Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

MAYO CLINIC

ORIGINAL ARTICLE

Examining Disparities and Excess Cardiovascular Mortality Before and During the COVID-19 Pandemic

Scott E. Janus, MD; Mohamed Makhlouf, MD; Nicole Chahine, MD; Issam Motairek, MD; and Sadeer G. Al-Kindi, MD

Abstract

Objective: To investigate the patterns and demographic features of cardiovascular disease (CVD) death and subtypes myocardial infarction (MI), stroke, and heart failure in the pre−COVID-19 era (2018-2019) vs during the COVID-19 pandemic (2020-2021) in the United States.

Methods: In this cross-sectional study, we used the US Multiple Cause of Death files for 2018 to 2021 to examine the trend of excess cause-specific deaths using *International Classification of Diseases, Tenth Revision* codes for CVD (I00 to I99), MI (I21 and I22), stroke (I60 to I69), and heart failure (I42 and I50). Our primary outcome was excess mortality from CVD and its 3 subtypes (MI, stroke, and heart failure) between prepandemic (2018-2019) and pandemic (2020-2021) years. We performed a subgroup analysis on race and month-to-month and year-to-year variation using χ^2 analysis to test statistical significance.

Results: Overall, 3,598,352 CVD deaths were analyzed during the study period. There was a 6.7% excess CVD mortality, 2.5% MI mortality, and 8.5% stroke mortality during the COVID-19 pandemic (2020-2021) compared with the prepandemic era (2018-2019). Black individuals had higher excess CVD mortality (13.8%) than White individuals (5.1%; $P<.001$). This remained consistent across subtypes of CVD, including MI (9.6% vs 1.0%; $P<.001$), stroke (14.5% vs 6.9%; $P<.001$), and heart failure (5.1% vs −1.2%; $P<.001$).

Conclusion: There has been a significant rise in CVD and subtype-specific mortality during the COVID-19 pandemic that has been persistent despite 2 years since the onset of the pandemic. Excess CVD mortality has disproportionately affected Black compared with White individuals. Further studies targeting and eliminating health care disparities are necessary.

 ■ Mayo Clin Proc. 2022;■■(■):1-9

Although the direct toll of COVID-19 in the United States has been devastating, concerns have risen about the indirect effects of the pandemic.[1] Despite that hospitalizations for acute cardiovascular conditions have been declining, cardiovascular disease (CVD) mortality has risen substantially during the COVID-19 pandemic in the United States.[2] Whether this is attributed to avoidance of medical care, overwhelmed medical personnel, a combination, or another underlying factor remains unknown.[3] Early reports (2019-2020) indicate a dramatic shift in cardiovascular mortality whether it is directly or indirectly related to COVID-19.[2]

Whereas underlying disparities are known to exist in society, including structural racism, and in the US health care system,[4] the COVID-19 pandemic seems to have exacerbated these inequalities[5] not just in health care but in all facets of society.[6] Recent publications have highlighted growing disparities in CVD death in the early (March to December 2020) COVID-19 pandemic.[7] We sought to investigate the patterns and demographic features of CVD, myocardial infarction (MI), stroke, and heart failure mortality from the prepandemic era (2018-2019) and during the COVID-19 pandemic (2020-2021).

From the Department of Medicine, University Hospitals, Cleveland, OH (S.E.J., M.M., I.M., S.G.A.-K.); Harrington Heart and Vascular Institute, University Hospitals and School of Medicine, Case Western Reserve University, Cleveland, OH (S.E.J., M.M., I.M., S.G.A.-K.); and Loyola University Medical Center, Maywood, IL (N.C.).

METHODS

This was a retrospective study using the Multiple Cause of Death files maintained by the National Center for Health Statistics through the Centers for Disease Control and Prevention (CDC) Wide-ranging Online Data for Epidemiologic Research (WONDER). The CDC Wonder data set is publicly available[8] and easily replicated as described. The data set contains the death certificates for US residents, in which the underlying cause of death is ascertained by the treating physician on the section of death on the certificate. Each certificate identifies a single cause of death and baseline demographic information.[9] The underlying and contributing causes of death are entered according to the provision of the *International Classification of Diseases, Tenth Revision* and associated selection rules and modifications. Race is reported by funeral directors as provided by an informant (surviving next of kin) or based on observation in the absence of an informant.[8] Population estimates were obtained through the 2020 Census Bureau of the US national and state resident population.[10]

We investigated the change in CVD, MI, stroke, and heart failure between January 1, 2018, and December 31, 2021.[11] Our primary outcome was excess mortality from CVD and its 3 subtypes comparing 3 consecutive years (2019 to 2021) with 2018. The year 2018 was established as our referent year, thus allowing us to evaluate the preexisting trends in mortality in the year 2019 (prepandemic era) for comparative purposes. We then compared total mortality from 2018 and 2019 (prepandemic years) with mortality during the COVID-19 pandemic years (2020 and 2021). We obtained the monthly cause of death using the provisional *International Classification of Diseases, Tenth Revision* codes for CVD (I00-I99, diseases of the circulatory system), MI (I21, acute MI; and I22, subsequent MI), stroke (I60 to I69, cerebrovascular disease), and heart failure (I42, cardiomyopathy; and I50, heart failure). We divided the population by race and compared Black with White individuals. Our subgroup exploratory analysis was investigating mortality of CVD, MI, cerebrovascular disease, and heart failure to state-level demographics. In addition, we examined the month-to-month mortality to view the temporal changes throughout each year and compared each month with the same month in the referent year (2018). Furthermore, we sought to explore the changes in location of death in the 2 eras, given the disruptions of health care delivery. Given that the population size did not change significantly between 2019 and 2021 and because we wanted to evaluate month-to-month variation, age-adjusted mortality rates were not used as they are available only for annual estimates. This study did not require institutional review board approval because the analysis solely used government-issued public data without any individually identifiable information.

Statistical Analyses

We used the total number of deaths per month and per year in our final analysis. We stratified our analysis by subgroup of state and race. We used χ^2 analysis to test statistical significance of the years 2019, 2020, and 2021 compared with the historical baseline (2018); P values $<.05$ were considered significant. We used IBM SPSS Statistics for analysis.

RESULTS

Overall, 3,598,352 CVD deaths were analyzed during the study period (Table 1). Baseline demographic characteristics demonstrated a higher percentage of older, female, and Black individuals in certain CVD subtypes like stroke and heart failure.

We first compared the 2 years before the pandemic (2018 and 2019) with the years during the pandemic (2020 and 2021). Overall, in the pandemic, CVD mortality rose by 6.7% with varying degrees by subtype (MI, 2.5%; stroke, 8.5%) and interestingly remained relatively steadfast in heart failure (−0.1%; Figure 1) in comparing the corresponding 2-year periods. To better understand temporal fluctuations, we compared

TABLE 1. Baseline Demographic Characteristics

Demographic characteristic	CVD mortality		MI mortality		Stroke mortality		HF mortality	
	2018-2019	2020-2021	2018-2019	2020-2021	2018-2019	2020-2021	2018-2019	2020-2021
No.	1,741,092	1,857,260	212,845	218,216	297,283	322,477	210,985	210,731
Sex								
Female	840,009 (48.2)	897,985 (47.4)	87,094 (40.9)	87,467 (40.1)	170,383 (57.3)	182,340 (56.5)	107,266 (50.8)	104,859 (49.8)
Male	901,083 (51.8)	977,275 (52.6)	125,751 (59.1)	130,749 (59.9)	126,900 (42.7)	140,137 (43.5)	103,719 (49.2)	105,872 (50.2)
Age at death, y								
18-24	1963 (0.1)	2070 (0.7)	76 (0.0)	78 (0.0)	248 (0.1)	299 (0.1)	371 (0.2)	391 (0.2)
25-34	9172 (0.5)	10,503 (0.7)	690 (0.3)	843 (0.4)	1152 (0.4)	1227 (0.4)	1319 (0.6)	1452 (0.7)
35-44	27,245 (1.6)	32,364 (1.7)	3408 (1.6)	3986 (1.8)	3445 (1.2)	4194 (1.3)	2921 (1.4)	3393 (1.6)
45-54	80,127 (4.6)	87,772 (4.7)	12,939 (6.1)	13,549 (6.2)	10,281 (3.5)	11,433 (3.5)	6796 (3.2)	7429 (3.5)
55-64	203,502 (11.7)	224,614 (12.7)	34,360 (16.1)	36,378 (16.7)	25,720 (8.7)	28,765 (8.9)	16,608 (7.9)	17,943 (8.5)
65-74	314,023 (18.0)	358,627 (19.7)	49,216 (23.1)	53,244 (24.4)	47,465 (16.0)	54,662 (17.0)	29,993 (14.2)	32,549 (15.4)
75-84	425,010 (24.4)	458,925 (24.7)	53,237 (25.0)	54,641 (25.0)	80,007 (26.9)	87,753 (27.2)	50,630 (24.0)	52,006 (24.7)
85+	680,050 (39.1)	682,385 (36.7)	58,919 (27.7)	55,497 (25.4)	128,965 (43.4)	134,144 (41.6)	102,347 (48.5)	95,568 (45.4)
Race								
American Indian or Alaska Native	8884 (0.5)	10,279 (0.7)	1157 (0.5)	1292 (0.6)	1423 (0.5)	1682 (0.5)	883 (0.4)	1063 (0.5)
Asian or Pacific Islander	45,014 (2.6)	52,369 (2.7)	5501 (2.6)	6401 (2.9)	10,753 (3.6)	12,718 (3.9)	3720 (1.8)	4030 (1.9)
Black or African American	224,703 (12.9)	255,691 (13.7)	24,152 (11.3)	26,468 (12.1)	39,730 (13.4)	45,492 (14.1)	26,856 (12.7)	28,221 (13.4)
Native Hawaiian	2384 (0.1)	2773 (0.7)	271 (0.1)	337 (0.2)	472 (0.2)	503 (0.2)	279 (0.1)	293 (0.1)
White	1,452,763 (83.4)	1,527,472 (82.7)	180,923 (85.0)	182,769 (83.8)	243,665 (82.0)	260,534 (80.8)	178,437 (84.6)	176,268 (83.6)
More than 1	7344 (0.4)	8676 (0.7)	841 (0.4)	949 (0.4)	1240 (0.4)	1548 (0.5)	810 (0.4)	856 (0.4)
Census region								
Region 1	315,282 (18.1)	321,959 (17.7)	34,695 (16.3)	33,651 (15.4)	44,030 (14.8)	45,522 (14.1)	36,906 (17.5)	35,197 (16.7)
Region 2	395,908 (22.7)	417,337 (22.7)	50,416 (23.7)	50,687 (23.2)	65,904 (22.2)	71,406 (22.1)	53,036 (25.1)	52,600 (25.0)
Region 3	684,455 (39.3)	745,276 (40.7)	90,278 (42.4)	94,369 (43.2)	123,675 (41.6)	136,082 (42.2)	83,653 (39.6)	84,452 (40.1)
Region 4	345,447 (19.8)	372,688 (20.7)	37,456 (17.6)	39,509 (18.1)	63,674 (21.4)	69,467 (21.5)	37,390 (17.7)	38,482 (18.3)
Place of death								
Inpatient facility	464,977 (26.7)	460,168 (24.7)	68,627 (32.2)	67,131 (30.8)	106,585 (35.9)	108,211 (33.6)	58,010 (27.5)	56,998 (27.0)
Outpatient facility or ED	169,462 (9.7)	171,400 (9.7)	40,130 (18.9)	38,070 (17.4)	8153 (2.7)	9097 (2.8)	9664 (4.6)	9522 (4.5)
Dead on arrival	8098 (0.5)	7302 (0.7)	1652 (0.8)	1497 (0.7)	237 (0.1)	221 (0.1)	369 (0.2)	289 (0.1)
Decedent's home	555,825 (31.9)	698,315 (37.7)	65,786 (30.9)	76,631 (35.1)	59,001 (19.8)	81,900 (25.4)	66,289 (31.4)	78,153 (37.1)
Hospice	106,689 (6.1)	98,112 (5.7)	4137 (1.9)	3711 (1.7)	36,293 (12.2)	35,646 (11.1)	17,481 (8.3)	13,574 (6.4)
Nursing home long term	348,498 (20.0)	314,983 (17.7)	24,133 (11.3)	21,137 (9.7)	73,461 (24.7)	69,617 (21.6)	49,241 (23.3)	40,474 (19.2)
Other	87,254 (5.0)	106,678 (5.7)	8348 (3.9)	10,008 (4.6)	13,521 (4.5)	17,758 (5.5)	9,896 (4.7)	11,694 (5.5)
Unknown	289 (0.0)	302 (0.7)	32 (0.0)	31 (0.0)	32 (0.0)	27 (0.0)	35 (0.0)	27 (0.0)

CVD, cardiovascular disease; ED, emergency department; HF, heart failure; MI, myocardial infarction.

Values are reported as number (percentage).

year-to-year with our standard pre−COVID-19 pandemic year of 2018. For total CVD, 2019 saw a rise of 0.7% in mortality, whereas 2020 (6.9%) and 2021 (7.1%) demonstrated a substantially higher CVD mortality (Figure 2). In the overall population and compared with 2018, MI mortality decreased by 4.0% in 2019 and increased by 0.5% in 2020, followed by an increase of 0.4% in 2021 (Figure 3). Regarding stroke mortality, there was a rise in 2019 by 1.5%, followed by a dramatic increase during the pandemic: 8.4% in 2020 and 10.1% in 2021 (Figure 4). Heart failure mortality showed a rise of 1.7% in 2019, 1.3% in 2020, and 0.1% in 2021 (Figure 5). Southern states had the highest increase in excess CVD mortality (Figure 6).

In examining trends in location of death (Table 2), there was a shift in the location of death during the pandemic in the overall population, with more deaths occurring at home with CVD (26%), MI (16.5%), stroke (38.8%), and heart failure (17.9%). Compared with CVD mortality in 2018, there was a rise in death of Black individuals by 35.7% in 2020 and 32.8% in 2021, whereas White individuals demonstrated a rise of only 23.6% in 2020 and 26.3% in 2021 ($P<.001$; Supplemental Table, available online at http://www.mayoclinicproceedings.org).

On subgroup analysis, there are striking differences in mortality in Black compared with White individuals. In 2020-2021, Black individuals had an excess CVD mortality by 13.8%; however, White individuals had an excess CVD mortality of 5.1% ($P<.001$). This remained consistent across subtype of CVD, including MI (9.6% compared with 1.0%; $P<.001$), stroke (14.5% compared with 6.9%; $P<.001$), and heart failure (5.1% compared with −1.2%; $P<.001$). On a year-to-year analysis by comparison with the baseline year of 2018, Black individuals had a rise of CVD mortality by 1.5% compared with White individuals by 0.5% (Figure 2) in 2019 (prepandemic year). However, in examining the COVID-19 pandemic years, we see a rise of 15.8% in 2020 in Black individuals but only a 5.1% rise in White individuals. This continued into 2021, when Black individuals had a rise of 13.5% and White individuals had a rise of 5.7% (Figure 2). This excess mortality remained consistent across MI in 2020 (9.5% for Black individuals compared with −1.2% for White individuals) and 2021 (6.7% compared with −1.0%, respectively; Figure 3). Cerebrovascular disease demonstrated the most striking difference. In 2020, Black individuals had a rise of 14.9% mortality compared with 6.7% in White individuals; and in 2021, Black individuals had a rise of 17.5% compared with 8.1% in White individuals (Figure 4). These disparities remained consistent in heart failure mortality. In 2020, Black individuals had a rise of 9.1% in mortality compared with 0% in White individuals; and in 2021, Black individuals had a 4.1% increase in mortality compared with −0.8% in White individuals (Figure 5).

Finally, we examined the month-to-month mortality of CVD and each subtype to examine temporal changes (Supplemental Figures 1 to 4, available online at http://www.mayoclinicproceedings.org). The results of the month-to-month variation of excess mortality visually demonstrate that for most of the study time, Black individuals had excess mortality for CVD and subtypes compared with White individuals. There are temporal spikes corresponding to waves of the COVID-19 pandemic (April 2020, first wave; July 2020, second wave; December 2020, third wave; September 2021, Delta variant).[12] At these critical time points, the excess CVD mortality remained substantially elevated for Black individuals compared with White individuals. For instance, during the first wave (May 2020,) Black individuals' excess CVD mortality was 44.3% compared with 8.6% excess CVD mortality seen in White individuals. During the second wave (July 2020), Black individuals' excess CVD mortality was 19.1% compared with 10.1% excess CVD mortality in White individuals; this continued in the third wave (December 2020), 19.8% excess CVD mortality in Black individuals compared with 11.0% excess CVD mortality in White individuals, and in the Delta variant (fourth wave, September 2021), 20.3% excess CVD mortality in Black individuals compared with 14.6% excess CVD mortality in White individuals.

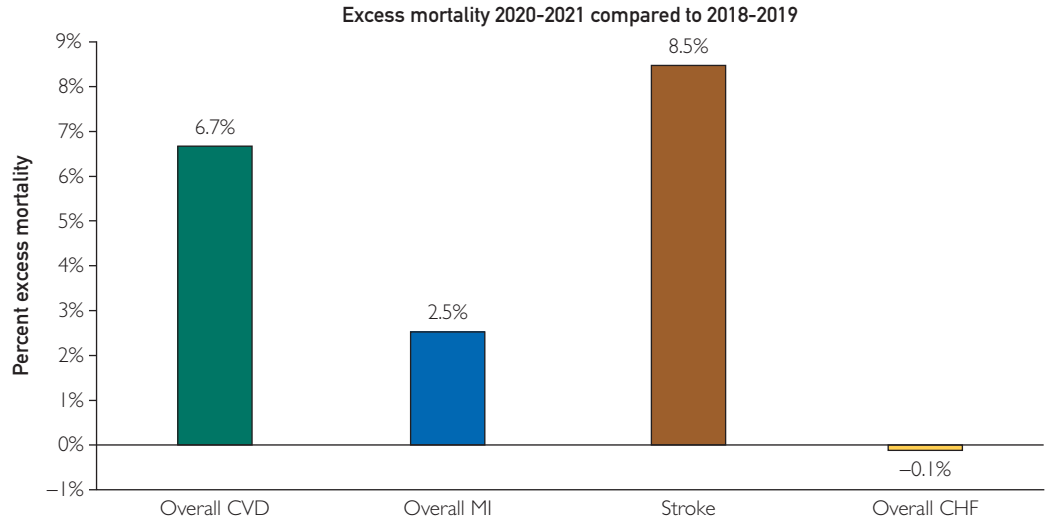

FIGURE 1. Overall mortality comparing pandemic years (2020-2021) with prepandemic years (2018-2019). CHF, congestive heart failure; CVD, cardiovascular disease; MI, myocardial infarction.

DISCUSSION

In this analysis, we found a significant rise in excess CVD mortality during the COVID-19 pandemic (6.7% in 2020-2021 compared with 2018-2020). However, this excess mortality appears to be unevenly distributed, with Black individuals having an almost 3-fold higher rate of excess CVD mortality (13.8%) compared with White individuals (5.1%). These results remained relatively consistent across CVD subtypes of MI, stroke, and heart failure mortality. Our results support and extend prior findings through 2021.[13]

The racial disparities in CVD mortality that have grown during the COVID-19 pandemic are discouraging.[14] Whereas early data indicate the direct toll of COVID-19 on Black individuals, the continuing (2 years and counting) and growing health care disparities and outcomes show the disproportionate indirect effects of the pandemic.[15] Explanations for health care inequity remain not well understood,[16] but they are likely to be multifactorial. A biologic explanation is that a higher prevalence of CVD comorbidities, including hypertension, obesity, and chronic kidney disease, among Black individuals may play a small role. More likely, structural and systematic racism plays a large, multigenerational role in health care outcomes.[17]

Our results found a significant trend for Black individuals to die at home compared with White individuals. Particularly in the early pandemic, avoidance of health care systems[18] probably led to reductions in individuals' seeking hospital care for acute non−COVID-19−related CVD illnesses. Regardless of the underlying cause, our data highlight the critical need to address and to improve access and distribution of health resources and care.

In addition, when plotted on a month-to-month comparison to the referent month of the year 2018, we visually demonstrate that this temporal trend extends throughout the study period. Spikes related to waves of COVID and variant subtypes seem to affect Black individuals to a higher degree. Reasons behind this are likely to be multifactorial, but a known contribution from discrimination in housing and access to care during these surges likely played a critical role.[19] However, the overall trendline demonstrates an almost continuously higher excess mortality in Black individuals. This further shows a continuous and systemic problem that plagues Black

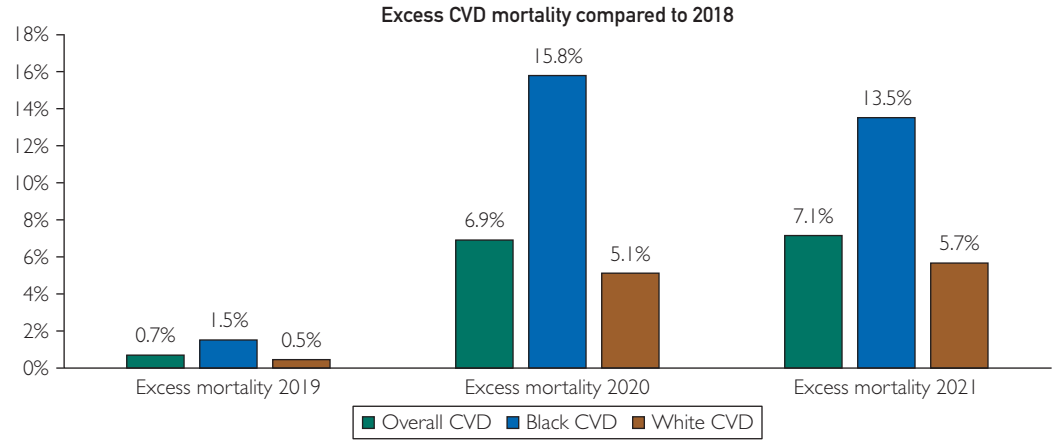

FIGURE 2. Excess cardiovascular disease (CVD) mortality by year compared with 2018 overall and by race.

individuals and communities and has a continual and longitudinal impact.

Policy-level changes must occur at a patient, provider, and system level.[20] Health care providers must understand the nuances in disease prevention and treatment differences in racial and ethnic groups. Cultural competency requires "tailoring delivery of care to meet patients' social, cultural, and linguistic needs."[21] Cultural competency training has preliminarily shown some ability to decrease bias,[22] but this must be balanced with lifelong cultural humility.[23] On a community level, community-based participatory research projects and intervention strategies are needed to provide sustaining and generational effects.[20] Last, elected officials must change policy to produce population-level efforts to improve lifestyles through primary and secondary prevention strategies.

Decades before the COVID-19 pandemic, studies reported that Black individuals exhibit less trust in health care systems.[24] Multivariate analysis found that perception of racism and mistrust of the medical care

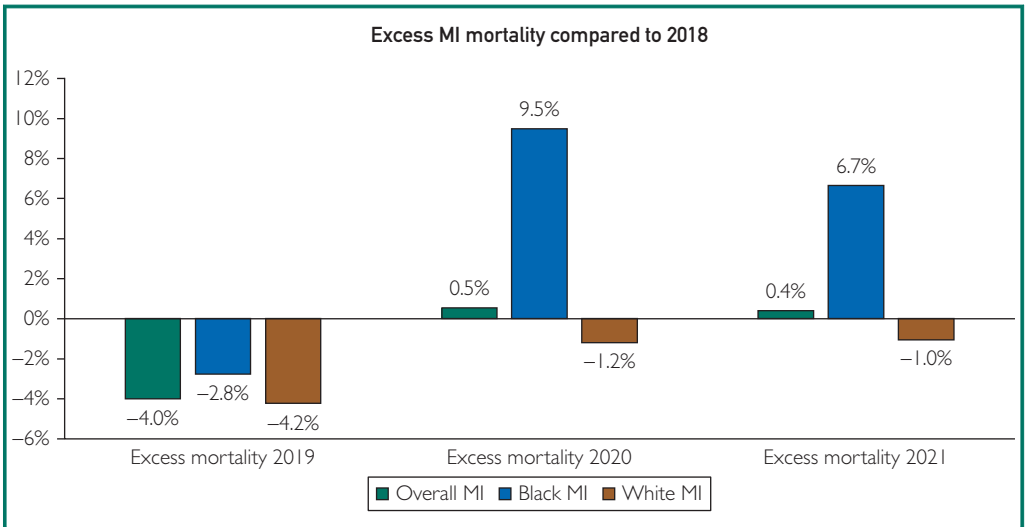

FIGURE 3. Excess myocardial infarction (MI) mortality by year compared with 2018 overall and by race.

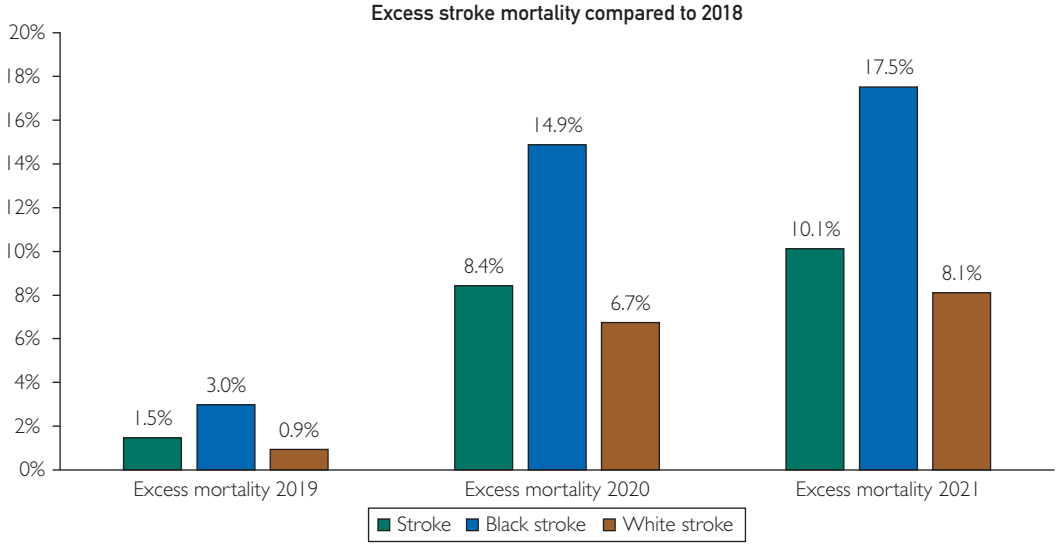

FIGURE 4. Excess stroke mortality by year compared with 2018 overall and by race.

system led to significantly less satisfaction with the delivery of care.[25] This is likely to have been exacerbated by the politicization of COVID-19 and the associated vaccines,[26] all of which has been further compounded by the fact that Black individuals are more likely to be exposed to and hospitalized by COVID-19.[27]

Our study does contain a few limitations. Our analysis was based on provisional diagnosis codes, which may be incomplete because of reporting delays. This study was also based on inclusion of only underlying causes of death as a result of CVD, and it may be possible that undiagnosed cases of COVID-19 partially contributed to the excess death seen. However, our results are consistent with literature cited previously. Last, because race was based on reporting on death certification, some may have been misadjudicated.

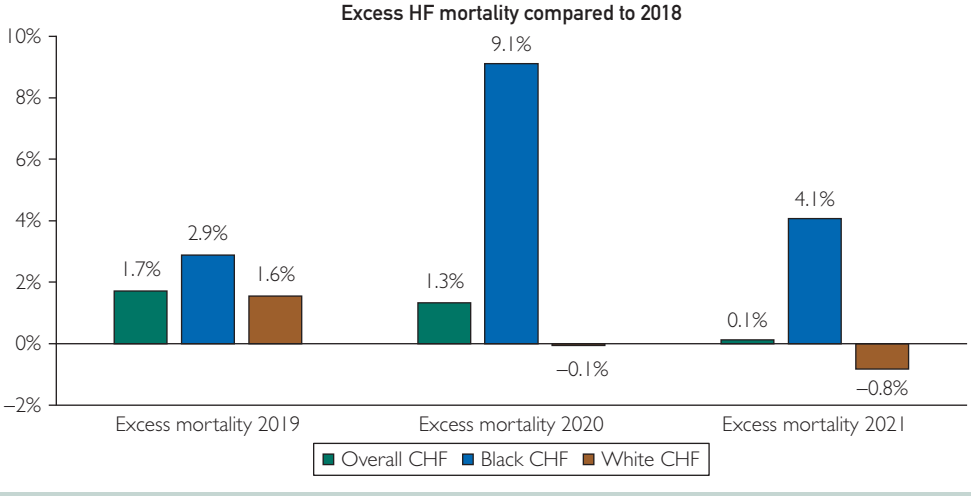

FIGURE 5. Excess heart failure (HF) mortality by year compared with 2018 overall and by race. CHF, congestive heart failure.

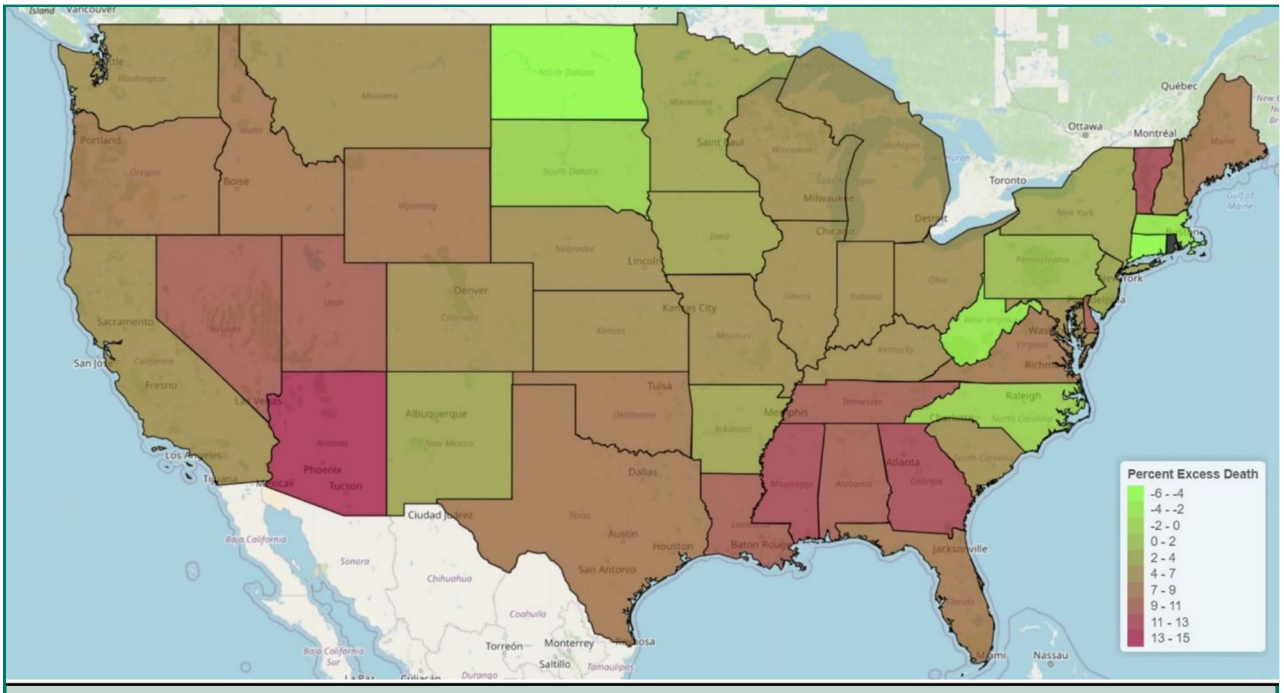

FIGURE 6. Heatmap of United States by percentage excess mortality comparing 2020-2021 with 2018-2019.

CONCLUSION

Whereas there has been a rise in CVD and subtype mortality during the COVID-19 pandemic, there is an unequal distribution, with Black individuals suffering a larger burden of mortality. Further studies targeting and eliminating health care disparities are necessary.

TABLE 2. Location of Percentage Excess Death Comparing 2020-2021 vs 2018-2019

Facility	Location of excess mortality 2020-2021 compared with 2018-2019, %			
	CVD	MI	Stroke	HF
Inpatient facility	−1.0	−2.2	1.5	−1.7
Outpatient facility or ED	1.1	−5.1	11.6	−1.5
Dead on arrival	−9.8	−9.4	−6.8	−21.7
Decedent's home	25.6	16.5	38.8	17.9
Hospice	−8.0	−10.3	−1.8	−22.3
Nursing home long term	−9.6	−12.4	−5.2	v17.8
Other	22.3	19.9	31.3	18.2
Unknown	4.5	−3.1	−15.6	−22.9

CVD, cardiovascular disease; ED, emergency department; HF, heart failure; MI, myocardial infarction.

POTENTIAL COMPETING INTERESTS

The authors report no competing interests.

SUPPLEMENTAL ONLINE MATERIAL

Supplemental material can be found online at http://www.mayoclinicproceedings.org. Supplemental material attached to journal articles has not been edited, and the authors take responsibility for the accuracy of all data.

Abbreviations and Acronyms: **CVD**, cardiovascular disease; **MI**, myocardial infarction

Correspondence: Address to Sadeer G. Al-Kindi, MD, Assistant Professor of Medicine, Case Western Reserve University, Harrington Heart and Vascular Institute, University Hospitals, 11100 Euclid Ave, Cleveland, OH 44106 (sadeer.alkindi@uhhospitals.org).

ORCID

Scott E. Janus: https://orcid.org/0000-0003-0635-6131

REFERENCES

1. Lange S, Ritchey M, Goodman A, et al. Potential indirect effects of the COVID-19 pandemic on use of emergency departments

for acute life-threatening conditions—United States, January-May 2020. *MMWR Morb Mortal Wkly Rep*. 2020;69(25):795-800.
2. Wadhera RK, Shen C, Gondi S, Chen S, Kazi DS, Yeh RW. Cardiovascular deaths during the COVID-19 pandemic in the United States. *J Am Coll Cardiol*. 2021;77(2):159-169.
3. Taylor S, Landry C, Rachor G, Paluszek M, Asmundson G. Fear and avoidance of healthcare workers: an important, under-recognized form of stigmatization during the COVID-19 pandemic. *J Anxiety Disord*. 2020;75:102289.
4. Janus S, Chami T, Mously H, et al. Proportionate and absolute vascular disease mortality by race and sex in the United States from 1999-2019. *J Am Heart Assoc*. July 19, 2022. https://doi.org/10.1161/JAHA.121.025276
5. Nordhues HC, Bhagra A, Stroud NN, Vencill JA, Kuhle CL. COVID-19 gender disparities and mitigation recommendations: a narrative review. *Mayo Clin Proc*. 2021;96(7):1907-1920.
6. Gould E, Wilson V. Black workers face two of the most lethal preexisting conditions for coronavirus—racism and economic inequality. Economic Policy Institute. June 1, 2020. Accessed June 11, 2022. https://www.epi.org/publication/black-workers-covid/
7. Romano S, Blackstock A, Taylor E, et al. Trends in racial and ethnic disparities in COVID-19 hospitalizations, by region—United States, March-December 2020. *MMWR Morb Mortal Wkly Rep*. 2021;70(15):560-565.
8. Centers for Disease Control and Prevention. CDC Wonder. Accessed March 3, 2022. https://wonder.cdc.gov/
9. Khan SU, Javed Z, Lone AN, et al. Social vulnerability and premature cardiovascular mortality among US counties, 2014 to 2018. *Circulation*. 2021;144(16):1272-1279.
10. US Census Bureau. Population and housing unit estimates. Accessed March 3, 2022. https://www.census.gov/programs-surveys/popest.html
11. Shah NN, Wass S, Hajjari J, et al. Proportionate cardiovascular mortality in chronic inflammatory disease in adults in the United States from 1999 to 2019. *J Clin Rheumatol*. 2022;28(2):97-103.
12. Jones B. The changing political geography of COVID-19 over the last two years. March 3, 2022. Accessed June 11, 2022. https://www.pewresearch.org/politics/2022/03/03/the-changing-political-geography-of-covid-19-over-the-last-two-years/
13. Wadhera RK, Figueroa JF, Rodriguez F, et al. Racial and ethnic disparities in heart and cerebrovascular disease deaths during the COVID-19 pandemic in the United States. *Circulation*. 2021;143(24):2346-2354.
14. Diaz CL, Watson KE. Racial/ethnic health disparities in cardiovascular disease during the COVID-19 pandemic: revisiting a long-lasting problem. *Cardiovasc Res*. 2022;118(1):e8-e10.
15. Nana-Sinkam P, Kraschnewski J, Sacco R, et al. Health disparities and equity in the era of COVID-19. *J Clin Transl Sci*. 2021;5(1):e99.
16. Acosta AM, Garg S, Pham H, et al. Racial and ethnic disparities in rates of COVID-19-associated hospitalization, intensive care unit admission, and in-hospital death in the United States from March 2020 to February 2021. *JAMA Netw Open*. 2021;4(10):e2130479.
17. Gee GC, Ford CL. Structural racism and health inequities: old issues, new directions. *Du Bois Review*. 2011;8(1):115-132.
18. Czeisler MÉ, Marynak K, Clarke KE, et al. Delay or avoidance of medical care because of COVID-19—related concerns—United States, June 2020. *MMWR Morb Mortal Wkly Rep*. 2020;69(36):1250-1257.
19. Parolin Z, Lee E. The role of poverty and racial discrimination in exacerbating the health consequences of COVID-19. *Lancet Reg Health Am*. 2022;7:100178.
20. Graham G. Disparities in cardiovascular disease risk in the United States. *Curr Cardiol Rev*. 2015;11(3):238-245.
21. Yancy CW, Wang TY, Ventura HO, et al. The Coalition to Reduce Racial and Ethnic Disparities in Cardiovascular Disease Outcomes (*credo*): why *credo* matters to cardiologists. *J Am Coll Cardiol*. 2011;57(3):245-252.
22. Raffoul M, Lin KW. Cultural competence education for health care professionals. *Am Fam Physician*. 2015;91(8):523-524.
23. Masters C, Robinson D, Faulkner S, Patterson E, McIlraith T, Ansari A. Addressing biases in patient care with the 5Rs of cultural humility, a clinician coaching tool. *J Gen Intern Med*. 2019;34(4):627-630.
24. Musa D, Schulz R, Harris R, Silverman M, Thomas SB. Trust in the health care system and the use of preventive health services by older black and white adults. *Am J Public Health*. 2009;99(7):1293-1299.
25. LaVeist TA, Nickerson KJ, Bowie JV. Attitudes about racism, medical mistrust, and satisfaction with care among African American and white cardiac patients. *Med Care Res Rev*. 2000;57(suppl 1):146-161.
26. Bolsen T, Palm R. Politicization and COVID-19 vaccine resistance in the U.S. *Prog Mol Biol Transl Sci*. 2022;188(1):81-100.
27. Asch DA, Islam MN, Sheils NE, et al. Patient and hospital factors associated with differences in mortality rates among Black and White US Medicare beneficiaries hospitalized with COVID-19 infection. *JAMA Netw Open*. 2021;4(6):e2112842.