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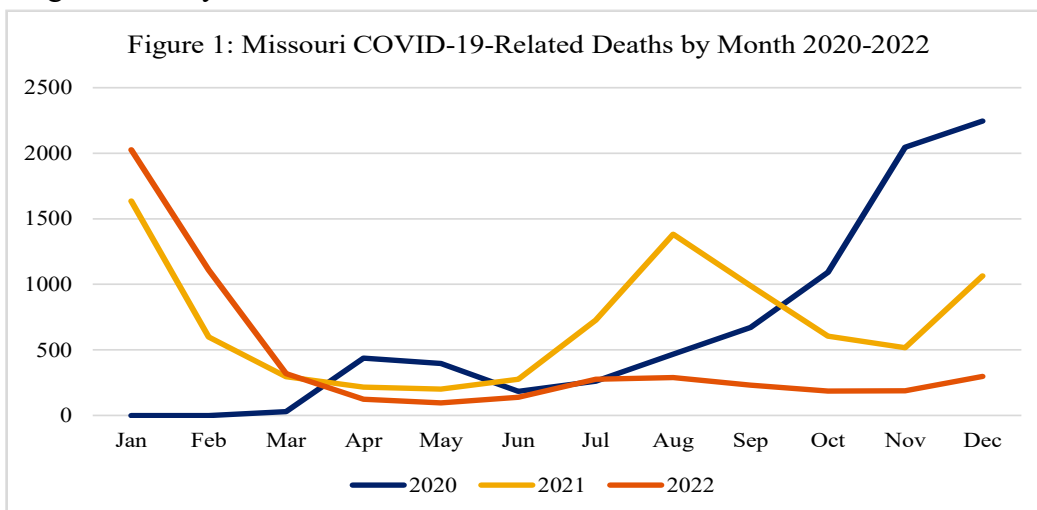
Missouri COVID-19 Mortality 2020-2022

During the three years of the COVID-19 pandemic, a total of 21,621 Missourians died of COVID-19 related deaths. There were 7,834 COVID-19-related deaths in 2020, 8,509 in 2021 and the number decreased to 5,278 in 2022. COVID-19 was the third leading cause of death in Missouri in 2020 and 2021 and the fourth leading cause in 2022.

The data in this report comes from Missouri resident death certificates, including resident in-state deaths and Missouri resident deaths that occurred in other states. It includes any death in which COVID-19 is an underlying or contributing cause of death. COVID-19 was the underlying cause for 89 percent of these deaths. The data will not match exactly to other data sources such as the Centers for Disease Control and Prevention (CDC) COVID Data Tracker or various media sources although it is reasonably close. Totals reported in this study differ by about five percent due to differences in data sources. The data for this analysis comes from Missouri's Vital Statistics Death file. The 2022 data reported in this article is still considered provisional, although final data is expected to change minimally.

For 2020-2022, the average number of total Missouri resident deaths per year was about 73,000 compared to about 62,000 for the previous three year period, 2017-2019, an increase of 17 percent. There was a total of 32,359 additional Missouri deaths in 2020-2022 vs 2017-2019 and COVID-19 accounted for about two-thirds of this increase. There were more deaths than births for each of the three years from 2020 to 2022. This is referred to as a natural decrease, and this was the first time since Missouri began keeping centralized vital statistics in 1911 that Missouri had experienced a natural decrease over a full year. The state life expectancy decreased from 77.4 years in 2019, the year before the pandemic, to 75.0 in 2020, 74.8 in 2021, and back up to 75.4 years in 2022.

Figure 1 shows the wide variation in COVID-19-related deaths by month. COVID-19 deaths peaked around 2,000 per month in November and December 2020, and January 2022. The average monthly count for the entire three-year period was about 600. Counts below 300 occurred in June and July 2020, March-June 2021 and April-December 2022.



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The median age at death for COVID-19-related deaths in 2020-2022 was 76.8 years, similar to the median age of all deaths of 76.0 years. In 2020 the median age of COVID-19 related deaths was 80.4 and dropped sharply to 73.0 years in 2021 and went back up to 76.6 years in 2022. From May to December of 2022, the median age of COVID-19 mortality was above 80 years again.

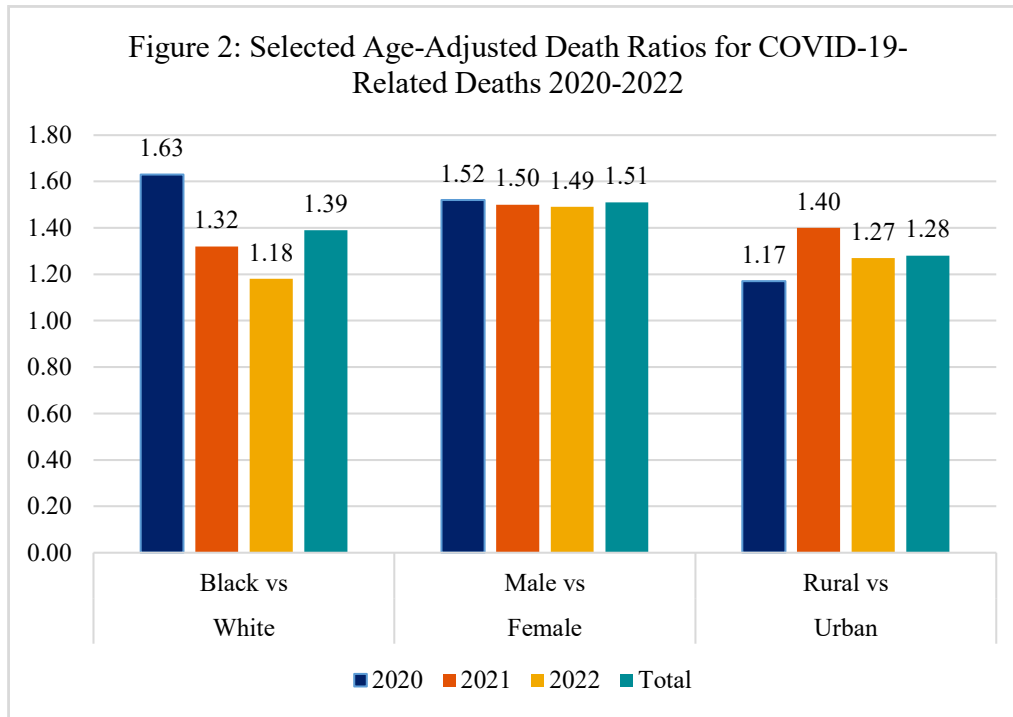
In 2021, when the Delta and Omicron variants were prevalent, the number of deaths under age 45 and aged 45-64 were greater than those in 2020 and 2022 combined. More than 30 percent of the 2021 COVID-19-related deaths were under age 65 compared to just 13.7 percent in 2020. The COVID-19 vaccines were widely used beginning in 2021, especially among the elderly and this, too, may have affected the age distribution.

These changes in age distribution by year also affected COVID-19 deaths by place of death. About 30 percent of COVID-19-related deaths occurred in nursing homes in 2020, and this dropped to 12 percent in 2021 and went back up to 19 percent for all of 2022 and 30 percent for the second half of 2022. Most COVID-19-related deaths occurred in hospitals, with about 60 percent occurring in 2020 and 2022 and 73 percent in 2021. In 2021, the peak year of hospital deaths, nearly 27 percent of all hospital deaths were COVID-19-related.

Age is the most important risk factor for COVID-19 mortality, as the death rate more than doubled for each ten-year increase in age as shown in Table 1. The death rate for persons aged 65 or more of 513.8 per 100,000 was 15.9 times higher than the death rate of 32.2 for persons under 65.

Table 1: COVID 19-related Deaths by Age with Rates per 100,000: Missouri 2020-2022

| Age | Year | | | | Death Rate |
|-------------------|------|------|------|-----------|------------|
| | 2020 | 2021 | 2022 | 2020-2022 | |
| <5 | 0 | 4 | 9 | 13 | 3.4 |
| 5-14 | 1 | 2 | 3 | 6 | 0.3 |
| 15-24 | 8 | 30 | 19 | 57 | 2.4 |
| 25-34 | 26 | 105 | 47 | 178 | 7.3 |
| 35-44 | 78 | 280 | 126 | 484 | 20.6 |
| 45-54 | 212 | 679 | 276 | 1167 | 53.9 |
| 55-64 | 750 | 1492 | 768 | 3010 | 121.8 |
| 65-74 | 1606 | 2081 | 1167 | 4854 | 249.1 |
| 75-84 | 2278 | 2066 | 1430 | 5774 | 610.5 |
| 85+ | 2875 | 1770 | 1433 | 6078 | 1701.8 |
| Total | 7834 | 8509 | 5278 | 21621 | 116.8 |
| Median age | 80.4 | 73.0 | 76.6 | 76.8 | |



As shown in Figure 2, demographically, COVID-19-related death rates were higher among Black/African-Americans than Whites, among males compared with females and among rural residents compared with their urban counterparts. These comparisons were made after adjustment for age. Males had COVID-19 death rates about 50 percent higher than females for all three years shown.

Overall, Black/African-American Missourians had death rates 39 percent higher than White Missourians, but this differential varied greatly by year. In 2020 the differential was 63 percent, 32 percent in 2021 and just 18 percent in 2022. This may have been a reflection of where the largest outbreaks were located. In 2020, the original outbreaks were in the St. Louis area, where large numbers of Black/African-Americans reside. In 2021, the Delta variant started in the rural areas, while in 2022, COVID-19 cases were widely scattered throughout the state.

The 2020-2022 age-adjusted death rates for rural residents averaged about 28 percent higher than urban residents. This peaked in 2021 when the differential was 40 percent. Fewer hospitals and other health resources in rural areas as well as the fact that rural residents tended to have lower vaccination rates and to be more financially disadvantaged than urban residents may have been factors in these differences.

When analyzing the relationships between counties with high or low age-adjusted death rates and other variables for 2020-2022, counties with fewer than 50 deaths were excluded because their confidence intervals varied by an average of nearly 30 percent. After excluding these 33 counties, the ten counties with the lowest rates included mostly suburban counties and counties with large colleges. Boone County, where the University of Missouri-Columbia is located, had the lowest COVID-19-related death rate in the state followed by Andrew, Nodaway, Platte, St. Charles, St. Louis, Cape Girardeau, Cass, Adair and Jackson. Nodaway, Cape Girardeau and Adair Counties include large universities, while Platte, Cass and Jackson are part of the Kansas City area and Andrew is near St. Joseph. Washington County had the state's highest rate for COVID-19 related deaths followed by these other rural counties scattered throughout the state; Ripley, Grundy, Livingston, Dent, Douglas, Gasconade, Pemiscot, Carroll and Bates.

Pearson correlation coefficients, which measure the degree of correlation between two variables, were calculated using county data as the base. The coefficients range from -1 to +1 with the closer they are to 1 or -1 the higher the degree of correlation and the closer to zero, the lower the correlation.

Table 2: COVID-19 Deaths with Pre-Existing Conditions by Selected Causes: Missouri Residents, 2020-2022

| | Cumulative 2020-2022 | | |
|--------------------------------|----------------------|---------|--------------------|
| | COVID 19 Deaths | | All Natural Deaths |
| | Number | Percent | Percent |
| Hypertension | 2,357 | 10.9 | 12.0 |
| Ischemic heart disease | 2,051 | 9.5 | 7.6 |
| Heart failure | 1,729 | 8.0 | 9.6 |
| Arrhythmia | 1,551 | 7.2 | 6.7 |
| Stroke | 1,064 | 4.9 | 3.9 |
| Other Circulatory conditions | 1,698 | 7.9 | 7.1 |
| Dementia | 1,462 | 6.8 | 3.4 |
| Alzheimer's disease | 772 | 3.6 | 1.1 |
| Diabetes | 2,121 | 9.8 | 6.5 |
| Chronic lower respiratory dis. | 1,988 | 9.2 | 6.2 |
| Cancer | 1,266 | 5.9 | 6.2 |
| Obesity | 724 | 3.3 | 1.4 |
| Liver Disease | 177 | 0.8 | 0.9 |
| AIDS | 25 | 0.1 | 0.1 |
| Total COVID-19 Deaths | 21,621 | | |

The COVID-19 vaccine rate of a county had the highest relationship to the age-adjusted death rates among variables studied at -0.52 meaning the higher the vaccine rate the lower the age-adjusted death rate. The poverty rate had a positive 0.39 coefficient which means the higher the poverty rate, the higher the death rate, followed by the proportion of the county urbanized (-.37). A coefficient of 0.22 or -0.22 is required in this situation to be a statistically significant Pearson correlation coefficient. The proportion of the county population that was Black/African-American had a coefficient of -0.17 with age-adjusted COVID-19 death rates, which was not significant.

Much has been discussed about various pre-existing conditions or co-morbidities that may exacerbate the effects of COVID-19 and increase the risk of severe illness or death. Some of these pre-existing conditions are shown in Table 2. These conditions came from a list that CDC created for those who are at high risk for getting very sick.¹ The leading co-morbidities listed as a contributing cause of death for COVID-19 related deaths include hypertension (10.9 percent), diabetes (9.8 percent), ischemic heart disease (9.5 percent), chronic lower respiratory diseases including asthma (9.2 percent), and heart failure (8.0 percent).

This distribution is not that different from the distribution of contributing causes for all natural deaths in Missouri as also shown in Table 2. Contributing causes that were much more

frequently mentioned on COVID-19 death certificates than all natural deaths included diabetes, obesity, chronic lower respiratory diseases, dementia and Alzheimer's disease. It should be noted that many of these conditions are likely underreported on the death certificate.

A study conducted by CDC² estimated the risk ratios of death for several of these pre-existing conditions, and obesity and diabetes were the leading co-morbidities with an increased risk of about 30 percent vs those without the condition. Chronic obstructive pulmonary disease had a higher risk of 20 percent and heart disease had a risk of 14 percent. These mortality risk ratios are similar to those found for some of the demographic variables such as race, gender or geographic residence, but nowhere near the nearly 16 to 1 risk ratio for age.

In summary, COVID-19 has had a catastrophic effect on Missouri's mortality, accounting for 21,621 deaths from 2020 to 2022. In 2022, the deaths were heavily skewed to the first quarter of the year with two-thirds of the deaths occurring in the first quarter. During the first quarter, COVID-19 ranked as the 3rd leading cause of death as it did in 2020 and 2021. However, from April to December 2022, COVID-19-related deaths averaged about 200 per month and ranked as the 8th leading cause of death in Missouri. So while the Public Health Emergency is over, the COVID-19 pandemic still exists but at a more manageable level.

1. Kompaniyets L, Pennington AF, Goodman AB, Rosenblum HG, Belay B, Ko JY, et al. "Underlying Medical Conditions and Severe Illness Among 540,667 Adults Hospitalized With COVID-19, March 2020–March 2021," *Prev Chronic Dis* 2021;18:210123. DOI: https://www.cdc.gov/pcd/issues/2021/21_0123.htm.

2. "People with Certain Medical Conditions," *Centers for Disease Control and Prevention*. Accessed August 12th, 2023. <https://www.cdc.gov/covid/risk-factors/>