Race, ethnicity, and the validity of cause of death assignment for COVID-19 in the United States

Andrew C. Stokes, PhD
Department of Global Health & Department of Sociology
Boston University

Presentation to the
National Committee on Vital and Health Statistics

April 1, 2021

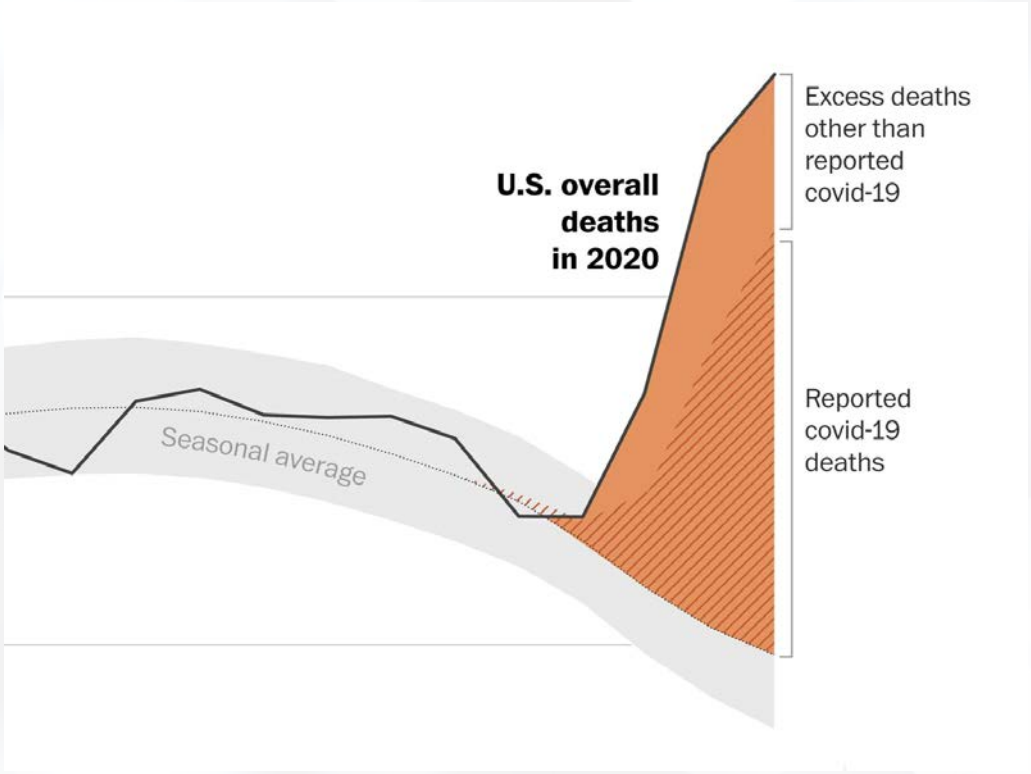
BOSTON UNIVERSITY

Agenda

1. Background
    a. What are the different types of excess deaths?
    b. How many excess deaths have occured?
    c. What is known about racial inequities in Covid-19 deaths?
2. Covid-19 and Excess Mortality: A County-Level Analysis
    a. Research Question and Hypothesis
    b. Methods
    c. Key Findings
3. Mechanisms that Could Explain Racial/Ethnic Inequities in the Reporting of Covid-19 Deaths
4. Future Directions for Research

Background

What Are Excess Deaths?



Excess deaths are typically defined as the difference between the observed number of deaths in a specific time period and expected number of deaths in the same time period.

Image from: https://www.washingtonpost.com/investigations/2020/05/02/excess-deaths-during-covid-19/

What Are the Different Types of Excess Deaths?

1. Directly assigned deaths
2. Excess deaths not assigned to Covid-19
    - “Misclassified” deaths
    - Indirect deaths

Adapted from tweet from: https://twitter.com/andrewnoymer/status/1241620288825167874?lang=en

Directly Assigned Deaths

Deaths Attributed to COVID-19 on Death Certificates

Data as of 3/24/2021

Deaths through week ending 3/20/2021

526,028

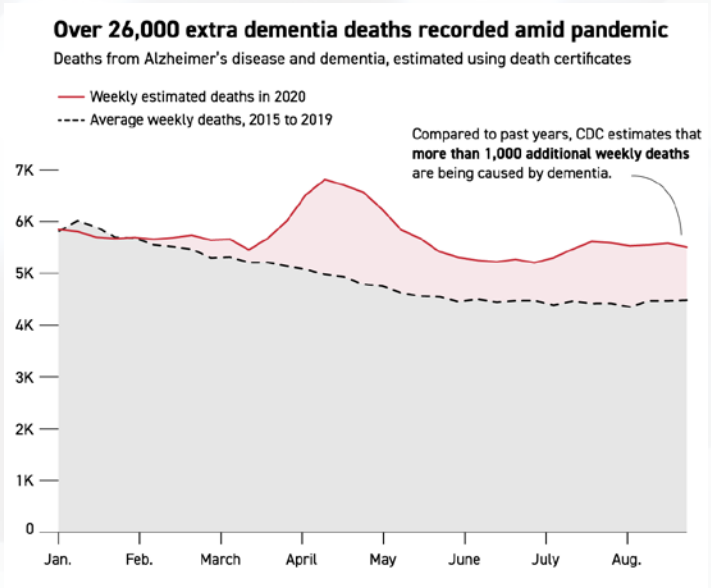
In an estimated 91% of these deaths, COVID-19 was listed as the underlying cause of death. In the remaining 9%, COVID-19 was listed as a contributing cause of death.

Source: https://www.cdc.gov/nchs/covid19/mortality-overview.htm

“Misclassified” Deaths

Total number of deaths above average since 2/1/2020, by cause of death

Respiratory diseases	Influenza and pneumonia	3,055
	Chronic lower respiratory disease	1,165
	Other diseases of the respiratory system	2,279
Circulatory diseases	Ischemic heart disease	18,886
	Heart failure	4,597
	Cerebrovascular diseases	14,735
	Other diseases of the circulatory system	4,869
	Hypertensive diseases	31,118
Malignant neoplasms	Malignant neoplasms	4,655
Alzheimer disease and dementia	Alzheimer disease and dementia	46,014
Other select causes	Diabetes	19,622
	Renal failure	1,868
	Sepsis	829



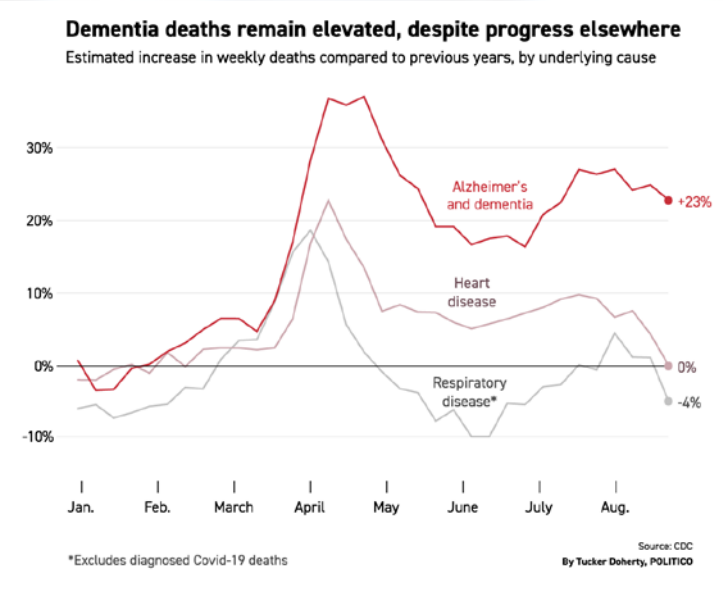


Chart (top) from: https://www.cdc.gov/nchs/nvss/vsrr/covid19/excess_deaths.htm
Figures (bottom) from: https://www.politico.com/news/2020/09/16/dementia-deaths-coronavirus-nursing-homes-416530

Indirect Deaths

Top 20 categories with lower visit counts during the early pandemic period	
Abdominal pain and other digestive or abdomen signs and symptoms	−66,456
Musculoskeletal pain, not low back pain	−52,150
Essential hypertension	−45,184
Nausea and vomiting	−38,536
Other specified upper respiratory infections	−36,189
Sprains and strains, initial encounter††	−33,709
Superficial injury; contusion, initial encounter	−30,918
Personal or family history of disease	−28,734
Headache, including migraine	−27,458
Other unspecified injury	−25,974
Nonspecific chest pain	−24,258
Tobacco-related disorders	−23,657
Urinary tract infections	−23,346
Asthma	−20,660
Disorders of lipid metabolism	−20,145
Spondylopathies/Spondyloarthropathy (including infective)	−19,441
Otitis media††	−17,852
Diabetes mellitus without complication	−15,893
Skin and subcutaneous tissue infections	−15,598
Chronic obstructive pulmonary disease and bronchiectasis	−15,520

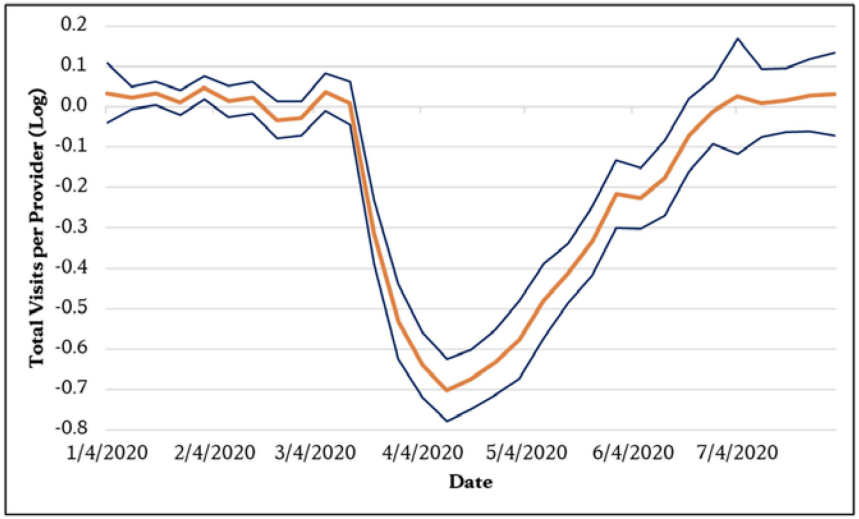
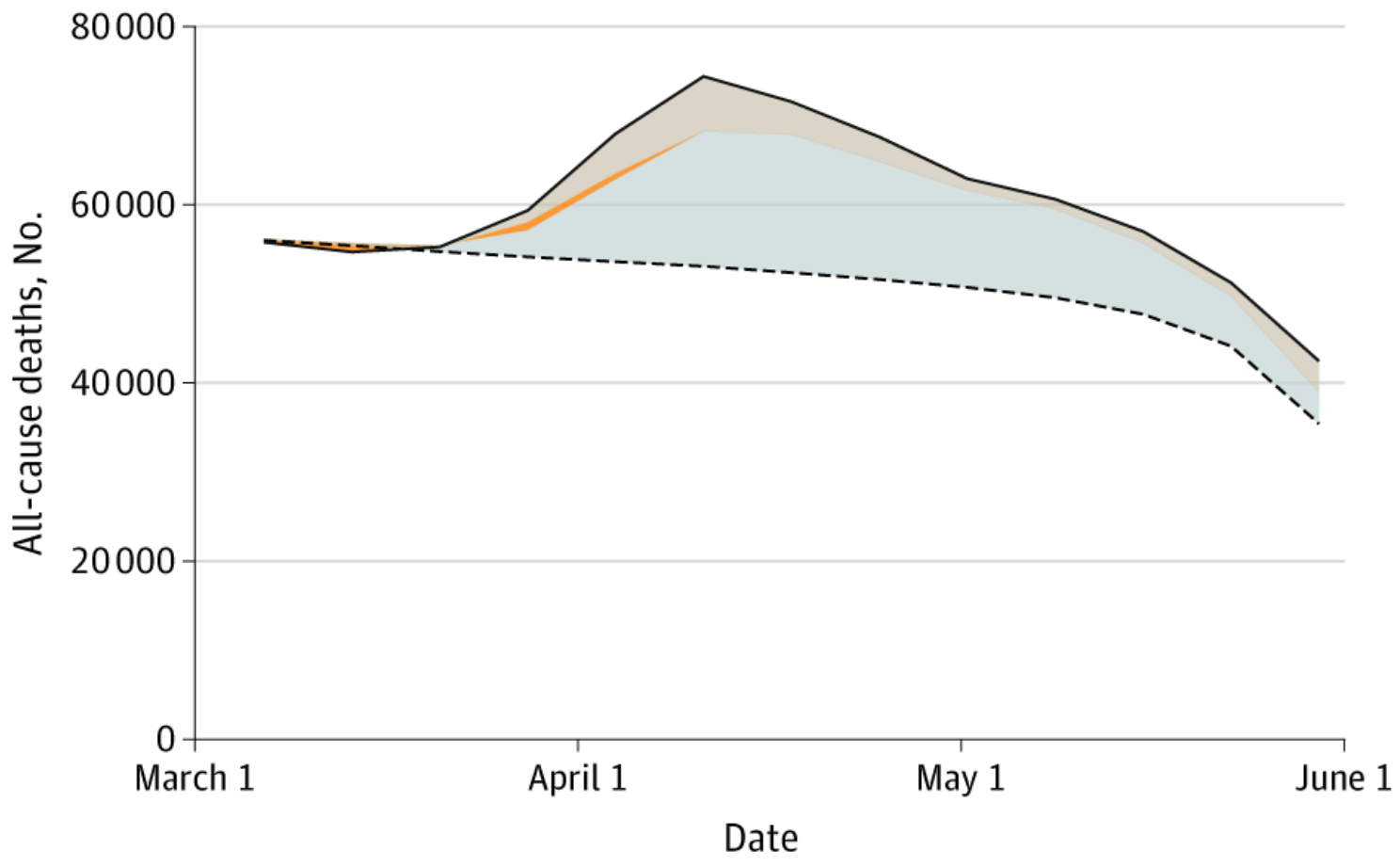


Figure 1: Weekly Trends in Outpatient Visits in 2020 Relative to the Same Week in 2010-19

Infographic and Table (top) from: https://www.cdc.gov/mmwr/volumes/69/wr/mm6923e1.htm | Graph (bottom) from: https://lernercenter.syr.edu/2020/11/17/ds-30/ (data source: CDC's Outpatient Influenza-like Illness Surveillance Network)

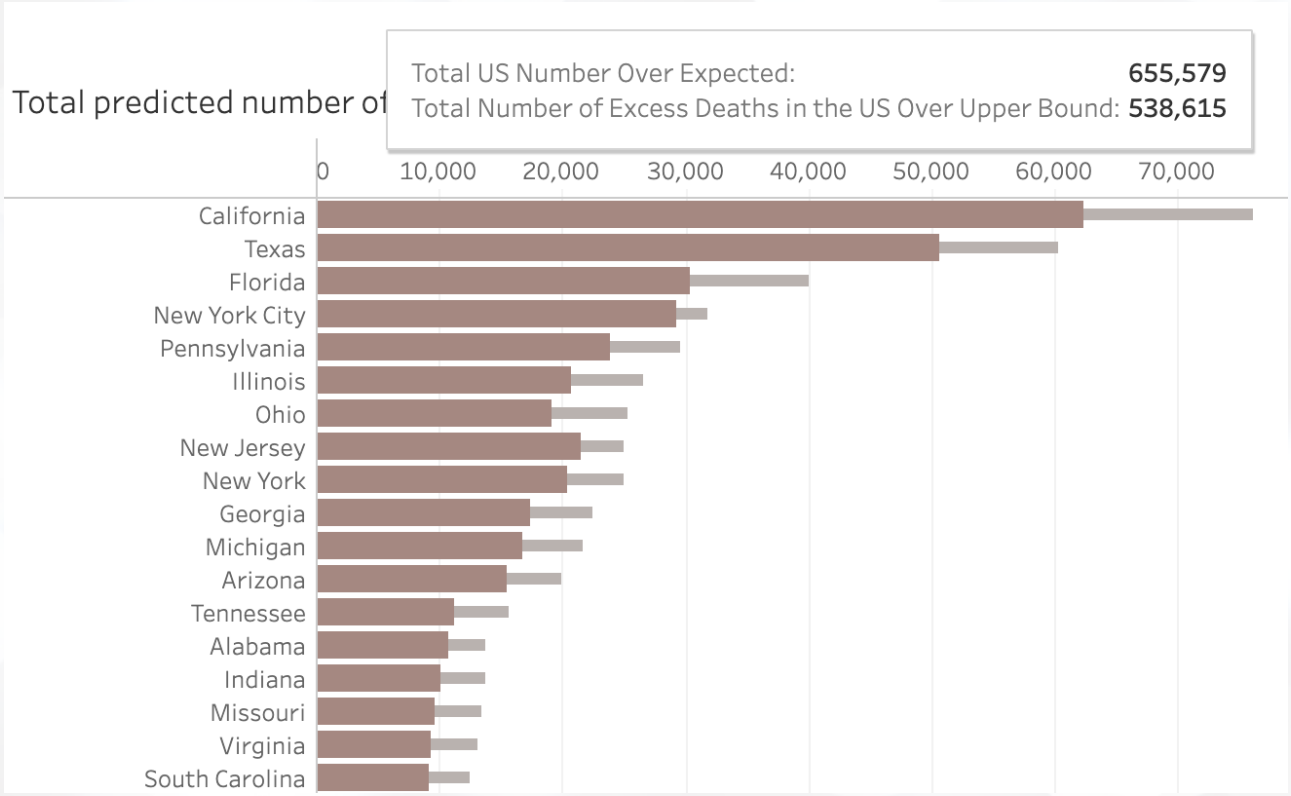
How Many Excess Deaths Have Occured?



% of Excess Deaths Not Assigned to Covid -19: 22% (05/30/2020)

Graph from: Weinberger DM, Chen J, Cohen T, et al. Estimation of Excess Deaths Associated With the COVID-19 Pandemic in the United States, March to May 2020. JAMA Intern Med. Published online July 01, 2020. doi:10.1001/jamainternmed.2020.3391

How Many Excess Deaths Have Occured?



NCHS Estimates as of 3/30/21: 538,615 to 655,579 excess deaths and 526,028 directly assigned Covid -19 deaths

% of Excess Deaths Not Assigned to Covid -19: 20%

Graph from: https://www.cdc.gov/nchs/nvss/vsrr/covid19/excess_deaths.htm

What Is Known About Inequities in Covid -19 Deaths?

Percentage of COVID-19 Deaths by Race & Hispanic Origin

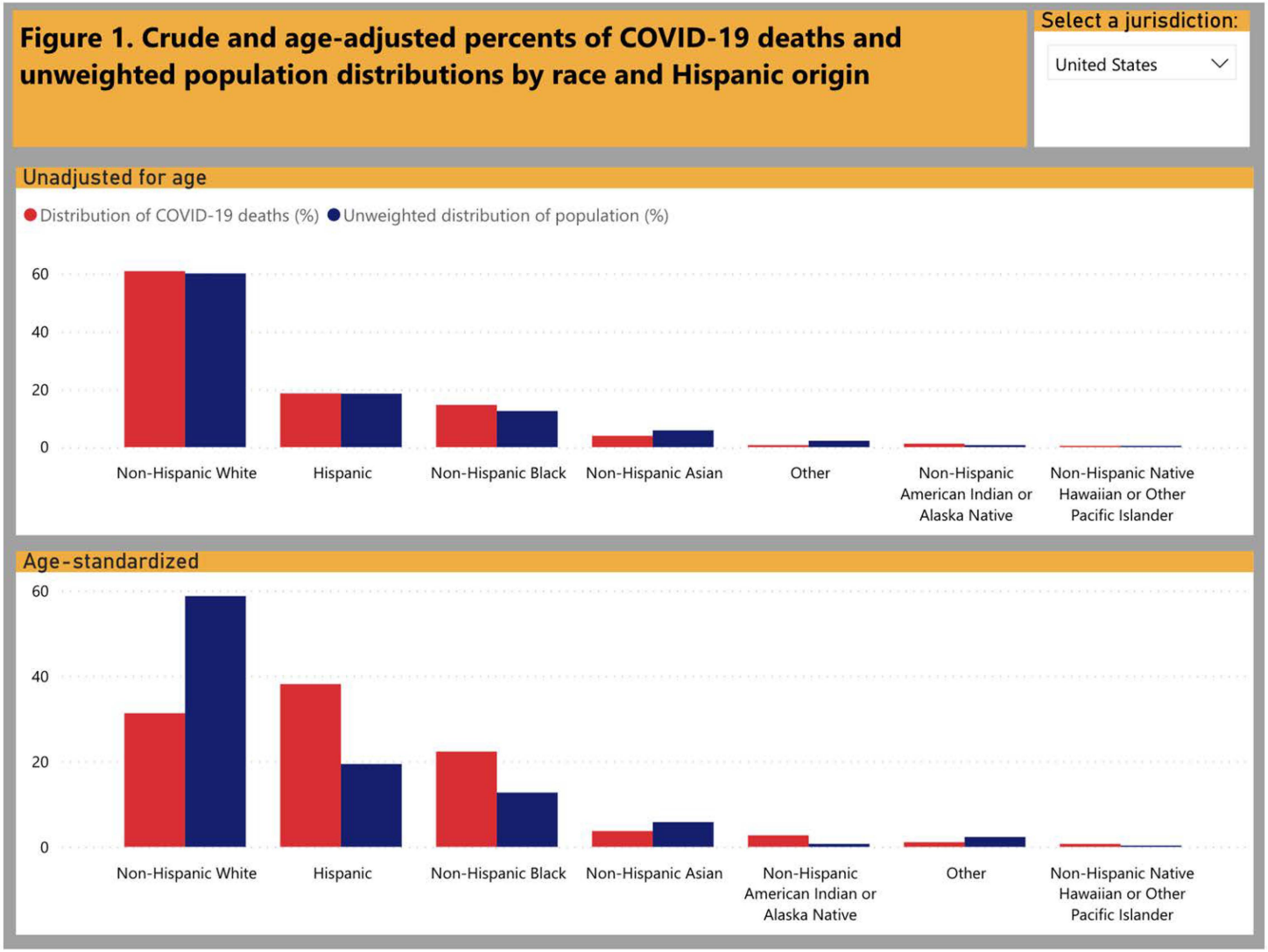
Data as of 3/24/2021

Non-Hispanic White	Hispanic	Non-Hispanic Black
61% (320,437 deaths)	19% (97,860 deaths)	15% (76,608 deaths)
Non-Hispanic Asian	**NH American Indian/Alaskan Native**	**NH Native Hawaiian/Pacific Islanders**
4% (20,402 deaths)	1% (6,060 deaths)	0.2% (950 deaths)

NOTE: This is the distribution of all COVID-19 deaths according to race and Hispanic origin. The non-Hispanic white population accounts for the majority of deaths overall which is reflected in this percentage distribution. When compared to their own race and Hispanic sub-population, COVID-19 deaths disproportionately affect Hispanic, non-Hispanic black, and non-Hispanic American Indian/Alaskan Native populations. Please see the Health Disparities page for more information.

Graph from: https://www.cdc.gov/nchs/covid19/mortality-overview.htm

What Is Known About Inequities in Covid -19 Deaths?



Graph from: https://www.cdc.gov/nchs/nvss/vsrr/covid19/health_disparities.htm

Covid-19 and Excess Mortality: A County-Level Analysis

Comment on this paper

Assessing the Impact of the Covid-19 Pandemic on US Mortality: A County-Level Analysis

Andrew C. Stokes, Dielle J. Lundberg, Irma T. Elo, Katherine Hempstead, Jacob Bor, Samuel H. Preston

doi: https://doi.org/10.1101/2020.08.31.20184036

This article is a preprint and has not been peer-reviewed [what does this mean?]. It reports new medical research that has yet to be evaluated and so should *not* be used to guide clinical practice.

Abstract | Full Text | Info/History | Metrics | Preview PDF

Abstract

Background Covid-19 excess deaths refer to increases in mortality over what would normally have been expected in the absence of the Covid-19 pandemic. Several prior studies have calculated excess deaths in the United States but were limited to the national or state level, precluding an examination of area-level variation in excess mortality and excess deaths not

Research Question

1. What are the total number of excess deaths associated with the Covid-19 pandemic to-date?
2. How does the percent of excess deaths not assigned to Covid-19 differ by county-level factors?

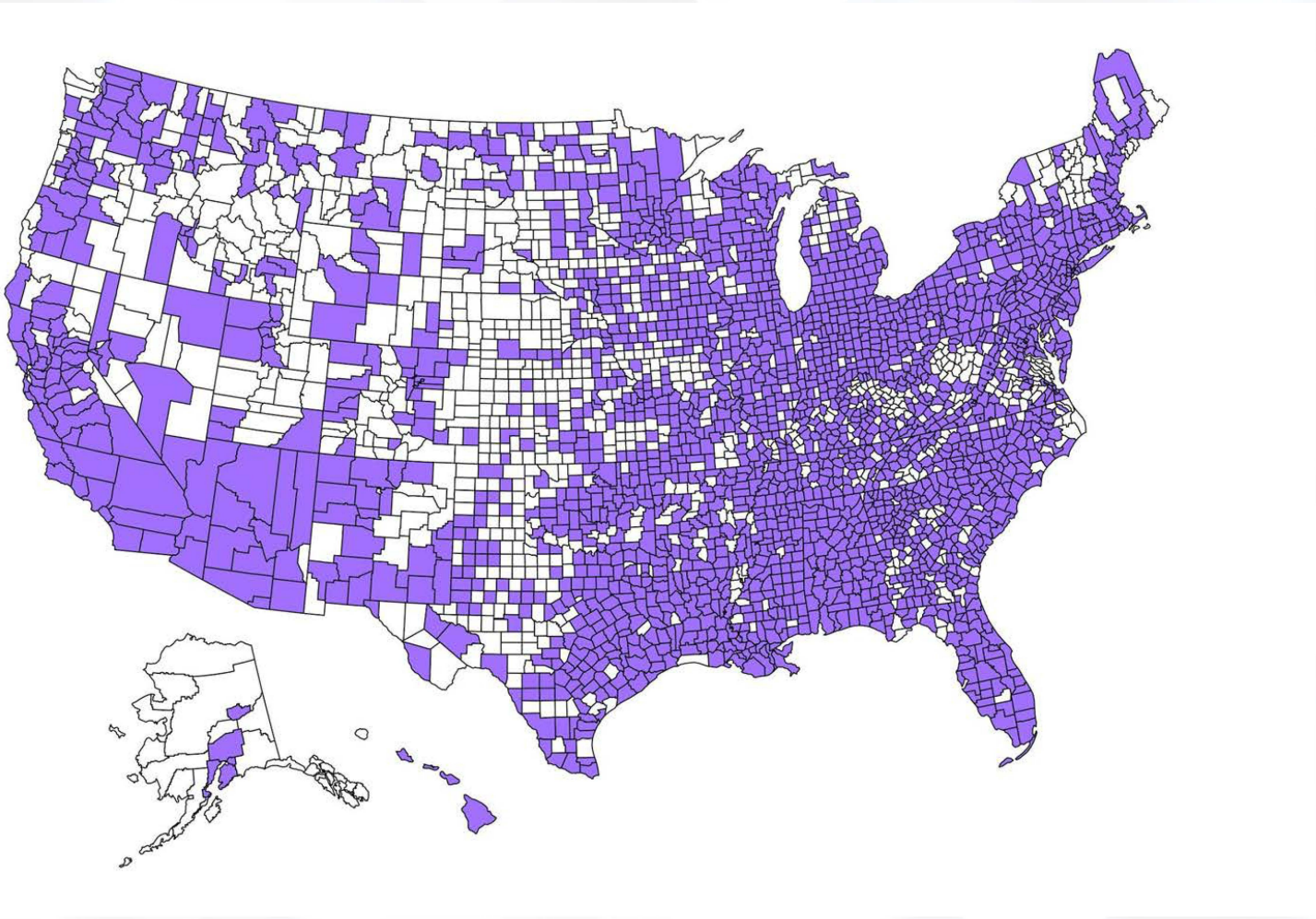
Methods

- We take advantage of spatial variation in Covid-19 mortality across US counties to estimate its relationship with all-cause mortality across all counties.
- We anticipate that counties with higher mortality from Covid-19 will also have experienced greater increases in mortality from other causes of death because the impact of the pandemic is not registered in Covid-19 deaths alone.
- We use the relationship between Covid-19 mortality and changing mortality from all causes of death to estimate excess mortality not directly assigned to Covid-19 as a cause of death.
- We then examine how the extent of excess mortality not assigned to Covid-19 varies across subsets of counties.

Methods

- NCHS provisional county-level data on all-cause mortality and direct Covid-19 deaths from January 1 to December 31, 2020 reported before March 12, 2021, limited to counties with 20 or more Covid-19 deaths
- Constructed a historical comparison period using CDC Wonder data from January to December 2013 through 2018
- Used county-level demographic and structural factors from the Robert Wood Johnson Foundation County Health Rankings
- Used U.S. Census population estimates for 2013-2018, 2020; weighted our models using the 2020 county population
- To identify counties where excess mortality was higher or lower than predicted in our model, we fully stratified our models and compared the upper and lower 25% of counties.

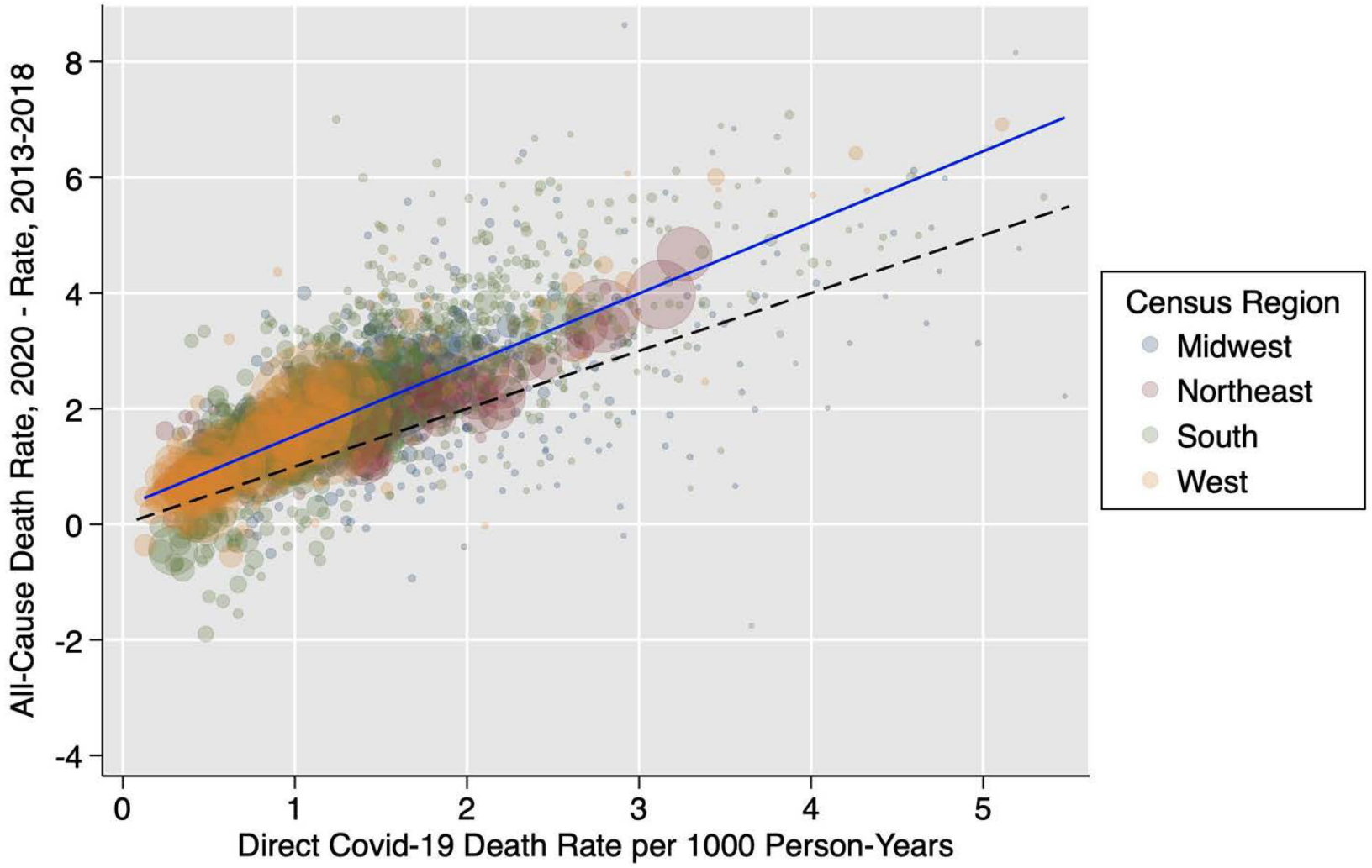
Findings



n=2,096 counties

(counties with 20 or more direct Covid-19 deaths in 2020 as of March 12, 2021)

Findings


All-Cause Death Rate, 2020 - Rate, 2013-2018
8
6
4
2
0
-2
-4
0
1
2
3
4
5
Direct Covid-19 Death Rate per 1000 Person-Years
Census Region
Midwest
Northeast
South
West

Findings

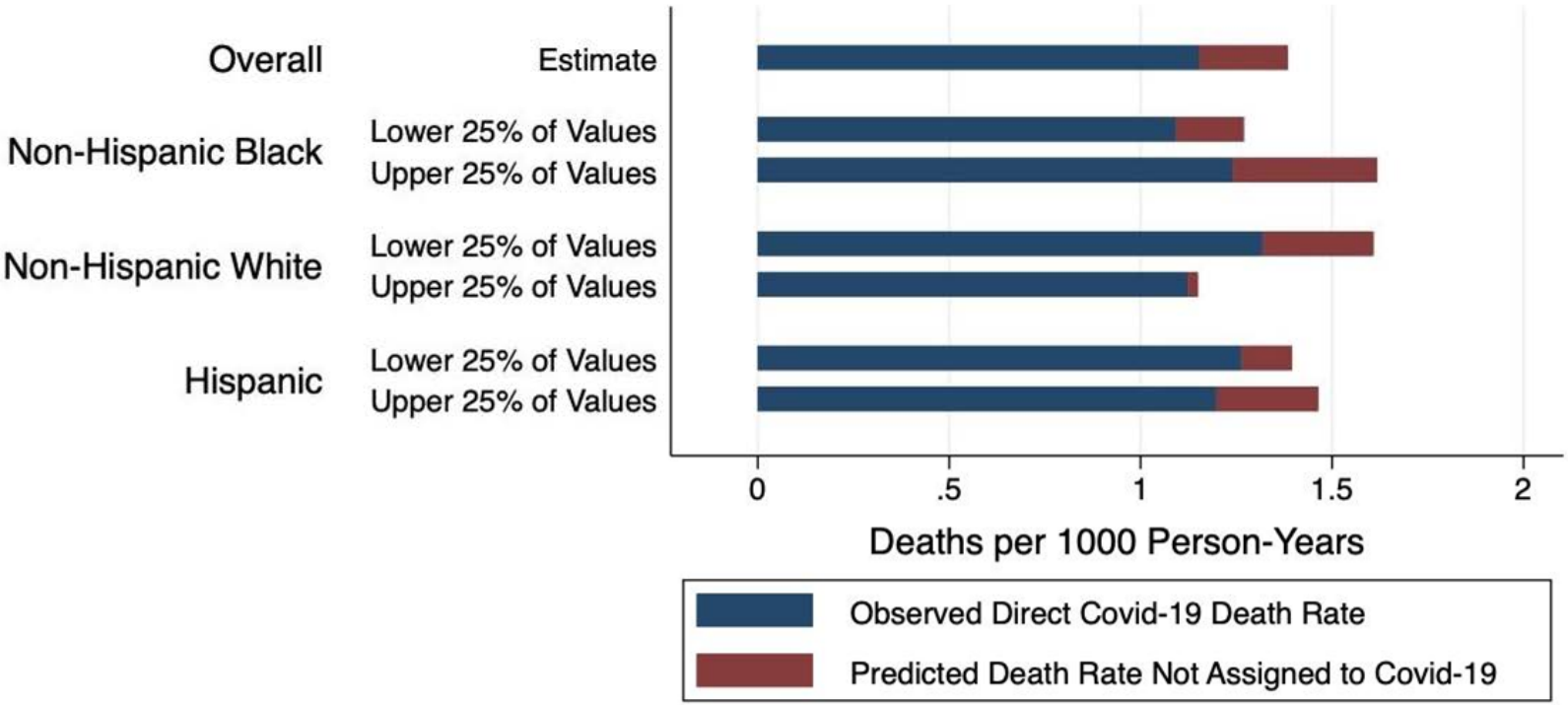
For every 100 deaths assigned to Covid-19, the number of all-cause deaths rose by 120 (95% CI, 116 to 124). 17% [95% CI, 14% to 19%] of all excess deaths were not directly assigned to Covid-19 on death certificates.

367,820	**+**	**74,172**	**=**	**441,992**
Directly Assigned Covid-19 Deaths		Excess Deaths Not Assigned to Covid-19 [95% CI, 60,162 to 88,183]		Total Excess Deaths [95% CI, 427,982 to 456,003]

Findings

The percent of excess deaths not assigned to Covid-19 is significantly higher in areas with more non-Hispanic Black residents and fewer non-Hispanic white residents.

Findings



Counties with more non-Hispanic Black residents, who were already at high risk of Covid-19 death based on direct counts, also reported higher rates of excess deaths not assigned to Covid-19.

Limitations

- Provisional all-cause and direct Covid-19 data for 2020
- The majority of counties in the study had fewer than 50 directly assigned Covid-19 deaths.
- We lacked disaggregated data on county-level mortality by age, sex, race/ethnicity, and sociodemographic and health characteristics.
- Lack of temporal and cause-specific detail at the county-level

Mechanisms that Could Explain Racial/Ethnic Inequities in the Reporting of Covid -19 Deaths

Potential Mechanisms

Potential Mechanism #1: Health Systems Factors

- In counties with more underreporting, differential access to testing and health care may make it less likely that residents receive a Covid-19 diagnosis before or after they die.

Potential Mechanisms

Potential Mechanism #2: Comorbidities

- The higher prevalence of comorbidities in these counties, due to racial inequities in health, may make accurate cause of death assignment less likely and lead to Covid-19 being overlooked as a contributing factor.

Potential Mechanisms

Potential Mechanism #3: Indirect Deaths

- More indirect deaths may have occurred in these counties due to social and economic consequences of the pandemic.

Potential Mechanisms

Potential Mechanism #4: Bias in Death Investigation Systems

- The death investigation system in the U.S. is irregular with some states relying on state medical examiner systems while some counties rely on county-based medical examiners, coroners, sheriff-coroners, or justices of the peace.
- Coroners in particular are often elected officials with little to no medical training.
- Interpersonal bias and political attitudes about the pandemic could influence whether Covid-19 is included on a death record or whether posthumous Covid-19 testing occurs.

Potential Mechanisms

Potential Mechanism #5: Home Deaths

- Areas that have more under-reporting of Covid-19 deaths could represent counties where a greater percentage of deaths are occuring at home.
- Dying at home could increase the likelihood that a death certifier (i.e. a coroner) would be involved in the death investigation process and decrease the likelihood that Covid-19 testing would occur.

Potential Mechanisms

- All of these factors represent pathways through which structural racism within health systems could affect the extent of underreporting of Covid-19 deaths.

Future Directions for Research

Future Directions

1. Investigate whether different types of death investigation systems are associated with more underreporting of Covid-19 deaths.
2. Investigate other factors associated with underreporting of Covid-19 deaths including the availability of Covid-19 testing.
3. Identify the causes of death that explain differences in excess mortality and underreporting across racial/ethnic groups.
4. Examine excess mortality and underreporting using individual-level mortality files.

Acknowledgments

- I am grateful to my co-authors: Samuel H. Preston, Irma T. Elo, Katherine Hempstead and Dielle J. Lundberg, and to other colleagues who provided generous feedback.
- Thank you to Farida Ahmad, Bob Anderson, and others at NCHS for their extensive input and support.
- I thank the Robert Wood Johnson Foundation for supporting this research.

Questions?

This research is in -progress and we would be grateful for your feedback:

Email: acstokes@bu.edu

Link to pre -print:
https://www.medrxiv.org/content/10.1101/2020.08.31.20184036v5

Technical Appendix

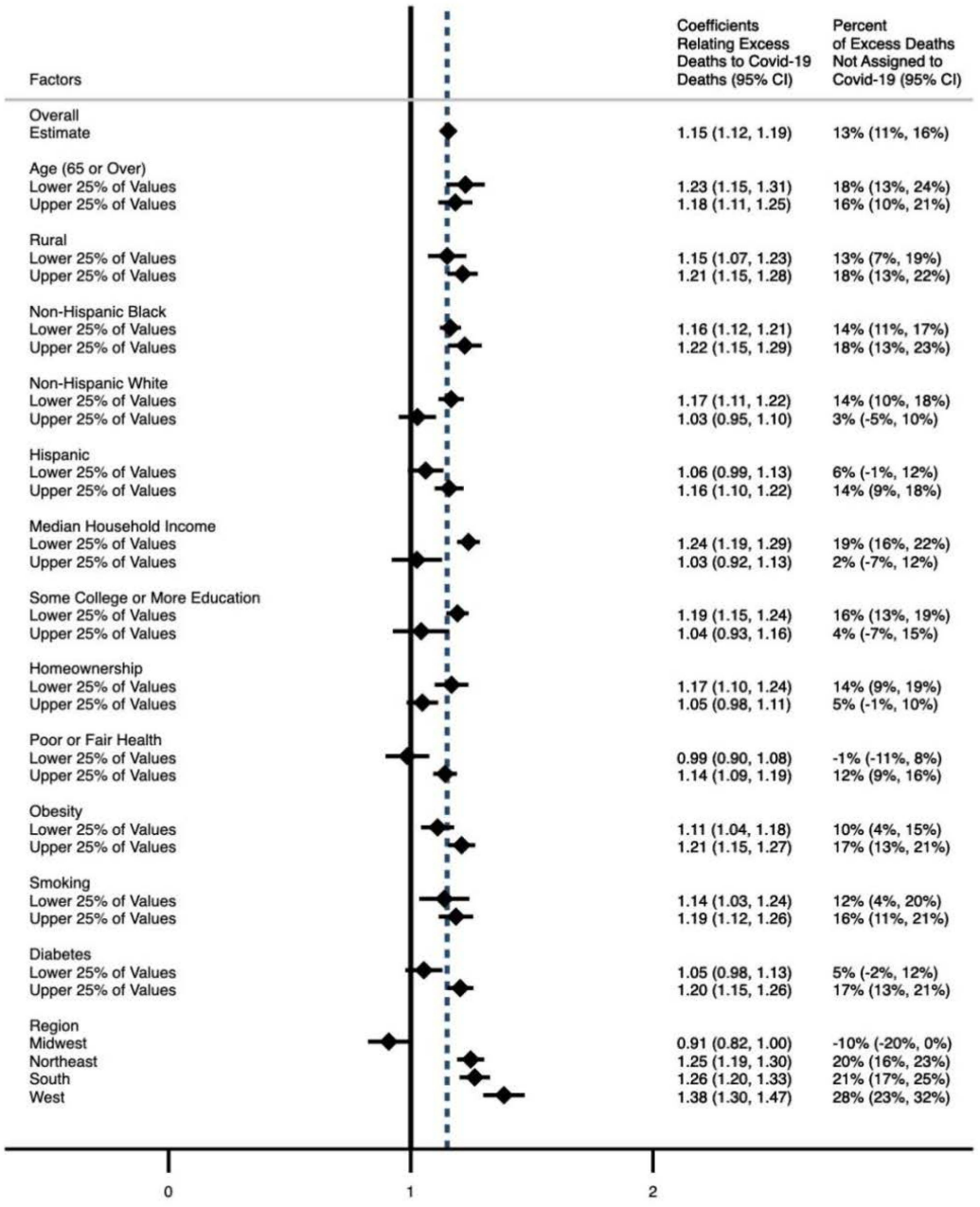
Table 2. Estimated Parameters of Linear Models of the Relationship Between Directly Assigned Covid-19 Deaths, Historical All-Cause Mortality and All-Cause Mortality in 2020[a,b]

	β_1	95% CI		β_2	95% CI		α	% Excess Deaths Not Attributed to Covid-19	95% CI	
Counties in the Sample (n=2,096)	1.03	1.02	1.04	1.20	1.16	1.24	0.105	17%	14%	19%
Included Counties with 10-19 Direct Covid-19 Deaths (n=2,612)	1.03	1.02	1.03	1.20	1.16	1.24	0.123	17%	14%	19%
Limited to Counties with 50+ Direct Covid-19 Deaths (n=1,187)	1.02	1.01	1.04	1.21	1.17	1.26	0.119	17%	14%	21%
Limited to Counties with 50,000+ Residents (n=976)	1.02	1.00	1.03	1.21	1.16	1.26	0.155	18%	14%	21%

a. $M(i) = \alpha + \beta_1 M^*(i) + \beta_2 C(i)$, where $M(i)$ = Death rate from all causes in county i in 2020, $M^*(i)$ = Death rate from all causes, county i in 2013-2018, and $C(i)$ = Covid-19 death rate in county i in 2020.

b. Estimated county population in 2020 used for weighting.

S3 Fig. Relationship Between Indirectly Age Standardized All-Cause Mortality and Direct Covid-19 Mortality across Strata of Sociodemographic and Health Factors[a,b,c]



S4 Table. Boundaries for Sociodemographic and Health Characteristic Quartiles[a]

Characteristics	Lower 25% Quartile		Upper 25% Quartile	
	Lowest Value	Highest Value	Lowest Value	Highest Value
% 65 or Older	7.4%	13.6%	17.6%	57.6%
% Rural	0%	1.3%	24.3%	100%
% Hispanic	0.6%	5.7%	26.0%	96.4%
% Non-Hispanic Black	0.1%	3.6%	18.6%	85.4%
% Non-Hispanic White	2.7%	42.1%	77.9%	97.9%
Median Household Income	25,385	52,577	74,686	140,382
% with Some College or Higher	20.4%	60.3%	71.8%	90.3%
% Homeownership	19.6%	56.9%	71.0%	89.8%
% Living with Poor or Fair Health	8.1%	14.0%	18.9%	41.0%
% with Obesity	14.4%	24.9%	32.8%	51.0%
% who Smoke	5.9%	12.6%	17.6%	41.5%
% with Diabetes	2.9%	8.4%	11.5%	34.1%

a. Quartiles are weighted by the estimated 2020 population.