Supplemental Online Content

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EXCESS DEATHS FROM COVID-19 AND OTHER CAUSES IN THE US, MARCH 1, 2020 TO JANUARY 2, 2021

Causes of death: Causes of death examined in this study were limited to those for which provisional death data were available during 2020 and the first weeks of the novel coronavirus disease 2019 (COVID-19). The Centers for Disease Control and Prevention provided data for 12 grouped causes (eTable).[1,2] Deaths from external causes were calculated as total all-cause deaths minus deaths from natural causes.

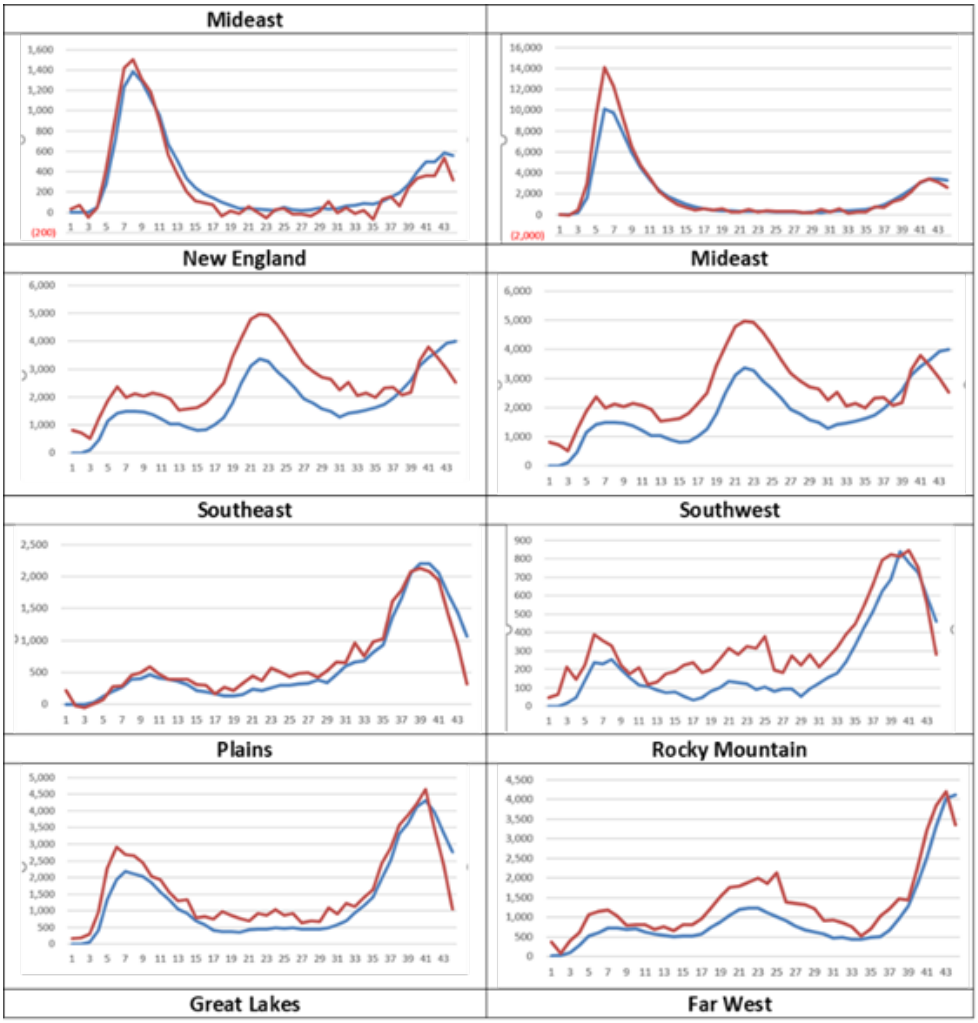
eTable. Grouped cause data reported by the Centers for Disease Control and Prevention	
Causes of death	**Definitions**
Natural causes[3]	Deaths from medical causes, not resulting from external causes (e.g., accident, suicide, homicide) or from causes pending or not determined
External causes	Deaths from accidents, suicide, homicide, and causes pending or not determined
	***International Classification of Disease 10* (ICD-10) codes**
Septicemia	A40-A41
Malignant neoplasms	C00-C97
Diabetes mellitus*	E10-E14
Alzheimer's disease*	G30
Diseases of the heart*	I00-I09,I11,I13,I20-I51
Cerebrovascular diseases*	I60-I69
Influenza and pneumonia	J10-J18
Chronic lower respiratory diseases	J40-J47
Other diseases of the respiratory system	J00-J06,J30-J39,J67,J70-J98
Nephritis, nephrotic syndrome, and nephrosis	N00-N07,N17-N19,N25-N27
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	R00-R99
COVID-19*	U07.1
* Results reported in Research Letter. Results for all 14 grouped causes available upon request.	

Modeling: A hierarchical Poisson regression model was fitted to weekly death data from January 2014 through February 2020. All model terms (intercept and slopes) were fit hierarchically, with an overall fixed effect for each parameter and a random effect that allowed each parameter to vary by state. The Bayesian Information Criterion (BIC) was compared for 30 alternative sets of covariates that adjusted for time using calendar year (January-December), epidemiological year (July-June), or a linear trend and compared different combinations of harmonics with varying periodicities (4, 6, 12, and 24 months). Modeling testing was performed on the data extract from February 3, 2021. The 5 models with the lowest BIC produced excess death estimates ranging from 481,876 to 503,536. The best-fitting model (lowest BIC) for that data extract used calendar year and periods of 6, 12, and 24 months and estimated 487,225 excess deaths. The second best-fitting model (second lowest BIC, using calendar year and periods of 12 and 24 months) produced a very similar estimate, 486,942 excess deaths—a difference of 283 deaths, or 0.06%. The same approach was used to estimate weekly death data by race and ethnicity, only that state was replaced with a race and ethnicity indicator. Based on a data extract from January 21, 2021 that provided race and ethnicity data, the best fitting model (lowest BIC) for modeling excess deaths by race-ethnicity included calendar year and periods of 12 and 24 months. Data were obtained for the Hispanic and non-Hispanic American Indian or Alaska Native, Asian, Black, White, and other populations. Due to concerns about the accuracy of vital statistics in the American Indian and Alaskan Native and Asian populations, results are reported only for Hispanic and non-Hispanic Black and White populations. Further details are available on request.

Analysis of regional patterns

State data were grouped by the 8 regions established by the U.S. Bureau of Economic Analysis.[4]

- **Far West**: Alaska, California, Hawaii, Nevada, Oregon, and Washington
- **Great Lakes**: Illinois, Indiana, Michigan, Ohio, and Wisconsin
- **Mideast**: Delaware, District of Columbia, Maryland, New Jersey, New York, and Pennsylvania
- **New England**: Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont
- **Plains**: Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota
- **Rocky Mountain**: Colorado, Idaho, Montana, Utah, and Wyoming
- **Southeast**: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, South Carolina, Tennessee, Virginia, and West Virginia
- **Southwest**: Arizona, New Mexico, Oklahoma, and Texas



In an exercise conducted on February 11, 2021, the authors examined the surge patterns for each of the 8 regions. They concluded independently that epidemic patterns were similar in New England and Mideast; Southeast and Southwest; and Plains, Rocky Mountain, and Far West states and that they could be merged to simplify presentation in the published paper. A bimodal pattern in Great Lakes states was considered distinctive and plotted separately.

eReferences

1. Weekly counts of deaths by state and select causes, 2014-2019. National Center for Health Statistics website. Updated January 21, 2021. Accessed January 22, 2021. https://data.cdc.gov/NCHS/Weekly-Counts-of-Deaths-by-State-and-Select-Causes/3yf8-kanr.

2. Weekly counts of deaths by state and select causes, 2020-2021. National Center for Health Statistics website. Updated February 17, 2021. Accessed February 18, 2021. https://data.cdc.gov/NCHS/Weekly-Counts-of-Deaths-by-State-and-Select-Causes/muzy-jte6

3. National Center for Health Statistics. Physicians' Handbook on Medical Certification of Death. Publication No. (PHS) 2003-1108. Washington, DC: US Department of Health and Human Services, 2003.

4. Real personal income for states, 2014. Bureau of Economic Analysis, U.S. Department of Commerce. Updated February 22, 2018. Accessed February 19, 2021 at https://www.bea.gov/news/blog/2016-07-07/real-personal-income-states-2014