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of surveyed scientists admitted that they could not replicate someone else's research.¹

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admitted that they couldn't replicate their own research.¹



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¹) Baker, Monya. "1,500 scientists lift the lid on reproducibility." Nature, no. 533 (May 26, 2016): 452-54. doi:10.1038/533452a.

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Christian Garcia ORCID iD: 0000-0001-9010-2614

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Covid-19 mortality needs age adjusting for international comparisons

Authors

Christian Garcia-Calavaro¹; Angel Paternina-Caicedo²; Adrian D. Smith³; Lee H. Harrison⁴; Fernando De la Hoz-Restrepo⁵; Enrique Acosta⁶; Tim Riffe⁶.

Affiliations

1. Universidad de Santiago, Santiago, Chile.
2. Universidad del Sinú, Cartagena, Colombia.
3. Nuffield Department of Population Health, University of Oxford, United Kingdom
4. Center for Genomic Epidemiology, University of Pittsburgh, Pittsburgh, United States.
5. Universidad Nacional de Colombia, Bogotá, Colombia.
6. Max Planck Institute for Demographic Research, Rostock, Germany.

Corresponding author: Christian Garcia-Calavaro, MD DrPH. Universidad de Santiago, Santiago, Chile. **Address:** Av. Libertador Bernardo O'Higgins 3363, Estación Central, Santiago, Chile. **Phone:** (+56)2-27153502. **Email:** christian.garcia.c@usach.cl.

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Covid-19 had caused a reported 1,423,988 deaths worldwide by November 26th, 2020¹. The impact of non-pharmacological interventions worldwide has been difficult to measure because testing capabilities, demographics, comorbidities, health infrastructure, and response differ across countries and territories. Crude death rates have been used to compare the response of each country to Covid-19²; however, this measure does not account for age, which is a strong predictor of mortality in Covid-19, with some studies showing a risk of death 120 times higher in the population older than 65 years³⁻⁵. Population age-structure varies widely between countries, with the percentage of the population ≥ 65 years old increasing with income⁶, while 18% of people in high-income countries are ≥ 65 years, in low-income countries this percentage is 3%⁶. Therefore, crude rates do not allow appropriate comparisons of mortality among countries with different age-structures. We compare mortality between 51 countries, as well as 50 states in the US and the District of Columbia that adopted different control strategies. We use data on

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deaths by 10-year age groups from COVerAGE-DB⁷, published and updated daily, population data from the United Nations, and the World Health Organization standard population for direct standardization by age^{8,9}. In addition, we report rates at similar timeframes (~100 days from the 50th confirmed case) to provide meaningful comparisons of community transmission.

In the US, the age-adjusted mortality rate at ~ 100 days is 16 times greater in the US state with the largest mortality (New Jersey), compared to the states with the lowest age-adjusted mortality rate (Alaska) (Figure and Supplementary Material Table 1). These patterns were present in different world countries, the age-adjusted mortality rate in Uruguay was 0.5, while in Peru was 47.6 at ~ 100 days of Covid-19 transmission (95 times higher). Countries in Europe (UK, Belgium, Ukraine, and Spain), Latin America (Ecuador, Peru, Mexico, Brazil, and Chile), Israel, and the United States, resulted in the highest age-adjusted mortality rates worldwide during the first 100 days of transmission (Figure and Supplementary Material Table 2). These data suggest that the measures to curb the transmission of the SARS-CoV-2 pandemic during the first 100 days might be a factor for the different mortality rates across regions and countries worldwide.

Our report has several limitations. The data were collected by an ongoing online effort to estimate age-specific mortality in 5- and 10-year age groups (lead by the Max Planck Institute for Demographic Research)⁷, depending on openly available government sources. Case and death definitions may vary between countries, with different testing capacities. Age is not the only factor related to Covid-19 severity¹⁰. Finally, the improvement of clinical management may reduce mortality risk over time. Further analyses could include comorbidities in the adjustment methods to compare countries.

In conclusion, age-adjustments are needed to compare mortality between populations with different risks and age-structures. Even though countries may use different reporting systems or have systems in different stages of development, countries and territories should follow the International Classification of Disease Standards for mortality classification and report to the World Health Organization, using standard age groups. International efforts should be directed to strengthen mortality surveillance and help overcome the lack of human resources and data digitization and evaluation, especially in developing countries. A stronger subnational and national mortality surveillance system could foster a supranational data curation and reporting effort to improve transparency and more robust assessment of country- and local-specific responses to the pandemic.

Conflict of interest statement: No author declares any conflict of interest.

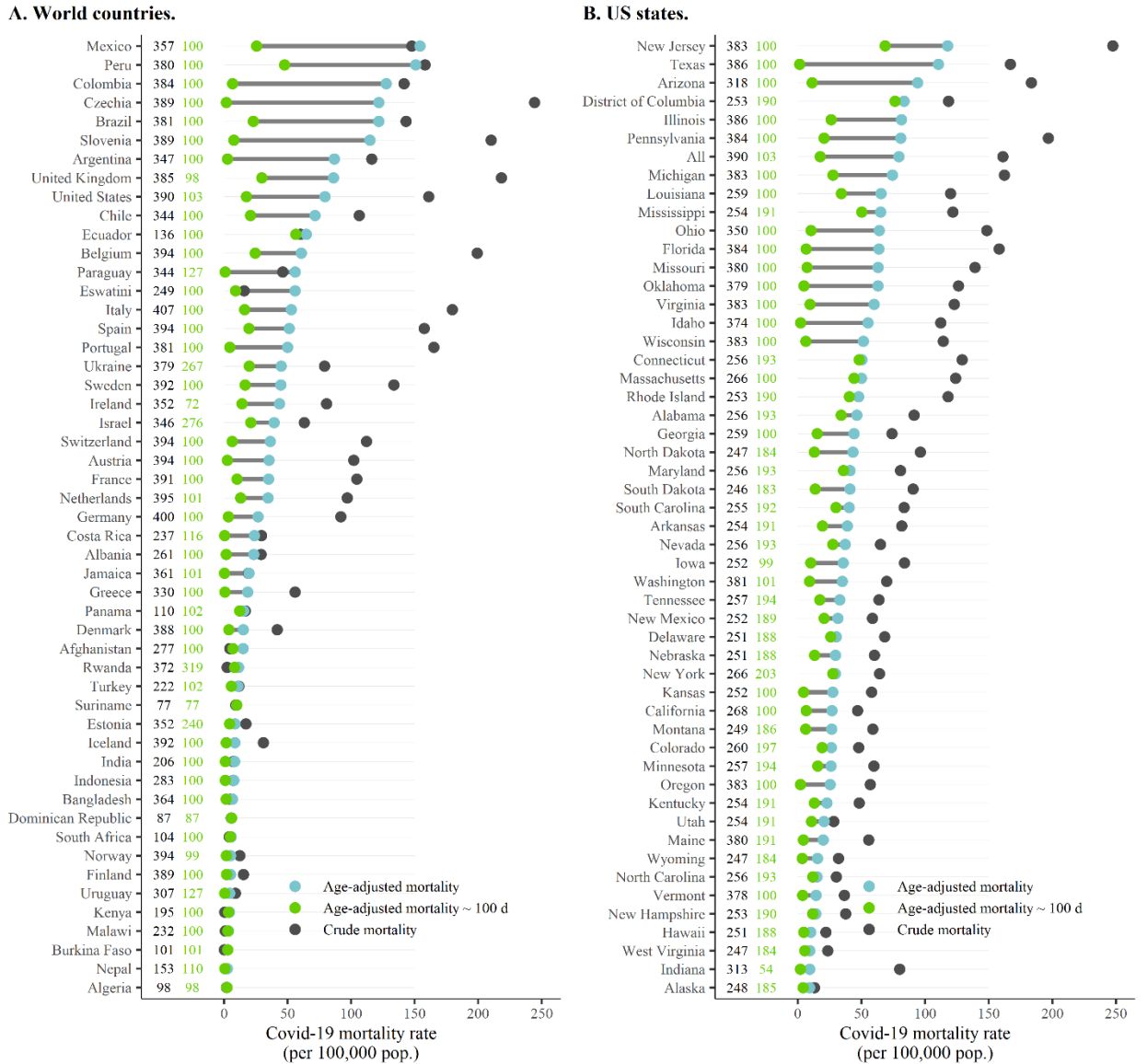
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Data availability statement: Data are openly available under the license CC-BY Attribution 4.0 International, in an OSF data repository (<https://osf.io/mpwjq/>). All data and code is available upon reasonable request to the authors EA and TR.

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Figure. Covid-19 crude, age-adjusted, and age-adjusted ~ 100 days mortality rates in 51 countries, 50 U.S. states, and the District of Columbia, by November 23, 2020



Both panels: Black Numbers in the left column represent the days between the 50th confirmed case and the last date with data for cumulative crude and age-adjusted death rate calculation. Green numbers in the right column represent the closest days to 100 days with reported data since the 50th confirmed case for age-adjusted ~100 days death rate. Panel B. Crude rates for Illinois is 525.2 (not shown).