (a 64 percent increase), 1.9 among American Indian and Alaska Native people (a 22 percent increase), and 2.7 among those with other or two or more races (a 60 percent increase) (data not shown). Differences relative to White unadjusted excess mortality were statistically significant at the 5 percent level for Hispanic, Black, and Asian people (appendix section 3.2).[15]

Adjusting for differences in age distributions

EXHIBIT 1

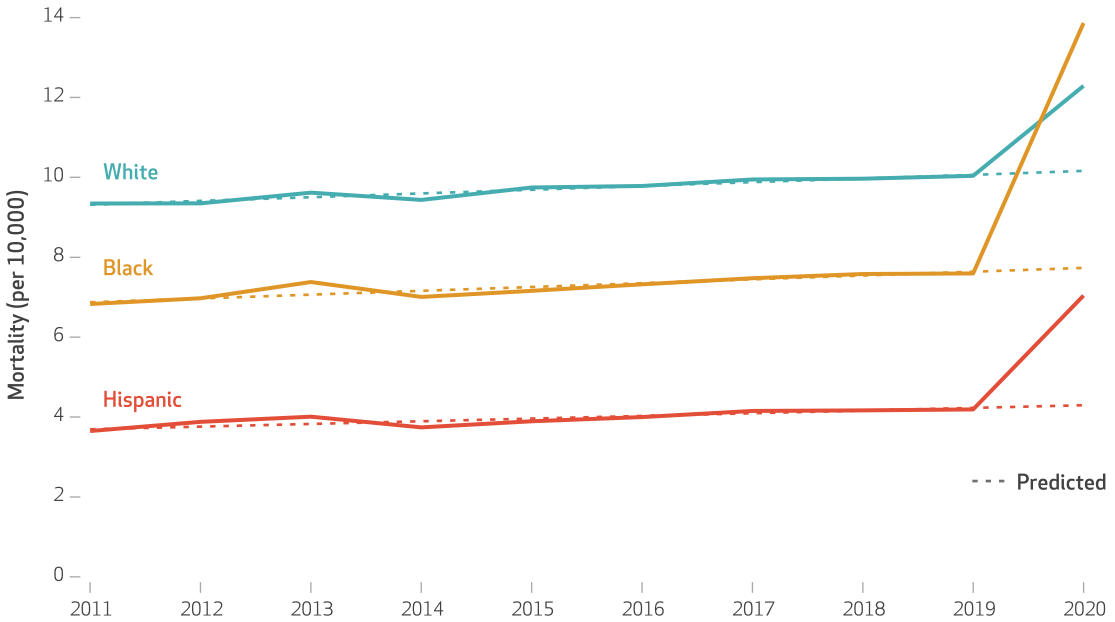
Summary statistics of the population in US census data, 2011–20

Variables	Apr. 2020	Jan. 2011–Apr. 2020
COUNTS		
No. of individual-months	241,500,000	26,680,000,000
No. of deaths	276,000	22,400,000
SUMMARY STATISTICS		
Average age, years	45.14	44.28
Female (%)	51.17	51.23
Geography (%)		
Northeast	17.43	17.72
Midwest	21.99	22.29
South	37.67	37.34
West	22.91	22.66
Race/ethnicity (%)		
White	65.96	67.36
Hispanic origin	14.70	13.67
Black	12.57	12.32
Asian	5.27	5.18
American Indian and Alaska Native	0.90	0.90
Native Hawaiian and Pacific Islander	0.19	0.19
Other or two or more, non-Hispanic	0.40	0.38

SOURCE Authors' calculations of data from Census Numident 2011–20, 2010 decennial census, 2010 Census Modeled Race File, and 2010–19 Master Address File Auxiliary Reference File. **NOTES** Table shows summary statistics for the baseline analytic data set constructed from the Census Bureau version of the Social Security Administration's Numerical Identification System (Numident) database covering population and deaths from January 2011 to April 2020. The first column shows summary statistics for people who were alive at the start of April 2020. The second column shows summary statistics for all people in our baseline analytic data set who were alive as of January 1, 2011, and who were tracked until April 2020 (dates are inclusive). Racial groups are non-Hispanic. All results were approved for release by the Census Bureau, Authorization No. CBDRB-FY21-ERD002-003.

EXHIBIT 2

Observed and predicted April mortality, by race/ethnicity, 2011–20



SOURCE Authors' calculations of data from Census Numident 2011–20, 2010 decennial census, 2010 Census Modeled Race File, and 2010–19 Master Address File Auxiliary Reference File. **NOTES** Figure shows observed and predicted all-cause mortality separately by race/ethnicity in the month of April, 2011–20. The race- and ethnicity-specific trends are estimated as discussed in the text on the full data set of 26,680,000,000 individual-months from January 2011 through April 2020. All results were approved for release by the Census Bureau, Authorization No. CBDRB-FY21-ERD002-003.

is important for comparing all-cause mortality by race and Hispanic origin, as age distributions differ starkly across racial/ethnic groups (appendix section 3.3).[15] Adjusting for age exacerbates differences in excess mortality between White people and people of each other race or Hispanic origin (column 2). For example, the difference between Hispanic and White excess mortality rises from 0.62 deaths per 10,000 (unadjusted) to more than 2 deaths per 10,000 once age adjusted. The highest excess mortality is still observed among Black Americans, with 6.8 ex-

EXHIBIT 3

Model estimates of all-cause excess mortality in April 2020, by race

	Excess mortality (per 10,000), April 2020					
	Model 1: unadjusted		Model 2: age adjusted		Model 3: age, sex, and state adjusted	
Race/ethnicity	Rate	SE	Rate	SE	Rate	SE
White	2.13	0.08	1.64	0.04	1.54	0.04
Hispanic origin	2.74	0.13	3.75	0.10	4.26	0.10
Black	6.13	0.17	6.85	0.13	6.77	0.13
Asian	2.86	0.16	3.00	0.13	2.73	0.13
American Indian and Alaska Native	1.95	0.24	2.81	0.24	3.91	0.24
Native Hawaiian and Pacific Islander	1.32	0.43	2.46	0.42	4.26	0.43
Other or two or more, non-Hispanic	2.74	0.30	4.00	0.30	3.42	0.30

SOURCE Authors' calculations of data from Census Numident 2011–20, 2010 decennial census, 2010 Census Modeled Race File, and 2010–19 Master Address File Auxiliary Reference File. **NOTES** Table shows regression-based estimates of levels of excess all-cause mortality by race in April 2020. Columns report the results of regression models with or without demographic adjustments as specified in column headings. Standard errors (SE) are heteroskedasticity robust. Racial groups are non-Hispanic. The details of the regression analysis used to construct the estimates are reported in the text. All results were approved for release by the Census Bureau, Authorization No. CBDRB-FY21-ERD002-003.

cess age-adjusted deaths per 10,000 people, which is a gap of 5.2 relative to White people. In contrast, adjusting for differences in the sex distribution between racial/ethnic groups does not meaningfully change our estimates of the levels or gaps in excess mortality for any race or Hispanic origin (appendix section 3.2).[15]

Adjusting for the state of residence has an important effect on the estimates of levels and differences in excess mortality for smaller racial groups (appendix section 3.2).[15] In particular, it substantially increases estimated excess mortality for American Indian and Alaska Native people, as well as for Native Hawaiian and Pacific Islander people. This, in turn, decreases the estimated gaps in excess mortality between these racial groups and White people.

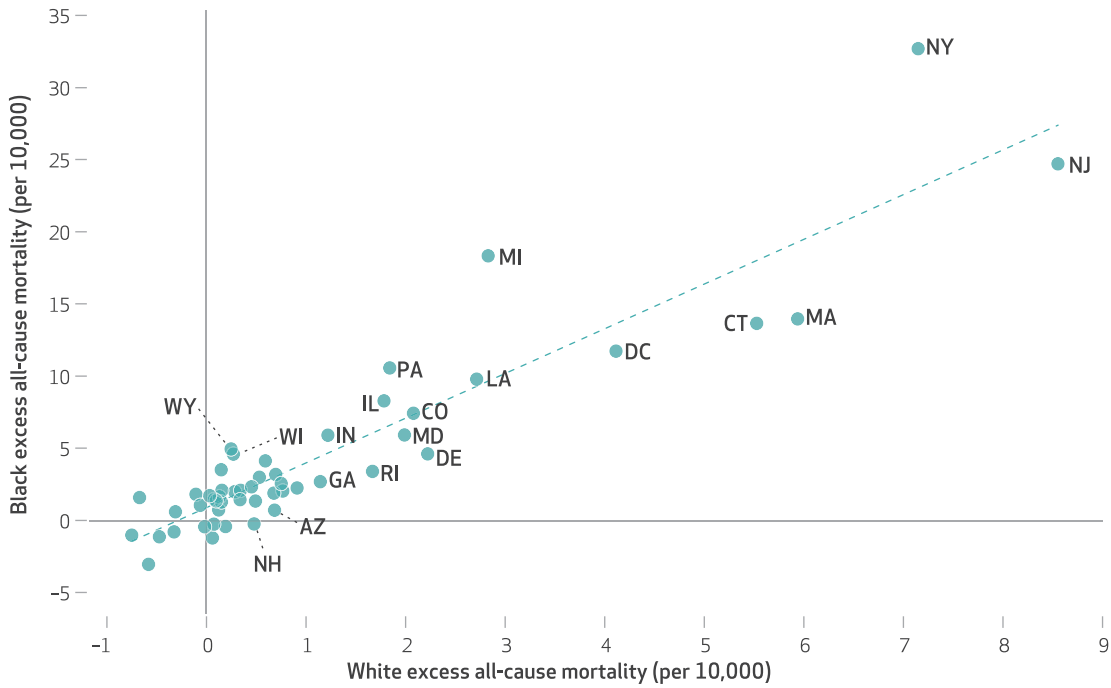
Exhibit 3 also reports results adjusting for sex, age, and state simultaneously. This allows us to compare excess mortality rates across races and Hispanic origin for a standardized distribution of sex, age, and state of residence. This adjusted excess mortality is lowest for White people, at 1.5 excess deaths per 10,000, and highest for Black people, at 6.8 excess deaths per 10,000. Relative to White people, adjusted excess mortality rates are higher by 2.7 deaths per 10,000 for Hispanic people, 1.2 for Asian people, 2.4 for American Indian and Alaska Native people, and 2.7 for Native Hawaiian and Pacific Islander people (data not shown).

RACIAL/ETHNIC DISPARITIES BY STATE Age- and sex-adjusted excess mortality showed substantial geographic variation across states for each race and Hispanic origin. Appendix section 3.4 reports the point estimates and 95% confidence intervals of White, Black, and Hispanic excess mortality for each state.[15] The (unweighted) interquartile range across states was 0.09–1.4 excess deaths per 10,000 for White people; 1.2–4.8 excess deaths per 10,000 for Black people, and 0.13–2.1 excess deaths per 10,000 for Hispanic people.

Although Black and Hispanic people experienced higher adjusted excess mortality than White people in nearly every state, exhibits 4 and 5 show that these racial/ethnic disparities differed substantially by state. We observed particularly staggering levels and racial/ethnic differences in excess all-cause mortality in New York and New Jersey—the two states that were affected the most by the first wave of the pandemic.

EXHIBIT 4

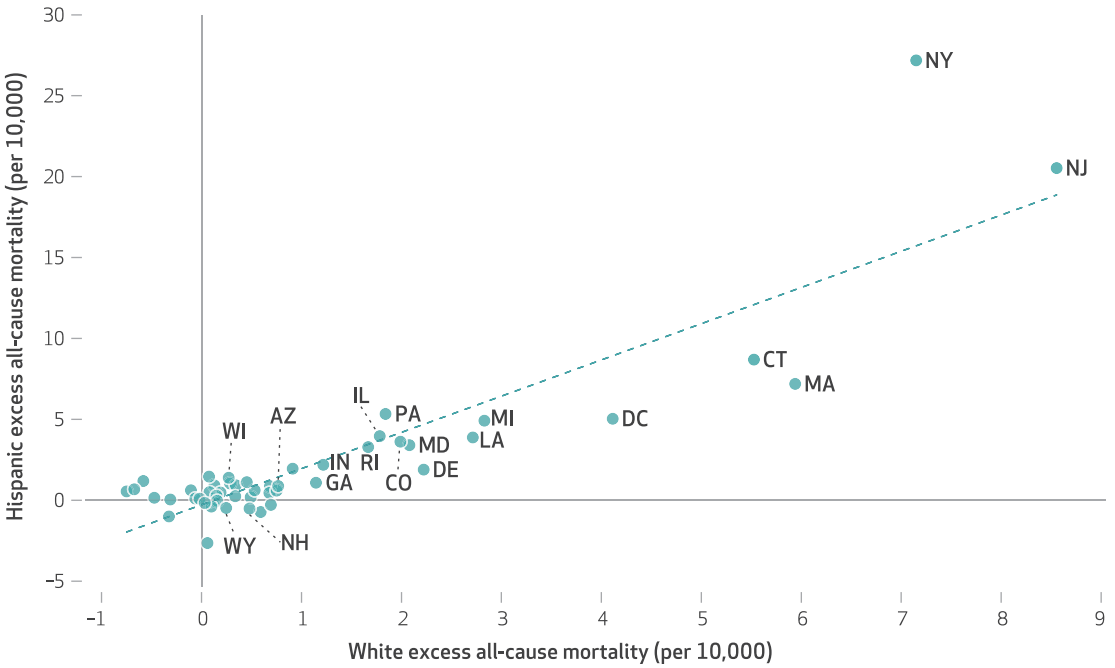
Association of Black and White excess all-cause mortality across states, April 2020



SOURCE Authors' calculations of data from Census Numident 2011–20, 2010 decennial census, 2010 Census Modeled Race File, and 2010–19 Master Address File Auxiliary Reference File. **NOTES** Figure reports the association in the estimates of sex- and age-adjusted all-cause excess mortality in April 2020 by state among non-Hispanic Black people versus non-Hispanic White people. The details of the regression analysis used to construct the estimates are reported in the text. The trend line marks the line of best fit for the relationship between White and Black excess mortality by state. All results were approved for release by the Census Bureau, Authorization No. CBDRB-FY21-ERD002-003.

EXHIBIT 5

Association of Hispanic and White excess all-cause mortality across states, April 2020



SOURCE Authors' calculations of data from Census Numident 2011–20, 2010 decennial census, 2010 Census Modeled Race File, and 2010–19 Master Address File Auxiliary Reference File. **NOTES** Figure reports the association in the estimates of sex- and age-adjusted all-cause excess mortality in April 2020 by state among Hispanic versus non-Hispanic White people. The details of the regression analysis used to construct the estimates are reported in the text. The trend line marks the line of best fit for the relationship between White and Hispanic excess mortality by state. All results were approved for release by the Census Bureau, Authorization No. CBDRB-FY21-ERD002-003.

White excess all-cause mortality was 7.1 per 10,000 in New York and 8.6 in New Jersey. Black people, however, experienced excess all-cause mortality that was 4.6 and 2.9 times higher in New York and New Jersey, respectively, amounting to 32.7 per 10,000 age- and sex-adjusted excess all-cause deaths among Black people in New York and 24.7 in New Jersey. Hispanic people fared only slightly better, with 27.2 per 10,000 age- and sex-adjusted excess all-cause deaths in New York and 20.5 per 10,000 in New Jersey.

In general, the difference between Black or Hispanic excess mortality and White excess mortality was larger in states where White excess mortality was higher. But even states with similar levels of adjusted White excess mortality exhibited substantial variation in the level of adjusted Black or Hispanic excess mortality. Michigan, for instance, had much higher adjusted Black excess mortality (18.3 excess deaths per 10,000) than Louisiana (9.8 per 10,000), even though the two states had comparable adjusted White excess mortality (2.8 and 2.7 per 10,000, respectively). Likewise, Pennsylvania had much higher adjusted Black excess mortality (10.6 excess deaths per 10,000) than Rhode Island (3.4 per 10,000), even though the two states had comparable adjusted White excess mortality (1.8 and 1.7 per 10,000, respectively). As another example, Hispanics experienced higher adjusted excess mortality in Pennsylvania than in Delaware, even though White adjusted excess mortality was similar in both states. All reported comparisons are statistically significant at a 5 percent confidence level (appendix section 3.4).[15]

In addition, in several states Black and Hispanic people experienced an increase in mortality in April 2020, whereas White people did not. For, example, in Wisconsin, we estimate adjusted excess mortality for Black people to be 4.6 per 10,000 (95% CI: 2.9, 6.3) and for Hispanic people to be 1.4 per 10,000 (95% CI: 0.5, 2.3), whereas White adjusted excess mortality was a statistically insignificant 0.27 per 10,000 (95% CI: −0.0, 0.6). In Kentucky, Alabama, South Carolina, California, and Washington, Black adjusted excess mortality was higher than 1.5 per 10,000 ($p < 0.05$ for the null of zero adjusted excess mortality in each state), whereas White adjusted excess mortality was under 0.5 per 10,000 in each of those states.

Discussion

Excess all-cause mortality differed substantially across racial and ethnic groups during the early spread of SARS-CoV-2. Our data allowed us to examine racial/ethnic disparities in national excess all-cause mortality for seven different groups, to examine the role of demographic differences in these disparities, and to examine differences in disparities by state. The results indicate pronounced differences in the overall impact of the pandemic across racial/ethnic groups and in the extent of disparities across states.

All racial/ethnic groups experienced substantial excess mortality in the first full month of the pandemic. When data were adjusted to a standardized distribution of sex, age, and state of residence, White and Asian people had the lowest excess mortality (at 1.5 and 2.7 excess deaths per 10,000, respectively), whereas Black people had the highest (at 6.8 excess deaths). Differences by race/ethnicity were more pronounced when adjusted for demographic differences, highlighting important differences in age and geographic distributions by race/ethnicity. Crude excess mortality overestimates the mortality effect for White people, who are on average older, and underestimates it for other races and Hispanic origin, who are on average younger. Our unadjusted national estimates of all-cause excess mortality are similar, but slightly higher, compared with those based on CDC data releases (2.75 per 10,000 in our data versus 2.4 per 10,000 based on CDC data);[1,2,19] compared with prior estimates of COVID-19-specific deaths, our estimates suggest that 35 percent of excess deaths during the first month of the pandemic are not directly attributable to SARS-CoV-2 infections. Our results are qualitatively consistent with findings of pronounced racial/ethnic disparities in COVID-19-specific deaths nationwide.[6,7,9]

Racial disparities in adjusted excess all-cause mortality varied substantially across states. The states that exhibited the highest levels of White excess mortality of 7–8 excess deaths per 10,000 and were generally the most affected by the first wave of the pandemic, New York and New Jersey, experienced staggering levels of Black and Hispanic excess mortality, ranging from 20 to more than 30 excess deaths per 10,000 people. Some states, such as Michigan and Pennsylvania, had substantially higher Black excess mortality than other states with similar White excess mortality (for example, Louisiana and Rhode Island, respectively). In addition, several states that experienced virtually no White excess mortality in April 2020 exhibited substantial Black excess mortality. For example, Wisconsin experienced significant Black excess mortality of 4.6 per 10,000, whereas the state's White excess mortality was statistically indistinguishable from zero (point estimate, 0.27).

Understanding what drives the variation in all-cause mortality across states and racial/ethnic groups is crucial for evidence-based policies.

These findings are consistent with the growing literature that has documented the broader importance of geography for understanding the patterns of health disparities in the US.[20] Although geographic difference in the overall level of excess mortality likely reflects the different timing of COVID-19's spread, the causes of the stark variation in racial/ethnic disparities across states are less clear. The geographic patterns that we document for the first full month of the pandemic may point to an important role of the indirect effects of the pandemic on non-White people. In the states where we observed excess mortality among White people that is close to zero, it is possible that community transmission of SARS-CoV-2 was still limited, whereas the indirect effects of the pandemic, such as the impact on the economy that has been documented to be much more geographically spread early on,[2] was already affecting non-White people.

As direct and indirect impacts of the pandemic would call for different mitigating policies—for instance, different vaccine distribution priority in the case of direct effects and differential economic interventions in the case of indirect effects—understanding what drives the variation in all-cause mortality across states and racial/ethnic groups is crucial for evidence-based policies. In addition, the geographic variation in the extent of racial/ethnic disparities in the pandemic's early and later impact may provide an opportunity to examine the relative roles of social and environmental factors (such as occupational and residential segregation) and underlying comorbidities in contributing to these disparities; such evidence would have important implications both for policies aimed at mitigating racial/ethnic disparities during the pandemic

and potentially more broadly beyond the pandemic.

In this article we demonstrate the enormous potential of linking administrative records and census responses at the individual level to explore these future research questions. An important limitation of our work was that we could not pinpoint the drivers of the geographic variation in the racial/ethnic disparities of the pandemic's impact. Several hypotheses about the underlying causes of racial/ethnic disparities in the mortality impact of COVID-19 have been put forward, including racial/ethnic differences in education and occupation;[21–24] neighborhood characteristics such as safety, food availability, and pollution;[22,24–26] risk for infection;[27] access to health care;[28] and comorbidities.[24,29] Our results suggest that factors driving racial/ethnic disparities may well differ across states. Assembling additional empirical evidence on the sources of geographic variation in racial/ethnic disparities during the period we studied as well as later in the pandemic will likely help shed light not only on the underlying reasons for the unequal impact of the pandemic on mortality across racial/ethnic groups in the US and the best associated policy responses but also on the drivers of racial/ethnic health disparities more generally. ■

An earlier version of this research was presented at the National Bureau of Economic Research COVID-19 and Health Outcomes Conference (virtual); December 4, 2020. Maria Polyakova and Victoria Udalova contributed equally as co–first authors. The authors thank the National Institute on Aging (Grant No. R01-AG032449; Amy Finkelstein, principal investigator) and the National Institute for Health Care Management Foundation (Polyakova, principal investigator) for financial support and James Okun for outstanding research assistance. Any conclusions expressed herein are those of the authors and do not necessarily represent the views of the Census Bureau. All results were approved for release by the Disclosure Review Board of the Census Bureau, Authorization No. CBDRB-FY21-ERD002-003. All numeric values were rounded according to Census Bureau disclosure protocols to preserve data privacy.

NOTES

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