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Kem C. Gardner
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Is Utah's Relatively Low COVID-19 Death Rate Due to its Younger Population?

Mike Hollingshaus, Senior Demographer, Kem C. Gardner Policy Institute

COVID-19 has upended our society. Health care professionals, public health researchers, first responders, and infectious disease specialists have made sacrifices and put in countless hours to keep us safe. How can demographers contribute to the effort?

Demographic analysis can clarify how population characteristics such as age structure (the percentage of people in each age group) affect death rates. Utah is reported to have one of the nation's lowest per-capita COVID-19 death rates, but it also has the youngest median age (31.3 years compared to the U.S. average of 38.4). Since the disease is deadlier for older adults,[1] one would expect Utah's rate to be lower simply because its population is younger.[2] Demographic techniques can clarify whether and how Utah's young age structure affects the COVID-19 death rates.

The per-capita rate is also called the cause-specific (COVID-19) crude death rate—crude because it is not adjusted for important demographic characteristics such as the age structure. It simply divides the total COVID-19 deaths by the total population. Unpacking that rate for different age groups reveals important demographic stories concealed within the data. It also lets us compare apples-to-apples, not apples-to-oranges.

Three Questions

This analysis answers three questions, providing a fuller context for making informed decisions.

1. What would Utah's COVID-19 death rate be if its population had the same age structure as the U.S. population?
2. What would the U.S. rate be if its age structure were identical to Utah's?
3. How much of Utah's lower rate is actually just due to having a younger population?

Table 1: Per-capita Crude and Age-adjusted COVID-19 Death Rates (per 100,000), U.S. and Utah, as of July 14, 2020

	Region		
Metric	**U.S.**	**Utah**	**Difference**
Crude Death Rate	41.3	7.0	34.3
Death Rate using U.S. Age Structure	41.3	10.1	31.2
Death Rate using Utah Age Structure	28.3	7.0	21.3

Note: Age Structure (also called the age distribution) is the percentage of the population in each age group.
Sources: National Center for Health Statistics, U.S. Census Bureau, Kem C. Gardner Policy Institute.

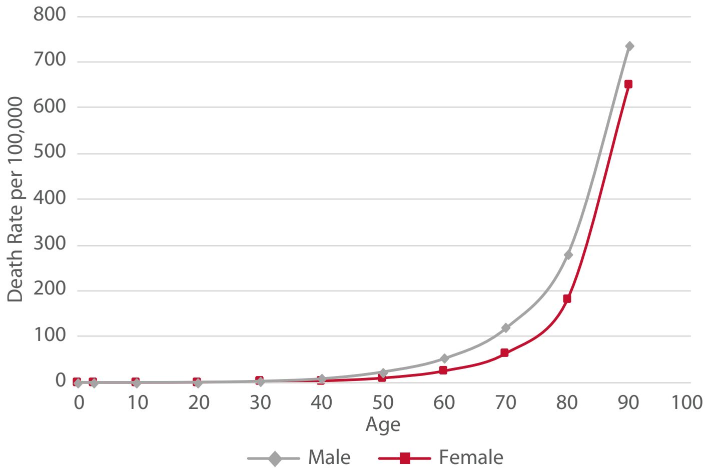
Three Answers

As of July 14, 2020, the CDC COVID Data Tracker reported the Utah and U.S. per-capita death rates as 7.0 and 41.3 per 100,000, a difference of 34.3.[3]

1. If Utah had the same age structure as the U.S., its death rate would rise by nearly 50% to 10.1 per 100,000.
2. Conversely, if the U.S.'s age structure were similar to Utah's, its death rate would drop by nearly one-third to 28.3 per 100,000, and deaths would have numbered under 100,000 instead of over 130,000 as of July 14.
3. About one-quarter of the Utah's death rate advantage is attributable to its younger population. The majority (three-fourths) is due to other factors.

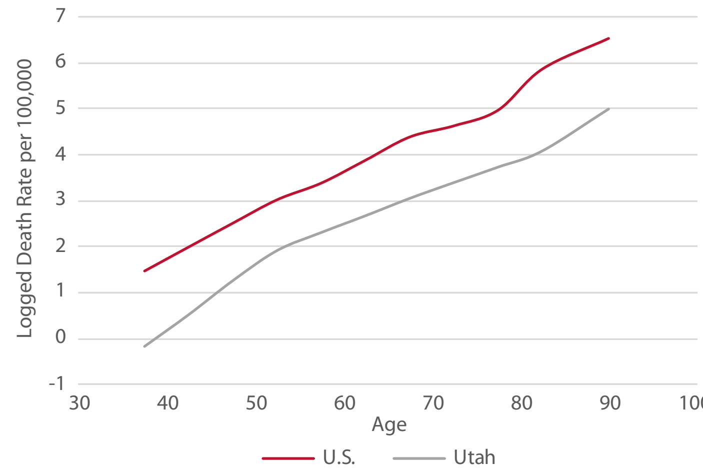
Based upon these findings, an improved comparison would be contrasting the U.S. per-capita death rate of 41.3 with Utah's adjusted death rate of 10.1, or the U.S. adjusted 28.3 with Utah's 7.0. This compares either apples-to-apples or oranges-to-oranges. These same findings also suggest other important variables should be considered, including additional demographic, socioeconomic, and environmental characteristics when comparing states. In many ways, this analysis is more exploratory than definitive, since the provisional data are still so fresh. But, it provides an alternative outlook on the data. This different way of thinking changes how policymakers view per-capita rates and recommends a nuanced approach to the decision-making process.

Figure 1: U.S. Provisional COVID-19 Death Rates by Sex for 11 Age Groups, as of July 14, 2020



Sources: National Center for Health Statistics, U.S. Census Bureau, Kem C. Gardner Policy Institute.

Figure 2: U.S. and Utah Provisional Logged COVID-19 Death Rates by Age, Ages 35-90, as of July 14, 2020



Sources: National Center for Health Statistics, U.S. Census Bureau, Kem C. Gardner Policy Institute.

Utah and U.S. COVID-19 Death Rates by Age

COVID-19 has been especially lethal to the elderly. Figure 1 plots provisional U.S. death rates for 11 age groups (under 1, 1-4, 5-14, 15-24, 25-34, 35-44, 45-54, 55-64, 65-74, and 85 and older). Interested readers can find more detail on data and methods near the end.

The rates appear to increase exponentially with age, as is common for death rates.[4] A good analogy is compound interest on a savings account, except the compounding happens over age instead of time—in fact, the math is same. There is an initial deposit (in this case, the underlying COVID-19 death risk) which is recorded at age 0, and that risk constantly compounds as a person grows older. In this particular dataset, less than one-in-a-thousand COVID-19 decedents were under age 25. Rates are also higher for males than females, as is common for death rates from most causes.

Figure 2 displays the age-specific death rates (on a logged scale) for both Utah and the U.S. after data modeling and smoothing. Data are restricted to ages 35 and older where the death risk is high enough to exert substantial leverage over the per-capita rates. The most important thing this graph shows is that the line for Utah is lower than the U.S. for all age groups. Returning to our investment analogy, it appears that both Utah and the U.S. have roughly the same rate of increase over age, but the initial deposit (or risk of death) is lower in Utah using this dataset.

Age Scenarios

What if Utah's Age Structure Were Identical to the U.S.'s?

To answer this question, assume Utah had the same percentage of people in each age group as the U.S. It implies that, among other things, Utah would have the same median age as the U.S. at 38.4 instead of 31.3. In this hypothetical situation, the overall death rate increases to 10.1 from 7.0 per 100,000, an increase of 3.1 which equates to a 44% increase. This would produce 317 Utah deaths compared to the CDC's published 220 as of July 14. For a simpler interpretation, Utah's per-capita death rate would increase by almost 50% if its population shared the same age structure as the U.S.

What if the U.S.'s Age Structure Were Identical to Utah's?

Imagine the U.S.'s median age suddenly dropped by 7.1 years to Utah's value of 31.3. Under this scenario, the U.S. per-capita COVID-19 death rate falls to 28.3 from 41.3 per 100,000, a decrease of 13.0, or 31%. This would produce 92,667 U.S. deaths compared to the CDC's published 135,235 as of July 14. For a simpler interpretation, the U.S. per-capita death rate would fall by nearly one-third if its people were the same age as in Utah, and the death toll would still number under 100,000.

But, this is not the case. The age structures are what they are. Pretending otherwise is only productive as a thought experiment to help explain why per-capita rates differ.

Decomposing the Difference

The per-capita rates are composed of the respective populations' age-specific rates and age distributions. To understand how each contributes to the difference, just decompose it—separate it into two parts: (1) the part explained by different age structures, and (2) the part explained by different age-specific rates.

How much of Utah's 34.3 per 100,000 advantage is due to the difference in the age distributions? Decomposition calculations (using the Kitagawa method) yield an answer of 8.0, or about 23% of the total difference. The remaining 26.3 per 100,000, or 77%, is due to differences in the age-specific rates. In simpler terms, about a quarter of Utah's per-capita COVID-19 death rate advantage over the U.S. is due to its younger population. Of course, this all depends upon the accuracy of the data and modeling assumptions.

What Explains Most of the Difference?

These results suggest that most of Utah's lower per-capita COVID-19 death rate (about three-fourths of it) can be attributed to factors other than age structure. Returning to Figure 2, Utah's age-specific rates appear to be lower than the U.S. rates across adult ages. What factors account for this lower line?

Measurement error is an obvious candidate. State differences in timely and accurate recording and reporting will affect any comparisons. These differences alone advise a cautious approach to interstate rankings until more complete and clean data become available. There are also possible errors in modeling assumptions. More time and data are required to adequately sift through all these issues.

A second potential explanation is better prevention, response, or treatment. This includes public policies and leadership that reduce disease transmission; health care treatment and resources; and how well individuals, communities, businesses, and governments adhere to and promote best practices. This interpretation is often preferred by states that perform well in the rankings. And it very well could end up accounting for much of Utah's lower death rate. However, other relevant demographic factors deserve consideration. Health disparities are rampant across demographic subpopulations. For example, racial/ethnic minorities have worse health outcomes for many illnesses including COVID-19.[5] These systematic inequalities are closely related to different socioeconomic and health care opportunities that persist across state lines. That being the case, what might on the surface appear to be better prevention and treatment in the state rankings could possibly be attributable to yet another structural sociodemographic characteristic—the distribution of inequality. It is also possible Utahns have healthier lifestyles and stronger social networks that make them more resilient and adaptive. More data and analysis could clarify how much these other sociodemographic characteristics affect the rates.

Finally, these numbers are continually growing, and if we're not careful Utah could teeter on the cusp of a death wave that eventually rivals or even surpasses the patterns seen for the U.S. Our state often fares better on metrics such as employment and volunteerism in part because Utah's leaders and residents work to make those metrics thrive. In this public health crisis, our outcomes will largely depend upon how wisely Utahns respond to the guidance of experts who have training and experience in handling epidemics. The ability to effectively trace, quarantine, and implement other proven public health measures will help Utah effectively weather the storm.

Data and Methods

I used the following data for Utah and the U.S.

Per-capita COVID-19 Death Rates and Total Death Counts.

These came from the CDC COVID Data Tracker already referenced, dated July 14, 2020.

The Age Distribution of COVID-19 Deaths.

The raw data were from the CDC for 11 age groups (under 1, 1-4, 5-14, 15-24, 25-34, 35-44, 45-54, 55-64, 65-74, and 85 and older).[6] Data were smoothed to five-year age categories, and suppressed values were imputed for Utah, using the penalized composite link model published by Rizzi et al., 2015, as implemented in the R package "ungroup."[7] The data covered the period Feb. 1 – Jun. 27, though completeness differs by state.

The Age Distribution of Population.

U.S. population data were from the U.S. Census Bureau 2019 vintage estimates,[8] and Utah data from the Kem C. Gardner Policy Institute vintage 2019 estimates.[9] Population estimates are dated for July 1, 2019.

When combined with the crude rates, the age distributions of deaths and population are sufficient to reconstruct age-specific rates. If *CDR* denotes the crude death rate, M_i the death rate for age-group *i*, f_i the age distribution of deaths, and C_i the age distribution of population, then $M_i = f_i / C_i * CDR$. I then implemented direct age-standardization and decomposition with the formulas that appear in Preston et al., 2001, on pages 24 and 28, respectively.[10] This decomposition method is often originally attributed to Kitagawa.[11]

Conclusion

Utah's per-capita COVID-19 death rate is considerably lower than the U.S. rate. With the limited data available, about one-fourth of that difference can be attributed to Utah having a younger population. Other socioeconomic, environmental, and demographic characteristics likely play a role in explaining some of the remaining differences. Utah could also have a lower per-capita rate due to better prevention, response, and treatment; but that conclusion is not justified until these other factors have been accounted for in statistical models.

As Utah progresses through this pandemic, having a low death rate is clearly only one (albeit incredibly important) measure of a successful response. Our experts with experience curtailing epidemics can consider all the indicators holistically to focus resources. The Gardner Institute will continue monitoring population metrics as appropriate. In the meantime, Utahns should proceed with caution and remember that demographics matter. In this case, they matter for wisely interpreting and acting upon population-level metrics such as the per-capita COVID-19 death rate.

Endnotes

1. Centers for Disease Control and Prevention. (2020). COVID-19 in Older Adults. National Center for Health Statistics. Retrieved from https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/older-adults.html on July 23, 2020.
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3. Centers for Disease Control and Prevention. (2020). CDC COVID Data Tracker: United States COVID-19 Cases and Deaths by State. National Center for Health Statistics. Retrieved from https://www.cdc.gov/covid-data-tracker/index.html#cases on July 15, 2020.
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5. Centers for Disease Control and Prevention. (2020). COVID-19 in Racial and Ethnic Minority Groups. National Center for Health Statistics. Retrieved from https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/racial-ethnic-minorities.html on July 16, 2020.
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9. Kem C. Gardner Policy Institute. (2020). Fact Sheet: Utah State and County Annual Population Estimates by Single Year of Age and Sex: 2010-2019. University of Utah: Salt Lake City. Retrieved from https://gardner.utah.edu/wp-content/uploads/UtahStatePopEst-2020.pdf on July 14, 2020.
10. Preston, S.H., Heuveline, P., & Guillot, M. (2001). *Measuring and Modeling Population Processes.* Blackwell Publishers: Malden, MA.
11. Kitagawa, E.M. (1955). Components of a Difference between Two Rates. *Journal of the American Statistical Association*, 50(272): 1168-1194.