Impact of Covid-19 Pandemic on Racial/Ethnic Differences in Mortality by Cause of Death

Anneliese Luck¹, Samuel H. Preston¹, Irma T. Elo¹, Andrew C. Stokes²

¹Department of Sociology and Population Studies Center, University of Pennsylvania, Philadelphia, PA, USA

²Department of Global Health, Boston University School of Public Health, Boston, MA, USA

Corresponding Author: Anneliese Luck, Department of Sociology and Population Studies Center, University of Pennsylvania, 3718 Locust Walk, Philadelphia, PA 19104; Email: anluck@sas.upenn.edu
ABSTRACT

This paper documents changes in mortality by race and ethnicity between 2019 and 2020. Using age-standardized death rates, it attributes changes for Black, Hispanic, and White populations to various underlying causes of death and shows how these racial and ethnic patterns vary by age and sex. Hispanic individuals had the largest increase in mortality attributed to Covid-19, but Black individuals had the largest increase in all-cause mortality. Exceptionally large increases in mortality from heart disease, diabetes, and external causes of death account for the adverse trend in all-cause mortality within the Black population. For the Black and White populations, percentage increases in all-cause mortality were similar for men and women and for ages 25-64 and 65+. Among the Hispanic population, however, percentage increases in mortality were greatest for working-aged men. Results are very similar when 2020 death rates are compared to those in 2019 and when they are compared to projected 2020 rates based on a time series extrapolation of death rates from 2015 to 2019.
INTRODUCTION

Mortality in the United States has long been stratified by race and ethnicity. Despite substantial improvements over the past century, a persistent life expectancy disparity between Black and White Americans remains (Harper et al., 2014). Conversely, Hispanic populations have consistently had lower mortality rates and longer life expectancy relative to both their non-Hispanic White and Black peers (hereafter referred to as White and Black) (Hummer & Chinn, 2011).

The onset of the Covid-19 pandemic in 2020 led to a sharp rise in mortality in the United States, with Black and Hispanic communities absorbing a disproportionate share of the impact (Alsan et al., 2021; Andrasfay & Goldman, 2021; Woolf et al., 2021). Recent work suggests that the life expectancy drop in 2020 led to an elimination of progress made in the past decade to narrow the Black-White life expectancy gap and a near elimination of the Hispanic life expectancy advantage (Andrasfay & Goldman, 2021; Woolf et al., 2021).

Racial and ethnic disparities appear in other epidemiologic features of the Covid-19 pandemic. Recent estimates suggest that both Black and Hispanic individuals, in addition to having higher death rates, are more likely to be infected and be hospitalized with Covid-19 (CDC, 2020). A variety of factors may place Black and Hispanic populations more at-risk of Covid-19 infection and mortality. These include heightened exposure to the virus as a result of holding frontline jobs, a higher prevalence of comorbid conditions, and unequal access to health insurance and care (Lopez et al., 2021; Macias Gil et al., 2020; Woolf et al., 2021) – all of which reflect underlying systems of structural racism and oppression that have long shaped unequal treatment and access to health equity in the United States (Bailey et al., 2017, 2021; McClure et al., 2020).

Although the racial disparities in Covid-19 deaths are well-documented, studies that only consider deaths directly attributable to Covid-19 may obscure the magnitude of racial/ethnic disparities in COVID-19 related mortality for several reasons. First, Covid-19 death counts do not capture the indirect impact of the pandemic on mortality levels, driven by increased economic and housing hardship, worsened mental health, and reductions in healthcare access caused by the pandemic (Cantor et al., 2020; Stokes et al., 2021). Second, official Covid-19
death counts fail to capture Covid-19 deaths that were misclassified to other causes of death. Deaths inappropriately ascribed to other causes of death may be especially prevalent among racial/ethnic minority groups receiving less adequate medical attention (Wrigley-Field et al., 2020). The potential importance of indirect effects and misclassification is revealed by evidence of increased mortality in 2020 relative to predicted trends for various causes other than Covid-19, including influenza/pneumonia, diabetes, heart disease, and external causes of deaths (Glei, 2021).

The present paper aims to identify racial/ethnic differences in the total mortality impact of the COVID-19 pandemic, including deaths assigned to Covid-19 as well as deaths from other causes that may have resulted from the indirect effects of the pandemic or misclassification of Covid-19 deaths. Using age-standardized death rates for White, Black, and Hispanic individuals, we examine patterns of mortality changes by cause of death, age, and sex. We also identify the causes of death that have had the greatest impact during the Covid-19 pandemic on changes in racial/ethnic mortality differentials.

METHODS

All analyses were conducted using a combination of publicly available datasets from the National Center for Health Statistics (NCHS) and United States Census Bureau. Provisional monthly death counts for January-December 2020, last updated on August 3, 2021, were obtained for the entire US population aged 25 and over by select causes of death, 10-year age group (25-34, 35-44, ... 75-85, 85+), sex, and race/ethnicity (NCHS, 2021). Deaths by cause in this study were based on underlying cause of death and did not include Covid-19 deaths that were not assigned as the underlying cause. This approach is the same as that used by the Center for Disease Control in their comparison of 2019 and 2020 deaths (Ahmad & Anderson, 2021) and by Glei (2021). Including deaths assigned to Covid-19 as a contributing cause of death would have raised Covid-19 deaths in 2020 by 9.6% (NCHS, 2021). The use of the broader criteria would have prevented our use of a mutually exclusive and exhaustive set of causes.

Yearly death counts for 2019 by age, sex, and race/ethnicity were obtained from the CDC’s Underlying Cause of Death file for each of the underlying causes referenced in the provisional
NCHS file used in these analyses [Appendix Table D] (NCHS, 2020a). CDC data included 13 specific underlying causes of death, one of which was Covid-19, as well as a residual category that included all other causes of death. For 2020, external causes of death were derived by subtracting natural deaths from all other deaths (e.g., Woolf et al., 2021), which aligns with ICD-10 codes for external causes of mortality (V01-Y89), the category used to calculate external cause deaths in 2019. Finally, mid-year population estimates by age, sex, and race/ethnicity were obtained from the Census Bureau’s monthly national-level population estimates to calculate cause-specific death rates by age, sex, and race/ethnicity (US Census Bureau, 2020).

Crude death rates were age-standardized using the mid-year 2020 national age distribution for population aged 25 and over. We also produced age-standardized rates for ages 25-64 and 65 and above. All-cause and cause-specific age-standardized death rates (ASDR) were derived by sex and by race/ethnicity for White, Black, and Hispanic populations. We start at age 25 because the number of deaths from Covid-19 in 2020 below age 25 was relatively small and the number of all-cause deaths below age 25 in 2020 was 2% below the average for 2015-19 (Rossen, 2020). We use age-standardized rates to avoid spurious changes in numbers of deaths or crude death rates resulting from population growth and/or aging (Shiels et al., 2021).

This paper focuses on the difference between the estimated 2020 ASDR by cause of death, sex, and race/ethnicity and their corresponding rates in 2019. We assume that the difference in age-standardized all-cause mortality rates between 2019 and 2020 reflect the effect of the Covid-19 pandemic on mortality, aligning with previous descriptive work on excess mortality in 2020 (Ahmad & Anderson, 2021). An alternative approach used in several other studies is to fit a time series function to data on mortality in years prior to 2020 and use the predicted value of mortality in 2020 to compare to actual mortality in 2020 (Chen et al., 2021; Weinberger et al., 2020; Woolf et al., 2021). We employ one variant of the time series approach to investigate whether results are sensitive to the choice of 2019 data as the baseline for comparison.
RESULTS
For the entire United States, the number of deaths at ages 25+ rose by 18.9% between 2019 and 2020 [Table 1]. After adjustment for the growth and aging of the population, the age-standardized death rate at ages 25+ rose by 17.0%. This percentage varied sharply among racial/ethnic groups. The death rate increased by only 12.7% among the White population, while it increased by 26.6% and 39.3% among the Black and Hispanic population, respectively.

Table 1 shows that the ordering of mortality change among the groups depends on whether we focus on the absolute or the percentage change in the age-standardized death rate. Black individuals suffered the largest absolute increase in age-standardized mortality, 407 per 100,000 people followed by Hispanics whose death rate increased by 361/100,000, whereas the White rate increased by only 166/100,000. If we compare the percentage increases, the ranking of Hispanic and Black populations reverses because the larger absolute increase in death rates among Black individuals is superimposed upon a much higher Black death rate in 2019 [Table 1]. We primarily feature the absolute change in mortality in this paper because it is the most direct measure of the change in the frequency of death per person.

Figure 1 illustrates the contribution of both Covid-19 and causes other than Covid-19 to changes in mortality between 2019 and 2020. The Black population had the largest increase in death rates, as noted earlier, but the reason was not that Black individuals had the highest death rates from Covid-19. In fact, the Hispanic population aged 25+ saw the highest death rate from Covid-19 in 2020 (286/100,000), compared to 259/100,000 for the Black population and 122/100,000 for the White population [Table 2].

The figure also reveals that mortality from underlying causes of death other than Covid-19 rose for all three groups. The Black population aged 25+ saw the largest growth in mortality from causes other than Covid-19, with an increase of 148/100,000, followed by the Hispanic population, (75/100,000) and the White population (44/100,000) [Table 2]. Of the total increase in mortality between 2019 and 2020, Covid-19 deaths accounted for 63.7% of the increase among Black, 73.5% among White, and 79.2% among Hispanic communities.
Other causes of death contributing to the mortality increase between 2019 and 2020 are shown in Table 2 and visually represented in Figure 2. Apart from Covid-19 and the residual category, the three largest increases in mortality for Black and Hispanic individuals were from heart disease, diabetes, and external causes of death. These were three of the four largest increases among White populations as well, along with Alzheimer’s disease. But the magnitude of the increases was markedly different; Black individuals saw by far the greatest increases for all three causes of death. In fact, Black individuals had a greater increase in mortality than both their White and Hispanic counterparts for every cause of death in Table 2 except malignant neoplasms, where mortality fell rather than rose.

Table 3 shows the contribution of each cause of death to changes between 2019 and 2020 in the difference between death rates of two racial/ethnic groups: Black vs. White, Black vs. Hispanic, and Hispanic vs. White. The same four cause-of-death categories dominate these comparisons. Fifty-seven percent of the increase in age-standardized Black mortality relative to White mortality was attributable to Covid-19, 14.0% was attributable to heart disease, 7.6% to external causes, and 4.8% to diabetes. The rise in the difference between Hispanic and White mortality was overwhelmingly attributable to Covid-19, which accounted for 84.1% of the relative rise in Hispanic mortality. The Black/Hispanic difference changed relatively little because Covid-19 and other causes of death moved in opposite directions for the two groups. Greater increases for Black mortality relative to Hispanic mortality from heart disease, external causes, and diabetes more than offset the greater increase from Covid-19 in the Hispanic population.

Appendix Table A presents information on changes in mortality that are broken down into the working ages, 25-64, and older ages 65+. For White individuals, mortality rose by the same percentage, 13%, in these two age intervals between 2019 and 2020. For Black individuals, mortality rose by 27% in both age intervals. For these two groups, the age-pattern of mortality change reflected pre-existing age-pattern of mortality in 2019. Among the Hispanic population, however, the increase in the death rate at ages 25-64, 47%, was substantially greater than the increase at ages 65+, 37%. Working-age Hispanic individuals had by far the sharpest percentage increase in mortality of any age/race/ethnicity group.
The age-pattern of mortality from Covid-19, like that of all causes of death combined, is skewed towards older individuals. As a result, the mortality changes that were noted above for ages 25+ closely reflect those that occurred at ages 65+. Covid-19 mortality accounted for 84.9% of the increase in death rates above age 65 for White, 70.4% for Black, and 81.6% for Hispanic individuals. Such statistics, however, obscure the radical differences in mortality change from causes other than Covid-19 at ages 65+: a rise of 343/100,000 among Black populations, 197 among Hispanic populations, and only 78 among Whites. The largest contributor in this group was heart disease, which accounted for 9.4% of the Black mortality increase at ages 65+ and 6.2% of the Hispanic increase, the largest fractions for any disease except Covid-19 itself. Diabetes, the second largest contributor, accounted for another 3.2% of the increase for Black populations and 2.7% for Hispanic populations. Mortality increases for heart disease and diabetes were small for White populations and were exceeded by an increase in Alzheimer’s mortality, which accounted for 3.5% of the total White mortality increase at ages 65+.

The story at ages 25-64 is quite different. Although Covid-19 accounted for most of the all-cause mortality increase only for the Hispanic population (72.9%), it was responsible for only 37.8% of the increase among White individuals and 48.0% among Black individuals. For all three race/ethnic groups, the cause of death contributing the most to increases in mortality between 2019 and 2020 at ages 25-64, apart from Covid-19 itself, was external causes of death. The rise in mortality from external causes for the Black population (33.9/100,000) was 2.7-3.0 times the increase for the other two groups. However, because the all-cause Black increase was so large relative to the White increase, external causes accounted for a higher fraction of the increase among White populations (23.8%) as compared to their Black peers (21.1%). It accounted for 8.9% for the Hispanic population. Increases in mortality from heart disease and diabetes were the third and fourth largest contributors to all-cause mortality increases at age 25-64 for all three groups.

The pattern of change in mortality between 2019 and 2020 was relatively similar for men and women (Appendix Tables B and C). At ages 25+, White mortality increased by 13.3% for men and 12.0% for women, while Black mortality increased 28.0% for men and 25.0% among women. Only Hispanic individuals showed a greater difference between men (44.0% increase)
and women (33.4% increase), a difference that was exaggerated at working-ages (51.9% vs. 37.9%). Sex differences in the contribution of Covid-19 to mortality change were also minor [Appendix Tables B and C]. At ages 25+, Covid-19 contributed 74.1% of mortality change among White males and 74.6% among White females. The equivalent percentages among Black individuals were 64.3% and 64.8% and among Hispanic individuals, 81.0% and 77.9%.

One cause of death showed a sharp differentiation between the sexes. For all three groups, mortality from external causes increased much more for men than for women. This distinction was especially pronounced in the working ages, where the rise in mortality was 19.4/100,000 for males vs. 3.5 for females among Hispanic, 18.4 vs. 6.8 among White, and 55.37 vs. 14.0 among Black populations. External cause mortality also rose by 18.5 for Black males aged 65+, over five times the increase for older Black women and slightly larger than the increase for working-age White men.

Our analysis has focused on absolute changes in death rates because that is the most direct measure of the risk of death per person. Percentage changes in death rates for different categories of causes of death shed additional light on the processes at work, especially when compared across racial/ethnic groups. Figure 3 present scatter diagrams of percentage changes in mortality at ages 25+ for different causes of death for White individuals on the x-axis and either Black or Hispanic individuals on the y-axis. Points above the 45-degree line indicate causes of death for which Black or Hispanic populations had a higher percentage increase (or smaller decline) than their White peers. Nearly all points are above the 45-degree lines. For both Black and Hispanic communities, the highest percentage increase relative to White communities pertains to influenza and pneumonia, a category with symptoms similar to those of Covid-19. Diabetes, heart disease, Alzheimer’s, chronic lower respiratory diseases, external causes, other respiratory diseases, and abnormal signs and symptoms are also categories for which increases in mortality for both minority groups are at least four percentage points greater than those among the White population (see Table 2 for numerical details).
Sensitivity Analysis

To test the assumption that 2019 mortality levels reflect what would have been expected in 2020 in the absence of the Covid-19 pandemic, we conducted a sensitivity analysis using an OLS regression of all-cause ASDRs from 2015 to 2019 to extrapolate the series and produce an expected all-cause mortality level for each race/ethnicity in 2020 [see results in Appendix Table E]. The all-cause ASDRs in 2019 for each race/ethnicity and standard age group were all within a 95% confidence interval of the expected 2020 ASDR based on the prior 5-year trend. The difference between 2019 death rates and predicted 2020 death rates was less than ½ of 1% for all racial/ethnic groups at ages 25+ and 65+ and between 0.8% and 1.2% at ages 25-64. A slightly higher ASDR predicted by prior 5-year trend for working-age populations across all race/ethnicities reflects increasing death rates in this age interval in recent years, a trend in part driven by a growing “deaths of despair” crisis (Elo et al., 2019).

Appendix Table E shows that the difference between actual and predicted all-cause mortality in 2020 was nearly identical to the difference between 2020 and 2019 mortality for all three racial/ethnic groups. That is also true of death rates from Covid-19 and from all other causes combined. Therefore, we conclude that using 2019 rates as a baseline for comparison to 2020 rates gives very similar results to those that would be attained using an alternative time series approach.

DISCUSSION

Mortality rose sharply for White, Black, and Hispanic populations between 2019 and 2020. The largest increase was suffered by the Black community. The reason for the larger rise among Black individuals was not the number of deaths assigned to Covid-19 as an underlying cause of death; Hispanic populations saw the largest increase in Covid-19 mortality. Instead, Black individuals had by far the largest increase in death rates from other causes of death, about double that among Hispanic individuals (148/100,000 vs. 75) and more than triple that among White individuals (148 vs. 44). Each Covid death was accompanied by an additional 0.26 deaths from other causes among Hispanics, 0.36 additional deaths among Whites, and 0.57 among Blacks. This ordering is consistent with the pre-pandemic levels of mortality, where Black individuals occupied the highest level and Hispanic individuals the lowest level (Table 1).
**High Covid-19 Mortality among Hispanic Communities**

Hispanic communities had the highest Covid-19 death rate in 2020, around 1.1 times higher than their Black peers and 2.3 times higher than their White peers, driving a nearly 40% increase in all-cause mortality in the Hispanic populations, relative to around 27% and 13% for Black and White populations, respectively (Table 2). These findings are consistent with other emerging evidence of the particularly adverse impact of the pandemic on Hispanic mortality (Riley et al., 2021; Rodriguez-Diaz et al., 2020; Simon et al., 2021). This pattern undermines established understandings of the “Hispanic Mortality Paradox,” or the historical tendency for Hispanic individuals to have better mortality outcomes than their non-Hispanic White counterparts despite their lower socioeconomic position (Ruiz et al., 2013).

The high relative mortality of Hispanic individuals from Covid-19 appears to be primarily attributable to a high relative incidence of infection and secondarily to a relatively high case-fatality rate. The largest study of disease incidence included approximately 50 million enrollees in the Epic Health Research Network (Rubin-Miller et al., 2020). The per capita infection rate was 143/10,000 for Hispanics, 107/10,000 for Blacks, and 46/10,000 for Whites. These ratios of Hispanic/White, Black/White, and Hispanic/Black infection rates are even higher than the respective ratios of Covid-19 mortality (Table 2), suggesting that infection rates are driving the mortality differentials. Other studies have also found that racial/ethnic differences in infection rates are far more important than differences in case-fatality levels in producing racial/ethnic differences in mortality (Benitez et al., 2020; Price-Haywood et al., 2020; Zelner et al., 2020).

A variety of distinct structural factors have likely contributed towards heightened Covid-19 incidence within the Hispanic community. Relative to other racial/ethnic groups, the Hispanic population is disproportionately overrepresented in essential occupations with high-exposure to Covid-19 and with limited workplace protections, such as in food-and-agricultural or manufacturing sectors (Macias Gil et al., 2020; Riley et al., 2021; Rodriguez-Diaz et al., 2020). Hispanic individuals are also more likely to live in denser, multigenerational living arrangements, magnifying the effect and spread of occupational exposure (Macias Gil et al., 2020; Riley et al., 2021). These factors may be particularly influential among Hispanic
immigrants, who have been found to face a more pronounced mortality disadvantage during the pandemic relative to their native peers (Riley et al., 2021). Consistent with the importance of workplace exposure, we show that all-cause and Covid-19 mortality was exceptionally inflated among the Hispanic working-aged and male population, unlike their Black and White peers who saw percent increases in mortality that were largely independent of age or sex. This pattern underscores the potential salience of pandemic working conditions in shaping the exceptionally high Covid-19 incidence and mortality among the Hispanic population.

Reduced access to adequate health care likely contributes towards higher Covid-19 case-fatality risks among Hispanic individuals. Hispanic communities have the lowest rate of health insurance coverage of any racial/ethnic group in the United States, with nearly 20% uninsured, compared to just 5% of the White population (Macias Gil et al., 2020). Additionally, language barriers, distrust and fear of healthcare institutions driven by broader anti-immigrant rhetoric and policy, and underlying financial hardship faced by Hispanic individuals, particularly those in the immigrant community, have all been linked to worse healthcare access and quality, potentially amplifying the impact of Covid incidence on mortality outcomes (Macias Gil et al., 2020; Riley et al., 2021; Rodriguez-Diaz et al., 2020; Simon et al., 2021). These health care barriers, coupled with a higher prevalence of comorbid conditions, such as diabetes and heart disease, likely worsen Covid-19 outcomes in the Hispanic community once infected (Kim & Hales, 2021; Simon et al., 2021).

**High Mortality from Non-Covid-19 Causes of Death Among Black Individuals**

Despite having levels of Covid incidence and mortality below those of Hispanic individuals, Black individuals saw the largest absolute increase in all-cause mortality, a pattern that emerged in another large national study (Miller et al, 2021). The increase is attributable to causes other than Covid-19. Among these causes, the largest increases in mortality occurred for external causes, heart disease, and diabetes. Heart disease and diabetes were also leading causes of increased mortality for Hispanic and White populations, but the increases for Black individuals were more than four times those of their White peers and 1.6-2.0 times those of their Hispanic peers (Table 2).
One explanation that has been offered for the increased mortality from heart disease and diabetes during the Covid-19 pandemic is that the pandemic disrupted health care in ways that hindered disease management for people with these chronic diseases (Ahmad & Anderson, 2021; Glei, 2021). These disruptions include those to health care systems and to personal networks of support. They would also affect the chances of detecting diseases. Fear of infection, loss of health insurance, reductions in visits to physicians and in elective procedures have been noted as indirect effects of the pandemic (Cantor et al., 2020; Dandona & Ghanim, 2021; Wessler et al., 2020). These factors are more salient among Black individuals for whom the pre-pandemic prevalence of serious heart disease, hypertension and diabetes exceeded that among White individuals (Kim & Hales, 2021). Those Medicare recipients with pre-pandemic heart disease or diabetes experienced unusually large increases in mortality in 2020 (Tarazi et al., 2021).

Mortality from external causes of death also rose sharply among Black individuals. Death rates from external causes increased by 27.9/100,000 for the Black population, nearly three times the increase for their White (9.7) or Hispanic (9.4) counterparts. Distinctions were even sharper among working-age males: 55.4 vs.18.4 and 19.4. Unfortunately, data do not currently permit us to distinguish among the diverse categories under this rubric. Previous research has shown that the principal national increase in mortality within this category between 2019 and 2020 pertains to drug-related mortality (Ahmad & Anderson, 2021; Faust et al., 2021; Friedman & Akre, 2021; Glei, 2021; Mulligan, 2020). There are indications that the rise may be more pronounced among Black and Hispanic communities (Friedman et al., 2021). Other mortality increases have been observed in homicides (Faust et al., 2021), including alcohol-related violence (Chalfin et al., 2021). Although suicides dropped nationally during the pandemic (Faust et al., 2021), emerging evidence suggestively attributes this reduction to decreases among White individuals, given an observable increase in Black and Hispanic suicide rates across many states (Pattani, 2021).

Growth in external cause mortality draws attention to the ways in which social isolation, economic instability, and treatment disruption may have exacerbated a “deaths of despair” crisis increasingly faced by working-age Americans over the past several decades (Friedman & Akre, 2021; Glei, 2021; Mulligan, 2020; Shiels et al., 2020).
Possible Errors in Diagnosis and Coding of Underlying Cause of Death

Another explanation of the increased death rate from heart disease and diabetes in 2020 relates to the process by which underlying cause of death is assigned on death certificates. Heart disease, diabetes, and Alzheimer’s, another disease with elevated death rates in 2020, are chronic conditions. When a victim of one of these diseases contracts Covid-19 and dies, the person certifying underlying cause is faced with a choice of which entity to list as underlying cause. In some instances, the chronic condition is likely to be chosen. A recent county-level analysis found that areas with less access to primary care and health insurance and more at-home deaths had a higher fraction of 2020 “excess deaths” not assigned to COVID-19 (Stokes et al., 2021). That was also true of areas with unusually high fractions of Black individuals. Lack of access to high-quality health care may decrease the likelihood of COVID-19 testing and diagnosis. Some jurisdictions across the U.S., especially early in the pandemic, required a positive test result for a death to be assigned to COVID-19 and thus the absence of testing may have led to a death being assigned to a comorbid chronic condition such as diabetes or heart disease. Accurate cause of death assignment is also likely complicated by the large number of home deaths occurring during the pandemic, especially among racial/ethnic minority populations (Pathak et al., 2021). When a death occurs at home, a medical certifier must deduce the cause of death based on medical history of the patient and/or interviews with family members. Deaths occurring at home are also more likely to be certified by a local coroner, who can lack medical training and has limited resources for performing post-mortem testing or autopsies (Stokes et al., 2021).

Although it is not a major factor in mortality change between 2019 and 2020, influenza/pneumonia represents another cause of death for which deaths may be spuriously inflated by the Covid-19 pandemic (Solomon et al., 2020). Early in the pandemic, it is clear that many deaths from Covid-19 were being assigned to influenza/pneumonia (Weinberger et al., 2020). As shown previously in Figure 3, this mis-assignment was likely much more common among Black and Hispanic communities than among their White counterparts, in view of their much higher percentage increase in death rates from the cause. The evident mis-assignment of Covid-19 deaths to influenza/pneumonia for Black and Hispanic individuals supports the possibility that related errors may have been occurring for heart disease and diabetes and possibly other causes of death.
Limitations

Deaths included in this analysis were available from the National Center for Health Statistics through August 3, 2021. It is possible that delays in registration will result in additional deaths being reported for 2020. Such delays are especially likely for external causes of death for which certification often involves multiple authorities. At the time of this writing, available data do not allow detailed external causes of death to be disaggregated simultaneously by age and racial/ethnic group.

As noted above in our sensitivity analysis, alternative methods of estimating what mortality would have been in 2020 in the absence of the Covid-19 pandemic would produce different estimates of the effect of the pandemic on mortality. In addition to the choice of modeling strategy, estimates may also be affected by the length of the time horizon used and the granularity of the time unit on the death series (Nepomuceno et al., 2021). In the present study, results were not sensitive to the use of a linear modeling approach based on an extended time series, which may at least partially reflect our use of age standardization to account for changes in the population age structure. Uncertainties are likely greatest for external causes of death because deaths from drug overdose were already increasing rapidly in 2019 so that some of the growth in this category in 2020 may be a result of preexisting trends (Glei, 2021).

Our study, based on data released by the National Center for Health Statistics, considers deaths from Covid-19 to be those in which Covid-19 is listed as the underlying cause of death. Since the most recent available data was limited to 13 selected causes of death, the construction of a residual category for all other causes was required for this study. Increases in this category comprised a small but not insignificant portion of all-cause ASDR increases (6.3% for Hispanic, 9.7% for Black, and 13.9% for White populations). As more granular cause-specific data becomes available, future studies should expand on this analysis to incorporate a wider range of underlying causes. Additionally, other studies may include among deaths attributable to Covid-19 those deaths in which the term appears elsewhere on the death certificate or when other criteria are invoked (Gundlapalli, 2021; NCHS, 2020b). As noted above, the number of Covid-19 deaths when including Covid-19 mentioned anywhere on the death certificate is 9.6% larger than
the number using the narrower criteria. Results regarding the number of deaths attributable to causes other than Covid-19 will also be affected by how cause of death is assigned.

While it may be tempting to imagine that the Covid-19 epidemic acted as a “multiplier” of pre-existing racial/ethnic differences in health and mortality, using three racial/ethnic groups enables us to see in what respect that view may be correct or requires modification. Black/White differentials have indeed become exaggerated during the pandemic, both with respect to Covid-19 deaths themselves and to all-cause mortality. However, the Hispanic experience is not consistent with this claim. Despite having the lowest pre-pandemic mortality, Hispanic individuals suffered the largest increase in mortality from Covid-19. The explanation for high Hispanic Covid-19 mortality appears related to a high incidence of Covid-19, likely shaped by structural factors, such as higher participation in essential occupations with fewer workforce protections and denser living arrangements.

If we treat the incidence of or mortality from Covid-19 as a measure of the assault of the virus on a community, then it is also useful to examine how this assault played out among other causes of death. In this case, pre-pandemic conditions are reified: each Covid death was accompanied by an additional 0.26 deaths from other causes within the Hispanic population, 0.36 additional deaths within the White, and 0.57 within the Black. Because of their adverse health circumstances before the pandemic, Black individuals had exceptionally large increases in mortality from heart disease, diabetes, and external causes during the pandemic. By showing clear racial/ethnic disparities in how the assault of the Covid-19 pandemic played out in communities across the United States, this paper highlights the importance of examining changes in mortality by cause of death for achieving a full understanding of the impact of the pandemic.

**Acknowledgements**

The authors would like to thank Robert N. Anderson and Farida B. Ahmad from the National Center for Health Statistics, Kevin Barragan from the U.S. Census Bureau and Katherine Hempstead from the Robert Wood Johnson Foundation. The authors acknowledge funding from the Robert Wood Johnson Foundation (#77521) and the National Institute on Aging (#R01-AG060115).
CITATIONS
Ahmad, F. B., & Anderson, R. N. (2021). The Leading Causes of Death in the US for 2020. *JAMA, 325*(18), 1829–1830. https://doi.org/10.1001/jama.2021.5469

Alsan, M., Chandra, A., & Simon, K. I. (2021). *The Great Unequalizer: Initial Health Effects of COVID-19 in the United States* (Working Paper No. 28958; Working Paper Series). National Bureau of Economic Research. https://doi.org/10.3386/w28958

Andrasfay, T., & Goldman, N. (2021). Association of the COVID-19 Pandemic With Estimated Life Expectancy by Race/Ethnicity in the United States, 2020. *JAMA Network Open, 4*(6), e2114520. https://doi.org/10.1001/jamanetworkopen.2021.14520

Bailey, Z. D., Feldman, J. M., & Bassett, M. T. (2021). How Structural Racism Works—Racist Policies as a Root Cause of U.S. Racial Health Inequities. *New England Journal of Medicine, 384*(8), 768–773. https://doi.org/10.1056/NEJMms2025396

Bailey, Z. D., Krieger, N., Agénor, M., Graves, J., Linos, N., & Bassett, M. T. (2017). Structural racism and health inequities in the USA: Evidence and interventions. *Lancet (London, England), 389*(10077), 1453–1463. https://doi.org/10.1016/S0140-6736(17)30569-X

Benitez, J., Courtemanche, C., & Yelowitz, A. (2020). Racial and Ethnic Disparities in COVID-19: Evidence from Six Large Cities. *Journal of Economics, Race, and Policy, 3*(4), 243–261. https://doi.org/10.1007/s41996-020-00068-9

Cantor, J. H., Sood, N., Bravata, D., Pera, M., & Whaley, C. M. (2020). *The Impact of the COVID-19 Pandemic and Policy Response on Health Care Utilization: Evidence from County-level Medical Claims and Cellphone data* (Working Paper No. 28131; Working Paper Series). National Bureau of Economic Research. https://doi.org/10.3386/w28131

CDC. (2020, February 11). *Risk for COVID-19 Infection, Hospitalization, and Death By Race/Ethnicity*. Centers for Disease Control and Prevention. https://www.cdc.gov/coronavirus/2019-ncov/covid-data/investigations-discovery/hospitalization-death-by-race-ethnicity.html

Chalfin, A., Danagoulian, S., & Deza, M. (2021). *COVID-19 Has Strengthened the Relationship Between Alcohol Consumption and Domestic Violence* (Working Paper No. 28523; Working Paper Series). National Bureau of Economic Research. https://doi.org/10.3386/w28523
Chen, Y.-H., Glymour, M. M., Catalano, R., Fernandez, A., Nguyen, T., Kushel, M., & Bibbins-Domingo, K. (2021). Excess Mortality in California During the Coronavirus Disease 2019 Pandemic, March to August 2020. *JAMA Internal Medicine, 181*(5), 705–707. https://doi.org/10.1001/jamainternmed.2020.7578

Dandona, P., & Ghanim, H. (2021). Diabetes, Obesity, COVID-19, Insulin, and Other Antidiabetes Drugs. *Diabetes Care*, dci210003. https://doi.org/10.2337/dci21-0003

Elo, I. T., Hendi, A. S., Ho, J. Y., Vierboom, Y. C., & Preston, S. H. (2019). Trends in Non-Hispanic White Mortality in the United States by Metropolitan-Nonmetropolitan Status and Region, 1990–2016. *Population and Development Review, 45*(3), 549–583. https://doi.org/10.1111/padr.12249

Faust, J. S., Du, C., Mayes, K. D., Li, S.-X., Lin, Z., Barnett, M. L., & Krumholz, H. M. (2021). Mortality From Drug Overdoses, Homicides, Unintentional Injuries, Motor Vehicle Crashes, and Suicides During the Pandemic, March-August 2020. *JAMA, 326*(1), 84–86. https://doi.org/10.1001/jama.2021.8012

Friedman, J., & Akre, S. (2021). COVID-19 and the Drug Overdose Crisis: Uncovering the Deadliest Months in the United States, January–July 2020. *American Journal of Public Health*, e1–e8. https://doi.org/10.2105/AJPH.2021.306256

Friedman, J., Mann, N. C., Hansen, H., Bourgois, P., Braslow, J., Bui, A. A. T., Beletsky, L., & Schriger, D. L. (2021). Racial/Ethnic, Social, and Geographic Trends in Overdose-Associated Cardiac Arrests Observed by US Emergency Medical Services During the COVID-19 Pandemic. *JAMA Psychiatry, 78*(8), 886–895. https://doi.org/10.1001/jamapsychiatry.2021.0967

Glei, D. (2021, May 18). THE US MIDLIFE MORTALITY CRISIS CONTINUES: INCREASED DEATH RATES FROM CAUSES OTHER THAN COVID-19 DURING 2020 | medRxiv. https://www.medrxiv.org/content/10.1101/2021.05.17.21257241v1

Gundlapalli, A. V. (2021). Death Certificate–Based ICD-10 Diagnosis Codes for COVID-19 Mortality Surveillance—United States, January–December 2020. *MMWR. Morbidity and Mortality Weekly Report, 70*. https://doi.org/10.15585/mmwr.mm7014e2

Hummer, R. A., & Chinn, J. J. (2011). RACE/ETHNICITY AND U.S. ADULT MORTALITY. *Du Bois Review: Social Science Research on Race, 8*(1), 5–24. https://doi.org/10.1017/S1742058X11000051
Kim, C., & Hales, C. M. (2021). *National Health Statistics Reports*. 6.

Lopez, L., Hart, L. H., & Katz, M. H. (2021). Racial and Ethnic Health Disparities Related to COVID-19. *JAMA*, 325(8), 719. https://doi.org/10.1001/jama.2020.26443

Macias Gil, R., Marcelin, J. R., Zuniga-Blanco, B., Marquez, C., Mathew, T., & Piggott, D. A. (2020). COVID-19 Pandemic: Disparate Health Impact on the Hispanic/Latinx Population in the United States. *The Journal of Infectious Diseases*, 222(10), 1592–1595. https://doi.org/10.1093/infdis/jiaa474

McClure, E. S., Vasudevan, P., Bailey, Z., Patel, S., & Robinson, W. R. (2020). Racial Capitalism Within Public Health—How Occupational Settings Drive COVID-19 Disparities. *American Journal of Epidemiology*, 189(11), 1244–1253. https://doi.org/10.1093/aje/kwaa126

Mulligan, C. B. (2020). *Deaths of Despair and the Incidence of Excess Mortality in 2020* (Working Paper No. 28303; Working Paper Series). National Bureau of Economic Research. https://doi.org/10.3386/w28303

NCHS. (2020a). *Underlying Cause of Death, 1999-2019 Request*. Accessed on July 13, 2021 from: https://wonder.cdc.gov/ucd-icd10.html

NCHS. (2020b). *Guidance for Certifying Deaths Due to Coronavirus Disease 2019*. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. https://asprtracie.hhs.gov/technical-resources/resource/8174/guidance-for-certifying-deaths-due-to-coronavirus-disease-2019-covid-19

NCHS. (2021). *AH Monthly Provisional Counts of Deaths for Select Causes of Death by Sex, Age, and Race and Hispanic Origin* | Data | Centers for Disease Control and Prevention. Accessed on August 12, 2021 from: https://data.cdc.gov/NCHS/AH-Monthly-Provisional-Counts-of-Deaths-for-Select/65mz-jvh5

Nepomuceno, M. R., Klimkin, I., Jdanov, D. A., Galarza, A. A., & Shkolnikov, V. (2021). Sensitivity of excess mortality due to the COVID-19 pandemic to the choice of the mortality index, method, reference period, and the time unit of the death series. *MedRxiv*, 2021.07.20.21260869. https://doi.org/10.1101/2021.07.20.21260869

Pathak, E. B., Garcia, R. B., Menard, J. M., & Salemi, J. L. (2021). Out-of-Hospital COVID-19 Deaths: Consequences for Quality of Medical Care and Accuracy of Cause of Death
Coding. *American Journal of Public Health, 111*(S2), S101–S106.
https://doi.org/10.2105/AJPH.2021.306428

Pattani, A. (2021, August 23). Pandemic Unveils Growing Suicide Crisis for Communities of Color. *Kaiser Health News*. https://khn.org/news/article/pandemic-unveils-growing-suicide-crisis-for-communities-of-color/

Price-Haywood, E. G., Burton, J., Fort, D., & Seoane, L. (2020). Hospitalization and Mortality among Black Patients and White Patients with Covid-19 | NEJM. *New England Journal of Medicine, 382*, 2534–2543.

Riley, A. R., Chen, Y.-H., Matthay, E. C., Glymour, M. M., Torres, J. M., Fernandez, A., & Bibbins-Domingo, K. (2021). Excess death among Latino people in California during the COVID-19 pandemic. *MedRxiv: The Preprint Server for Health Sciences*, 2020.12.18.20248434. https://doi.org/10.1101/2020.12.18.20248434

Rodriguez-Diaz, C. E., Guilamo-Ramos, V., Mena, L., Hall, E., Honermann, B., Crowley, J. S., Baral, S., Prado, G. J., Marzan-Rodriguez, M., Beyrer, C., Sullivan, P. S., & Millett, G. A. (2020). Risk for COVID-19 infection and death among Latinos in the United States: Examining heterogeneity in transmission dynamics. *Annals of Epidemiology, 52*, 46-53.e2. https://doi.org/10.1016/j.annepidem.2020.07.007

Rossen, L. M. (2020). Excess Deaths Associated with COVID-19, by Age and Race and Ethnicity—United States, January 26–October 3, 2020. *MMWR. Morbidity and Mortality Weekly Report, 69*. https://doi.org/10.15585/mmwr.mm6942e2

Rubin-Miller, L., Alban, C., Sep 16, S. S. P., & 2020. (2020, September 16). COVID-19 Racial Disparities in Testing, Infection, Hospitalization, and Death: Analysis of Epic Patient Data. *KFF*. https://www.kff.org/coronavirus-covid-19/issue-brief/covid-19-racial-disparities-testing-infection-hospitalization-death-analysis-epic-patient-data/

Ruiz, J. M., Steffen, P., & Smith, T. B. (2013). Hispanic mortality paradox: A systematic review and meta-analysis of the longitudinal literature. *American Journal of Public Health, 103*(3), e52-60. https://doi.org/10.2105/AJPH.2012.301103

Shiels, M. S., Almeida, J. S., García-Closas, M., Albert, P. S., Freedman, N. D., & Berrington de González, A. (2021). Impact of Population Growth and Aging on Estimates of Excess U.S. Deaths During the COVID-19 Pandemic, March to August 2020. *Annals of Internal Medicine, 174*(4), 437–443. https://doi.org/10.7326/M20-7385
Shiels, M. S., Tatalovich, Z., Chen, Y., Haozous, E. A., Hartge, P., Nápoles, A. M., Pérez-Stable, E. J., Rodriquez, E. J., Spillane, S., Thomas, D. A., Withrow, D. R., Berrington de González, A., & Freedman, N. D. (2020). Trends in Mortality From Drug Poisonings, Suicide, and Alcohol-Induced Deaths in the United States From 2000 to 2017. *JAMA Network Open, 3*(9), e2016217–e2016217. https://doi.org/10.1001/jamanetworkopen.2020.16217

Simon, P., Ho, A., Shah, M. D., & Shetgiri, R. (2021). Trends in Mortality From COVID-19 and Other Leading Causes of Death Among Latino vs White Individuals in Los Angeles County, 2011-2020. *JAMA*. https://doi.org/10.1001/jama.2021.11945

Solomon, D. A., Sherman, A. C., & Kanjilal, S. (2020). Influenza in the COVID-19 Era. *JAMA, 324*(13), 1342–1343. https://doi.org/10.1001/jama.2020.14661

Stokes, A. C., Lundberg, D. J., Bor, J., & Bibbins-Domingo, K. (2021). Excess Deaths During the COVID-19 Pandemic: Implications for US Death Investigation Systems. *American Journal of Public Health, 111*(S2), S53–S54. https://doi.org/10.2105/AJPH.2021.306331

Stokes, A. C., Lundberg, D. J., Elo, I. T., Hempstead, K., Bor, J., & Preston, S. H. (2021). COVID-19 and excess mortality in the United States: A county-level analysis. *PLoS Medicine, 18*(5), e1003571. https://doi.org/10.1371/journal.pmed.1003571

Tarazi, W. W., Finegold, K., Sheingold, S. H., Wong Samson, L., Zuckerman, R., & Bosworth, A. (2021). COVID-19-Related Deaths and Excess Deaths Among Medicare Fee-For-Service Beneficiaries. *Health Affairs, 40*(6), 879–885. https://doi.org/10.1377/hlthaff.2020.02521

US Census Bureau. (2020). *National Population by Characteristics: 2010-2019*. The United States Census Bureau. Accessed on August 4, 2021 from: https://www.census.gov/data/tables/time-series/demo/popest/2010s-national-detail.html

Weinberger, D. M., Chen, J., Cohen, T., Crawford, F. W., Mostashari, F., Olson, D., Pitzer, V. E., Reich, N. G., Russi, M., Simonsen, L., Watkins, A., & Viboud, C. (2020). Estimation of Excess Deaths Associated With the COVID-19 Pandemic in the United States, March to May 2020. *JAMA Internal Medicine, 180*(10), 1336–1344. https://doi.org/10.1001/jamainternmed.2020.3391
Wessler, B. S., Kent, D. M., & Konstam, M. A. (2020). Fear of Coronavirus Disease 2019—An Emerging Cardiac Risk. *JAMA Cardiology, 5*(9), 981–982. https://doi.org/10.1001/jamacardio.2020.2890

Woolf, S. H., Chapman, D. A., Sabo, R. T., & Zimmerman, E. B. (2021). Excess Deaths From COVID-19 and Other Causes in the US, March 1, 2020, to January 2, 2021. *JAMA, 325*(17), 1786–1789. https://doi.org/10.1001/jama.2021.5199

Woolf, S. H., Masters, R. K., & Aron, L. Y. (2021). Effect of the covid-19 pandemic in 2020 on life expectancy across populations in the USA and other high income countries: Simulations of provisional mortality data. *BMJ, 373*, n1343. https://doi.org/10.1136/bmj.n1343

Wrigley-Field, E., Garcia, S., Leider, J. P., Robertson, C., & Wurtz, R. (2020). Racial Disparities in COVID-19 and Excess Mortality in Minnesota. *Socius, 6*. https://doi.org/10.1177/2378023120980918

Zelner, J., Trangucci, R., Naraharisetti, R., Cao, A., Malosh, R. E., Broen, K., Masters, N., & Delamater, P. V. (2020). Racial disparities in COVID-19 mortality are driven by unequal infection risks. *Clinical Infectious Diseases: An Official Publication of the Infectious Diseases Society of America*. https://doi.org/10.1093/cid/ciaa1723
Figure 1: Age-Standardized Death Rates (ASDR) by Race/Ethnicity, 2019-2020

Note: Figure shows All-Cause ASDR by race/ethnicity (both sexes) in 2019 and 2020, with Covid-19 and non-Covid-19 increases in 2020 highlighted. Y-axis scales change between age group panels.
Figure 2: Change in Causes of Death other than Covid-19 by Race/Ethnicity, 2019-2020

Note: Figure shows absolute ASDR change by race/ethnicity (both sexes) for all non-Covid-19 causes of death in 2020, relative to 2019. Y-axis scales change between age group panels.
Figure 3: Racial/Ethnic Comparisons of Non-Covid-19 ASDR Change (Both Sexes, Ages 25+), 2019-2020

Panel A
Non-Hispanic Black vs. Non-Hispanic White

Panel B
Hispanic vs. Non-Hispanic White

Note: Figure shows racial/ethnic comparisons ASDR percent change for all non-Covid-19 causes of death in 2020, relative to 2019. Shaded area indicates where percent increase was greater for Black (Panel A) and Hispanic (Panel B) than their White peers.
Table 1. All-Cause Deaths, Population, and ASDR for ages 25+ by Race/Ethnicity and Sex

|                      | Male  | Female | Total  | Male  | Female | Total  | Male  | Female | Total  |
|----------------------|-------|--------|--------|-------|--------|--------|-------|--------|--------|
| **Total Population** |       |        |        |       |        |        |       |        |        |
| 2020                 | 1,731,439 | 1,593,707 | 3,325,146 | 109,725,881 | 116,909,132 | 226,635,013 | 1,747 | 1,230 | 1,467 |
| 2019                 | 1,435,071 | 1,359,755 | 2,794,826 | 108,906,904 | 116,099,507 | 225,006,411 | 1,479 | 1,064 | 1,543 |
| Absolute Change      | 296,368 | 233,952 | 530,320 | 818,977 | 809,625 | 1,628,602 | 267 | 166 | 213 |
| Ratio                | 1.207 | 1.172 | 1.190 | 1.008 | 1.007 | 1.007 | 1.181 | 1.156 | 1.170 |
| **Non-Hispanic White** |     |        |        |       |        |        |       |        |        |
| 2020                 | 1,262,029 | 1,196,340 | 2,458,369 | 70,348,355 | 74,383,706 | 144,732,061 | 1,727 | 1,245 | 1,469 |
| 2019                 | 1,100,650 | 1,060,892 | 2,161,542 | 70,293,191 | 74,355,654 | 144,648,845 | 1,525 | 1,112 | 1,303 |
| Absolute Change      | 161,379 | 135,448 | 296,827 | 55,164 | 28,052 | 83,216 | 203 | 133 | 166 |
| Ratio                | 1.147 | 1.128 | 1.137 | 1.001 | 1.000 | 1.001 | 1.133 | 1.120 | 1.127 |
| **Non-Hispanic Black** |    |        |        |       |        |        |       |        |        |
| 2020                 | 226,329 | 206,040 | 432,369 | 12,612,934 | 14,600,484 | 27,213,418 | 2,411 | 1,581 | 1,935 |
| 2019                 | 171,989 | 160,812 | 332,801 | 12,452,724 | 14,436,702 | 26,889,426 | 1,884 | 1,264 | 1,528 |
| Absolute Change      | 54,340 | 45,228 | 99,568 | 160,210 | 163,782 | 323,992 | 527 | 317 | 407 |
| Ratio                | 1.316 | 1.281 | 1.299 | 1.013 | 1.011 | 1.012 | 1.280 | 1.250 | 1.266 |
| **Hispanic**         |       |        |        |       |        |        |       |        |        |
| 2020                 | 167,347 | 126,119 | 293,466 | 17,890,593 | 17,867,600 | 35,758,193 | 1,592 | 1,016 | 1,279 |
| 2019                 | 109,426 | 90,347 | 199,773 | 17,491,893 | 17,462,061 | 34,953,954 | 1,106 | 762 | 918 |
| Absolute Change      | 57,921 | 35,772 | 93,693 | 398,700 | 405,539 | 804,239 | 487 | 254 | 361 |
| Ratio                | 1.529 | 1.396 | 1.469 | 1.023 | 1.023 | 1.023 | 1.440 | 1.334 | 1.393 |
Table 2. Change in ASDR (ages 25+) by Cause of Death and Race/Ethnicity, Both Sexes

| Cause of Death and Race/Ethnicity | All Cause | Covid-19 | Non-Covid-19 | Alzheimer disease | Cerebrovascular diseases | Chronic lower respiratory diseases | Diabetes mellitus | Diseases of heart | External Causes | Influenza and pneumoni a | Malignant neoplasms | Nephritis, nephrotic syndrome, nephrosis | Other diseases of respiratory system | Septicemia | Symptoms and signs not elsewhere classified | All Other Causes |
|----------------------------------|-----------|----------|---------------|-------------------|--------------------------|----------------------------------|-----------------|-----------------|---------------|-------------------------|------------------|-------------------------------|------------------------|-------------|-----------------------------------------------|-------------------|
| Non-Hispanic White               |           |          |               |                   |                          |                                  |                 |                 |               |                        |                  |                               |                        |             |                                               |                   |
| ASDR, 2020                       | 1,468.9   | 121.9    | 1,347.0       | 62.1              | 67.8                    | 76.7                           | 38.4             | 312.0           | 119.1         | 22.9                     | 276.5            | 20.5                          | 20.4                   | 17.2        | 14.0                                          | 299.3             |
| ASDR, 2019                       | 1,303.0   | 3.4%     | 1,303.0       | 57.6              | 65.1                    | 81.0                           | 34.8             | 304.5           | 109.4         | 22.5                     | 279.6            | 20.8                          | 20.6                   | 16.9        | 13.9                                          | 276.2             |
| % Change                         | 12.7%     | 100.0%   | 3.4%          | 7.8%              | 4.1%                     | -5.4%                          | 10.5%            | 2.5%            | 8.9%          | 1.8%                     | -1.1%            | -1.5%                          | -1.4%                  | 2.2%        | 0.7%                                          | 8.4%              |
| Absolute Change                  | 165.9     | 121.9    | 44.0          | 4.5                | 2.7                      | (4.4)                          | 3.7              | 7.5             | 9.7           | 0.4                      | (3.1)            | (0.3)                          | (0.3)                  | 0.4         | 0.1                                           | 23.1              |
| % of Absolute All-Cause Change   | 100.0%    | 73.5%    | 2.7%          | 1.6%              | -2.6%                    | 2.2%                           | 4.5%             | 5.9%            | 0.2%          | -1.9%                    | -0.2%            | -0.2%                          | 0.2%                   | 0.1%        | 13.9%                                         |                   |
| Non-Hispanic Black               |           |          |               |                   |                          |                                  |                 |                 |               |                        |                  |                               |                        |             |                                               |                   |
| ASDR, 2020                       | 1,934.8   | 259.2    | 1,675.6       | 57.6              | 104.7                   | 55.8                           | 85.3             | 420.3           | 140.3         | 30.8                     | 312.5            | 48.1                          | 21.7                   | 30.4        | 18.0                                          | 350.0             |
| ASDR, 2019                       | 1,528.0   | 9.7%     | 1,528.0       | 50.7              | 96.9                    | 53.6                           | 70.2             | 378.9           | 112.4         | 24.8                     | 321.0            | 46.1                          | 18.6                   | 29.0        | 15.5                                          | 310.5             |
| % Change                         | 26.6%     | 100.0%   | 9.7%          | 13.6%             | 8.1%                     | 4.2%                           | 21.6%            | 10.9%           | 24.9%         | 24.2%                    | -2.6%            | 4.3%                          | 16.9%                  | 4.8%        | 16.3%                                         | 12.7%             |
| Absolute Change                  | 406.8     | 259.2    | 147.6         | 6.9                | 7.8                      | 2.3                            | 15.2             | 41.4            | 27.9          | 6.0                      | (8.4)            | 2.0                           | 3.1                    | 1.4         | 2.5                                           | 39.5              |
| % of Absolute All-Cause Change   | 100.0%    | 63.7%    | 36.3%         | 1.7%              | 1.9%                     | 0.6%                           | 3.7%             | 10.2%           | 6.9%          | 1.5%                     | -2.1%            | 0.5%                          | 0.8%                   | 0.3%        | 0.6%                                          | 9.7%              |
| Hispanic                         |           |          |               |                   |                          |                                  |                 |                 |               |                        |                  |                               |                        |             |                                               |                   |
| ASDR, 2020                       | 1,278.9   | 285.8    | 993.1         | 53.0              | 63.6                    | 29.1                           | 56.8             | 225.6           | 74.7          | 22.0                     | 189.2            | 21.5                          | 17.2                   | 13.1        | 7.8                                           | 219.5             |
| ASDR, 2019                       | 918.2     | 8.2%     | 918.2         | 46.5              | 59.7                    | 29.1                           | 47.3             | 204.4           | 65.3          | 17.8                     | 193.3            | 21.6                          | 16.7                   | 12.3        | 6.9                                           | 196.9             |
| % Change                         | 39.3%     | 100.0%   | 8.2%          | 13.9%             | 6.3%                     | -1.2%                          | 20.2%            | 10.4%           | 14.3%         | 23.1%                    | -2.1%            | -0.9%                          | 3.1%                   | 6.4%        | 14.1%                                         | 11.5%             |
| Absolute Change                  | 360.7     | 285.8    | 74.9          | 6.3                | 3.9                      | (0.4)                          | 9.3              | 21.2            | 9.4          | 4.1                      | (4.1)            | (0.2)                          | 0.5                    | 0.8         | 1.0                                           | 22.6              |
| % of Absolute All-Cause Change   | 100.0%    | 79.2%    | 20.8%         | 1.8%              | 1.1%                     | -0.1%                          | 2.6%             | 5.9%            | 2.6%          | 1.1%                     | -1.1%            | -0.1%                          | 0.1%                   | 0.2%        | 0.3%                                          | 6.3%              |
| Table 3. Change in ASDR (ages 25+) Racial Disparities by Cause of Death and Race/Ethnicity, Both Sexes |
|---------------------------------------------------------------|
| **Black-White Disparity**                                     |
| All Cause | Covid-19 | Non-Covid-19 | Alzheimer disease | Cerebrovascular diseases | Chronic lower respiratory diseases | Diabetes mellitus | Diseases of heart | External Causes | Influenza and pneumonia | Malignant neoplasms | Nephritis, nephrotic syndrome, nephrosis | Other diseases of respiratory system | Septicemia | Symptoms and signs not elsewhere classified | All Other Causes |
|-----------|----------|--------------|-----------------|-------------------------|------------------------------------|------------------|-----------------|----------------|-----------------------|-------------------|------------------------------------------|-----------------|-----------------------|-----------------|
| 465.87 | 137.23 | 328.64 | (4.50) | 36.92 | (20.84) | 46.89 | 108.26 | 21.22 | 7.91 | 36.01 | 27.61 | 1.34 | 13.17 | 3.97 | 50.68 |
| 225.04 | - | 225.04 | (6.91) | 31.76 | (27.48) | 35.38 | 74.44 | 3.01 | 2.32 | 41.32 | 25.31 | (2.08) | 12.13 | 1.55 | 34.29 |
| 240.83 | 137.23 | 103.60 | 2.41 | 5.16 | 6.64 | 11.50 | 33.82 | 18.21 | 5.60 | (5.31) | 2.30 | 3.42 | 1.04 | 2.43 | 16.39 |
| **Absolute Change** | | | | | | | | | | | | | | | | |
| 100.0% | 57.0% | 43.0% | 1.0% | 2.1% | 2.8% | 4.8% | 14.0% | 7.6% | 2.3% | -2.2% | 1.0% | 1.4% | 0.4% | 1.0% | 6.8% |
| **Hispanic-White Disparity**                                  |
| All Cause | Covid-19 | Non-Covid-19 | Alzheimer disease | Cerebrovascular diseases | Chronic lower respiratory diseases | Diabetes mellitus | Diseases of heart | External Causes | Influenza and pneumonia | Malignant neoplasms | Nephritis, nephrotic syndrome, nephrosis | Other diseases of respiratory system | Septicemia | Symptoms and signs not elsewhere classified | All Other Causes |
|-----------|----------|--------------|-----------------|-------------------------|------------------------------------|------------------|-----------------|----------------|-----------------------|-------------------|------------------------------------------|-----------------|-----------------------|-----------------|
| 190.01 | 163.85 | 353.86 | (9.12) | (4.14) | (47.54) | 18.39 | (86.43) | (44.39) | (0.92) | (87.32) | 0.96 | (3.12) | (4.18) | (6.22) | (79.83) |
| (384.78) | - | (384.78) | (11.12) | (5.38) | (51.55) | 12.50 | (100.12) | (44.02) | (4.64) | (86.35) | 0.84 | (3.93) | (4.61) | (7.08) | (79.33) |
| 194.77 | 163.85 | 30.92 | 2.00 | 1.24 | 4.01 | 5.89 | 13.69 | (0.37) | 3.72 | (0.98) | 0.13 | 0.81 | 0.42 | 0.86 | (0.50) |
| **Absolute Change** | | | | | | | | | | | | | | | | |
| 100.0% | 84.1% | 15.9% | 1.0% | 0.6% | 2.1% | 3.0% | 7.0% | -0.2% | 1.9% | -0.5% | 0.1% | 0.4% | 0.2% | 0.4% | -0.3% |
| **Black-Hispanic Disparity**                                  |
| All Cause | Covid-19 | Non-Covid-19 | Alzheimer disease | Cerebrovascular diseases | Chronic lower respiratory diseases | Diabetes mellitus | Diseases of heart | External Causes | Influenza and pneumonia | Malignant neoplasms | Nephritis, nephrotic syndrome, nephrosis | Other diseases of respiratory system | Septicemia | Symptoms and signs not elsewhere classified | All Other Causes |
|-----------|----------|--------------|-----------------|-------------------------|------------------------------------|------------------|-----------------|----------------|-----------------------|-------------------|------------------------------------------|-----------------|-----------------------|-----------------|
| 655.88 | (26.62) | 682.50 | 4.62 | 41.06 | 26.71 | 28.49 | 194.69 | 65.61 | 8.83 | 123.33 | 26.64 | 4.46 | 17.36 | 10.19 | 130.51 |
| 609.82 | - | 609.82 | 4.20 | 37.14 | 24.08 | 22.88 | 174.56 | 47.03 | 6.95 | 127.67 | 24.47 | 1.85 | 16.74 | 8.63 | 113.62 |
| 46.06 | (26.62) | 72.69 | 0.41 | 3.93 | 2.63 | 5.61 | 20.13 | 18.58 | 1.88 | (4.34) | 2.17 | 2.61 | 0.62 | 1.56 | 16.89 |
| **Absolute Change** | | | | | | | | | | | | | | | | |
| 100.0% | -57.8% | 157.8% | 0.9% | 8.5% | 5.7% | 12.2% | 43.7% | 40.3% | 4.1% | -9.4% | 4.7% | 5.7% | 1.3% | 3.4% | 36.7% |
| ASDR AGES 25 to 64 | All Cause | Covid-19 | Non- Covid-19 | Alzheimer disease | Cerebrovascular diseases | Chronic lower respiratory diseases | Diabetes mellitus | Diseases of heart | External Causes | Influenza and pneumonia | Malignant neoplasms | Nephritis, nephrotic syndrome | Other diseases of respiratory system | Septicemia | Symptoms and signs not elsewhere classified | All Other Causes |
|------------------|-----------|----------|----------------|-------------------|-------------------------|-------------------------------|-----------------|-----------------|----------------|-------------------------|-----------------|---------------------------|--------------------------|------------|--------------------------|---------------------|
| **Non-Hispanic White** | 8.7%      | 1.5%     | 4,566.02       | 10.97            | 14.45                   | 79.09                        | 108.59          | 5.81            | 97.55          | 4.21                    | 4.37            | 5.76                      | 4.81                      | 87.72      | 77.56                    |                      |
| ASDR, 2020       | 13.0%     | 100.0%   | 8.1%           | 1.7%              | -0.1%                    | 12.9%                        | 9.0%             | 13.2%           | 14.3%          | -0.8%                    | 1.2%            | 5.5%                      | 14.2%                      | 4.2%       | 13.1%                    |                      |
| % Change         | 20.7%     | 33.06    | 0.04           | 0.88              | (0.01)                   | 1.65                         | 6.56             | 12.65           | 0.73           | (0.78)                   | 0.05            | 0.23                      | 0.72                      | 0.19       | 10.16                    |                      |
| Absolute Change  | 100.0%    | 37.8%    | 62.2%          | 1.7%              | 0.0%                     | 3.1%                         | 12.3%            | 23.8%           | 1.4%           | -1.5%                    | 0.1%            | 0.4%                      | 1.4%                      | 0.4%       | 19.1%                    |                      |
| **Non-Hispanic Black** | 76.14     | 77.25    | 684.19         | 27.93            | 16.03                    | 35.98                        | 154.14           | 147.38          | 10.39          | 121.25                   | 15.33           | 8.20                      | 11.05                     | 84.41      | 127.25                   |                      |
| ASDR, 2019       | 69.02     | 60.02    | 0.72           | 24.99            | 15.03                    | 27.86                        | 134.75           | 113.45          | 8.00           | 125.29                   | 13.86           | 6.66                      | 10.31                     | 7.35       | 112.17                   |                      |
| % Change         | 31.9%     | 100.0%   | 14.0%          | 17.4%            | 11.8%                    | 29.1%                        | 14.4%            | 29.9%           | 29.9%          | -3.2%                    | 10.7%           | 23.1%                     | 7.2%                      | 14.4%      | 13.4%                    |                      |
| Absolute Change  | 161.01    | 83.76    | 0.13           | 2.95              | 1.00                     | 8.12                         | 19.39            | 33.94           | 2.39           | (4.05)                   | 1.48            | 1.54                      | 0.74                      | 1.06       | 15.09                    |                      |
| % of Absolute All-Cause Change | 100.0%    | 52.0%    | 1.8%           | 0.6%              | 5.0%                     | 12.0%                        | 21.1%            | 1.5%            | -2.5%          | 0.9%                     | 1.6%            | 0.5%                      | 0.7%                      | 9.4%       | 9.4%                     |                      |
| **Hispanic**     | 81.6%     | 18.4%    | 2,891.31       | 106.30            | 177.59                   | 760.94                        | 88.15            | 72.40           | 57.63          | 70.64                    | 58.47           | 40.42                     | 21.17                     | 683.78     | 621.59                   |                      |
| ASDR, 2020       | 68.1%     | 12.3%    | 3,088.09       | 213.81           | 222.80                   | 106.30                        | 177.59           | 760.94          | 88.15          | 72.40                    | 57.63           | 70.64                     | 58.47                     | 40.42      | 21.17                     |                      |
| % Change         | 29.6%     | 24.2%    | 6.8%           | 2.4%              | -0.2%                    | 2.7%                         | 6.2%             | 0.2%            | 1.1%           | -1.2%                    | -0.2%           | 0.0%                      | 0.2%                      | 0.2%       | 5.8%                     |                      |
| Absolute Change  | 100.0%    | 18.4%    | 2.4%           | 1.1%              | -0.2%                    | 2.7%                         | 6.2%             | 0.2%            | 1.1%           | -1.2%                    | -0.2%           | 0.0%                      | 0.2%                      | 0.2%       | 5.8%                     |                      |

Appendix Table A. Change in ASDR (ages 25-64 and ages 65+) by Cause of Death and Race/Ethnicity, Both Sexes
### Table B. Change in ASDR by Cause of Death and Race/Ethnicity, Male Population

| Cause of Death | Non-Hispanic White | Non-Hispanic Black | Hispanic | All Causes | CoV-19 | CoV-19 |
|----------------|---------------------|---------------------|----------|-----------|--------|--------|
| Alzheimer disease | 1.37% | 3.22% | 0.31% | 1.16% | 2.10% | 0.41% |
| Chronic respiratory diseases | 0.3% | 0.6% | 0.2% | 0.3% | 0.5% | 0.1% |
| Diabetes mellitus | 1.4% | 2.0% | 0.5% | 1.2% | 2.2% | 0.4% |
| Heart disease | 5.8% | 7.3% | 2.0% | 4.7% | 7.0% | 1.3% |
| Influenza and pneumonia | 1.4% | 1.9% | 0.3% | 1.1% | 2.2% | 0.4% |
| Malnutrition | 1.4% | 2.0% | 0.4% | 1.1% | 2.2% | 0.4% |
| Neoplastic, hematopoietic, lymphatic | 3.0% | 4.1% | 1.0% | 2.7% | 4.6% | 0.9% |
| Other diseases of respiratory system | 5.6% | 7.6% | 1.9% | 4.7% | 7.4% | 1.5% |
| Septicemia | 0.1% | 0.2% | 0.0% | 0.0% | 0.0% | 0.0% |
| Symptoms and signs not elsewhere classified | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| All Other Causes | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |

| Cause of Death | Non-Hispanic White | Non-Hispanic Black | Hispanic | All Causes | CoV-19 | CoV-19 |
|----------------|---------------------|---------------------|----------|-----------|--------|--------|
| Alzheimer disease | 0.7% | 1.5% | 0.1% | 0.7% | 1.5% | 0.1% |
| Chronic respiratory diseases | 0.1% | 0.1% | 0.0% | 0.1% | 0.1% | 0.0% |
| Diabetes mellitus | 0.1% | 0.2% | 0.0% | 0.1% | 0.2% | 0.0% |
| Heart disease | 0.1% | 0.1% | 0.0% | 0.1% | 0.1% | 0.0% |
| Influenza and pneumonia | 0.1% | 0.1% | 0.0% | 0.1% | 0.1% | 0.0% |
| Malnutrition | 0.1% | 0.1% | 0.0% | 0.1% | 0.1% | 0.0% |
| Neoplastic, hematopoietic, lymphatic | 0.1% | 0.1% | 0.0% | 0.1% | 0.1% | 0.0% |
| Other diseases of respiratory system | 0.1% | 0.1% | 0.0% | 0.1% | 0.1% | 0.0% |
| Septicemia | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Symptoms and signs not elsewhere classified | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| All Other Causes | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |

| Cause of Death | Non-Hispanic White | Non-Hispanic Black | Hispanic | All Causes | CoV-19 | CoV-19 |
|----------------|---------------------|---------------------|----------|-----------|--------|--------|
| Alzheimer disease | 0.1% | 0.3% | 0.0% | 0.1% | 0.3% | 0.0% |
| Chronic respiratory diseases | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Diabetes mellitus | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Heart disease | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Influenza and pneumonia | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Malnutrition | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Neoplastic, hematopoietic, lymphatic | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Other diseases of respiratory system | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Septicemia | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Symptoms and signs not elsewhere classified | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| All Other Causes | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |

| Cause of Death | Non-Hispanic White | Non-Hispanic Black | Hispanic | All Causes | CoV-19 | CoV-19 |
|----------------|---------------------|---------------------|----------|-----------|--------|--------|
| Alzheimer disease | 0.3% | 0.7% | 0.0% | 0.4% | 0.9% | 0.1% |
| Chronic respiratory diseases | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Diabetes mellitus | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Heart disease | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Influenza and pneumonia | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Malnutrition | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Neoplastic, hematopoietic, lymphatic | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Other diseases of respiratory system | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Septicemia | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Symptoms and signs not elsewhere classified | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| All Other Causes | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |
## Appendix Table C. Change in ASDR by Cause of Death and Race/Ethnicity, Female Population

| Cause                                      | Non-Hispanic White | Non-Hispanic Black | Hispanic | All Cause |
|--------------------------------------------|--------------------|--------------------|----------|-----------|
| Covid-19                                   | 1,143.80           | 305.12             | 816.65   | 328.87    |
| Non-Covid-19                               | 189.80             | 42.61              | 64.75    | 21.12     |
| Alzheimer's disease                        | 44.00              | 8.20               | 10.19    | 2.34      |
| Cerebrovascular diseases                   | 21.12              | 4.45               | 6.79     | 1.76      |
| Chronic lower respiratory diseases         | 12.15              | 2.52               | 3.06     | 0.62      |
| Diabetic complications of heart            | 4.00               | 0.87               | 0.57     | 0.13      |
| Diseases of heart                         | 10.68              | 1.90               | 2.61     | 0.87      |
| Diseases of nervous system                 | 9.87               | 1.87               | 2.52     | 0.75      |
| Malnutrition                              | 13.92              | 2.61               | 3.06     | 0.62      |
| Neoplastic (Stomach, lung, kidney, breast) | 121.95             | 25.20              | 31.32    | 9.61      |
| Other diseases of respiratory system       | 20.35              | 3.73               | 5.97     | 1.39      |
| Pepticulaneous                              | 5.97               | 1.13               | 2.42     | 0.51      |
| Symptoms and signs not elsewhere noted     | 53.00              | 11.32              | 19.33    | 5.89      |
| All Other Causes                           | 338.47             | 73.00              | 113.44   | 35.28     |

### Percent Change

| Cause                                      | Non-Hispanic White | Non-Hispanic Black | Hispanic | All Cause |
|--------------------------------------------|--------------------|--------------------|----------|-----------|
| Covid-19                                   | 12.03              | 1.95               | 10.19    | 2.34      |
| Non-Covid-19                               | 12.03              | 1.95               | 10.19    | 2.34      |
| Alzheimer's disease                        | 12.03              | 1.95               | 10.19    | 2.34      |
| Cerebrovascular diseases                   | 12.03              | 1.95               | 10.19    | 2.34      |
| Chronic lower respiratory diseases         | 12.03              | 1.95               | 10.19    | 2.34      |
| Diabetic complications of heart            | 12.03              | 1.95               | 10.19    | 2.34      |
| Diseases of heart                         | 12.03              | 1.95               | 10.19    | 2.34      |
| Diseases of nervous system                 | 12.03              | 1.95               | 10.19    | 2.34      |
| Malnutrition                              | 12.03              | 1.95               | 10.19    | 2.34      |
| Neoplastic (Stomach, lung, kidney, breast) | 12.03              | 1.95               | 10.19    | 2.34      |
| Other diseases of respiratory system       | 12.03              | 1.95               | 10.19    | 2.34      |
| Pepticulaneous                              | 12.03              | 1.95               | 10.19    | 2.34      |
| Symptoms and signs not elsewhere noted     | 12.03              | 1.95               | 10.19    | 2.34      |
| All Other Causes                           | 12.03              | 1.95               | 10.19    | 2.34      |

### Absolute Change

| Cause                                      | Non-Hispanic White | Non-Hispanic Black | Hispanic | All Cause |
|--------------------------------------------|--------------------|--------------------|----------|-----------|
| Covid-19                                   | 189.80             | 42.61              | 816.65   | 328.87    |
| Non-Covid-19                               | 64.75              | 10.19              | 64.75    | 10.19     |
| Alzheimer's disease                        | 8.20               | 1.87               | 8.20     | 1.87      |
| Cerebrovascular diseases                   | 4.45               | 0.87               | 4.45     | 0.87      |
| Chronic lower respiratory diseases         | 2.52               | 0.57               | 2.52     | 0.57      |
| Diabetic complications of heart            | 0.87               | 0.13               | 0.87     | 0.13      |
| Diseases of heart                         | 1.90               | 0.26               | 1.90     | 0.26      |
| Diseases of nervous system                 | 1.87               | 0.37               | 1.87     | 0.37      |
| Malnutrition                              | 2.61               | 0.51               | 2.61     | 0.51      |
| Neoplastic (Stomach, lung, kidney, breast) | 2.34               | 0.51               | 2.34     | 0.51      |
| Other diseases of respiratory system       | 1.90               | 0.26               | 1.90     | 0.26      |
| Pepticulaneous                              | 0.87               | 0.13               | 0.87     | 0.13      |
| Symptoms and signs not elsewhere noted     | 2.12               | 0.45               | 2.12     | 0.45      |
| All Other Causes                           | 21.12              | 4.45               | 21.12    | 4.45      |

### Percent Change

| Cause                                      | Non-Hispanic White | Non-Hispanic Black | Hispanic | All Cause |
|--------------------------------------------|--------------------|--------------------|----------|-----------|
| Covid-19                                   | 12.03              | 1.95               | 10.19    | 2.34      |
| Non-Covid-19                               | 12.03              | 1.95               | 10.19    | 2.34      |
| Alzheimer's disease                        | 12.03              | 1.95               | 10.19    | 2.34      |
| Cerebrovascular diseases                   | 12.03              | 1.95               | 10.19    | 2.34      |
| Chronic lower respiratory diseases         | 12.03              | 1.95               | 10.19    | 2.34      |
| Diabetic complications of heart            | 12.03              | 1.95               | 10.19    | 2.34      |
| Diseases of heart                         | 12.03              | 1.95               | 10.19    | 2.34      |
| Diseases of nervous system                 | 12.03              | 1.95               | 10.19    | 2.34      |
| Malnutrition                              | 12.03              | 1.95               | 10.19    | 2.34      |
| Neoplastic (Stomach, lung, kidney, breast) | 12.03              | 1.95               | 10.19    | 2.34      |
| Other diseases of respiratory system       | 12.03              | 1.95               | 10.19    | 2.34      |
| Pepticulaneous                              | 12.03              | 1.95               | 10.19    | 2.34      |
| Symptoms and signs not elsewhere noted     | 12.03              | 1.95               | 10.19    | 2.34      |
| All Other Causes                           | 12.03              | 1.95               | 10.19    | 2.34      |
### Appendix Table D. Selected Underlying Causes of Death with ICD-10 Codes

| Underlying Cause of Death                        | ICD-10 Codes                          |
|-------------------------------------------------|---------------------------------------|
| COVID-19                                         | U071                                  |
| Alzheimer Disease                                | G30                                   |
| Cerebrovascular Diseases                         | I60-I69                               |
| Chronic Lower Respiratory Diseases               | J40-J47                               |
| Diabetes Mellitus                                | E10-E14                               |
| Diseases of heart                                | I00-I09,I11,I13,I20-I51               |
| External Causes                                  | V01-Y89                               |
| Influenza and Pneumonia                          | J09-J18                               |
| Malignant Neoplasms                              | C00-C97                               |
| Nephritis, Nephrotic Syndrome, and Nephrosis     | N00-N07,N17-N19,N25-N27               |
| Other Diseases of Respiratory System             | J00-J06,J30-J39,J67,J70-J98           |
| Septicemia                                       | A40-A41                               |
| Symptoms Signs Not Elsewhere Classified          | R00-R99                               |
### Appendix Table E. Sensitivity Analysis

|                      | ASDR               | Absolute Change |
|----------------------|--------------------|-----------------|
|                      | 2020   | 2019   | Trend | 95% conf. interval | Relative to 2019 | Relative to Trend | Difference | Ratio |
| AGES 25+             |        |        |       |                    |                  |                  |            |       |
| Non-Hispanic White   |        |        |       |                    |                  |                  |            |       |
| All Cause            | 1,468.7 | 1,303.0 | 1,303.2 | (1275.9, 1330.4) | 165.9            | 165.5            | 0.46       | 1.003 |
| Covid-19             | 121.8   | -      | -      |                    | 121.9            | 121.8            | 0.16       | 1.001 |
| All Other Causes     | 1,346.9 | 1,303.0 | 1,303.2 |                    | 44.0             | 43.7             | 0.30       | 1.007 |
| Non-Hispanic Black   |        |        |       |                    |                  |                  |            |       |
| All Cause            | 1,934.0 | 1,528.0 | 1,533.9 | (1504.2, 1563.6) | 406.8            | 400.1            | 6.70       | 1.017 |
| Covid-19             | 258.6   | -      | -      |                    | 259.2            | 258.6            | 0.53       | 1.002 |
| All Other Causes     | 1,675.4 | 1,528.0 | 1,533.9 |                    | 147.6            | 141.4            | 6.16       | 1.044 |
| Hispanic             |        |        |       |                    |                  |                  |            |       |
| All Cause            | 1,278.7 | 918.2   | 917.4  | (904.5, 930.3)     | 360.7            | 361.3            | -0.59      | 0.998 |
| Covid-19             | 285.6   | -      | -      |                    | 285.8            | 285.6            | 0.18       | 1.001 |
| All Other Causes     | 993.1   | 918.2   | 917.4  |                    | 74.9             | 75.7             | -0.78      | 0.990 |
| AGES 25-64           |        |        |       |                    |                  |                  |            |       |
| Non-Hispanic White   |        |        |       |                    |                  |                  |            |       |
| All Cause            | 460.5   | 407.5   | 412.3  | (396.2, 428.3)     | 53.1             | 48.2             | 4.94       | 1.102 |
| Covid-19             | 20.1    | -      | -      |                    | 20.1             | 20.1             | 0.02       | 1.001 |
| All Other Causes     | 440.4   | 407.5   | 412.3  |                    | 33.1             | 28.1             | 4.92       | 1.175 |
| Non-Hispanic Black   |        |        |       |                    |                  |                  |            |       |
| All Cause            | 761.0   | 600.4   | 607.6  | (591.2, 624.0)     | 161.0            | 153.4            | 7.63       | 1.050 |
| Covid-19             | 77.2    | -      | -      |                    | 77.2             | 77.2             | 0.06       | 1.001 |
| All Other Causes     | 683.8   | 600.4   | 607.6  |                    | 83.8             | 76.2             | 7.57       | 1.099 |
| Hispanic             |        |        |       |                    |                  |                  |            |       |
| All Cause            | 405.7   | 275.9   | 278.1  | (271.7, 284.5)     | 130.0            | 127.6            | 2.36       | 1.019 |
| Covid-19             | 94.7    | -      | -      |                    | 94.7             | 94.7             | 0.02       | 1.000 |
| All Other Causes     | 311.0   | 275.9   | 278.1  |                    | 35.2             | 32.9             | 2.34       | 1.071 |
| AGES 65+             |        |        |       |                    |                  |                  |            |       |
| Non-Hispanic White   |        |        |       |                    |                  |                  |            |       |
| All Cause            | 4,565.6 | 4,053.5 | 4,039.8 | (3940.1, 4139.5)   | 512.5            | 525.8            | -13.29     | 0.975 |
| Covid-19             | 434.3   | -      | -      |                    | 434.9            | 434.3            | 0.60       | 1.001 |
| All Other Causes     | 4,131.3 | 4,053.5 | 4,039.8 |                    | 77.6             | 91.5             | -13.88     | 0.848 |
| Non-Hispanic Black   |        |        |       |                    |                  |                  |            |       |
| All Cause            | 5,537.3 | 4,377.4 | 4,374.9 | (4290.5, 4468.4)   | 1,161.7          | 1,157.9          | 3.83       | 1.003 |
| Covid-19             | 816.0   | -      | -      |                    | 818.0            | 816.0            | 1.98       | 1.002 |
| All Other Causes     | 4,721.3 | 4,377.4 | 4,374.9 |                    | 343.7            | 341.9            | 1.85       | 1.005 |
| Hispanic             |        |        |       |                    |                  |                  |            |       |
| All Cause            | 3,960.4 | 2,891.3 | 2,881.2 | (2818.3, 2944.2)   | 1,069.5          | 1,079.2          | -9.68      | 0.991 |
| Covid-19             | 872.1   | -      | -      |                    | 872.7            | 872.1            | 0.68       | 1.001 |
| All Other Causes     | 3,088.4 | 2,891.3 | 2,881.2 |                    | 196.8            | 207.1            | -10.36     | 0.950 |