Baltimore City: County-level comparisons of COVID-19 cases and deaths

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Introduction

To date, the SARS-CoV-2 virus has caused over 200 million cases and over 4.5 million deaths worldwide, straining public health workers in every corner of the globe. While vaccines and emerging variants have shifted the global picture of COVID-19, the United States (US) maintains the highest number of confirmed COVID-19 cases and deaths.

Like many municipalities in the US, Baltimore City identified their first cases of COVID-19 in March 2020, the same month the World Health Organization declared COVID-19 a pandemic. Within two months, the city was regularly reporting up to a hundred confirmed cases each day, spurring the introduction of various mitigations strategies such as physical distancing, hand hygiene, mask use, and stay at home orders. In addition, the Baltimore City Health Department rapidly scaled up critical operations such as COVID-19 testing, case investigations, contact tracing, and mass vaccinations in partnership with both public and private entities.

This report describes the burden of COVID-19 in Baltimore City represented as cumulative and monthly estimates of COVID-19 incidence, mortality, and case fatality and compares this burden with 325 other US counties with similar sociodemographic profiles. This report is intended to provide a high-level comparison of COVID-19 burden and the overall COVID-19 response by Baltimore City during January 2020 to June 2021. This report does not examine the direct impact of specific mitigation strategies.

Methods

US counties with similar sociodemographic profiles were previously clustered into eight groups by Wallace *et al* [1]. Briefly, random forest and data from the 2014 Behavior Risk Factor Surveillance System were used to identify individual-level characteristics most predictive of county-level smoking prevalence, obesity prevalence, and motor vehicle crash mortality. Identified characteristics – race/ethnicity, educational attainment, age, marital status, employment status, sex, and health insurance status – and K-means clustering were used to assign counties into eight groups with similar sociodemographic profiles. In our analysis, we focused on Baltimore City and 325 other US counties in the "semi-urban, mid/low socioeconomic status" group.

Daily county-level counts of confirmed COVID-19 cases and deaths were obtained from the COVID-19 Data Repository by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University [2]. All data were based on the date of report. We estimated cumulative and monthly incidence rates using 2019 county-level population estimates obtained from the US Census Population and Housing Unit Estimates Datasets [3]. Cumulative and monthly case fatality ratios were estimated as the proportion of confirmed deaths among confirmed cases. We used percentiles to rank counties, where higher percentiles represented lower rates and ratios. A notably high number of deaths was reported on 27 May 2021 due to a reclassification of earlier deaths [4]. As exact dates of death were not available for these deaths, we calculated the median number of daily deaths during May and June 2021 to determine how many deaths would likely have been reported on that date if reclassification did not occur. Ninety of the total 92 deaths were reassigned to 90 dates with the highest counts of COVID-19 deaths.

We described vaccine coverage over time using the CDC COVID-19 Vaccinations in the United States, County dataset [5]. We estimated the proportion of population 12+ years with at least one dose of COVID-19 vaccine. We used percentiles to rank counties, where higher percentiles represented higher vaccine coverage.

Results

The first confirmed COVID-19 cases among the total 326 counties were reported on 3 March 2020. By 30 June 2021, counties reported a median of 2,716 cumulative confirmed cases (interquartile range (IQR): 1,432-5,900) and a median of 75 cumulative deaths (IQR: 41 to 140). The median population of counties was 24,780 persons (IQR: 13,528-55,440).

Baltimore City reported 53,141 cumulative confirmed COVID-19 cases and 1,261 deaths, leading to 89 cases per 1,000 population and 210 deaths per 100,000 population (**Table 1**). By 30 June 2021, the cumulative COVID-19 incidence rate in Baltimore City was lower than 265 of 326 counties (81st percentile), the cumulative mortality rate was lower than 237 of 326 counties (73rd percentile), and the cumulative case fatality ratio was lower than 183 of 326 counties (56th percentile); however, differences between counties were minor (case fatality ratio IQR: 2.0-3.1 per 100 cases). Higher percentiles represent lower rates and ratios.

Baltimore City reported relatively high monthly incidence rates (**Figures 1 & 2**) and mortality rates (**Figures 3 & 4**) between March and June 2020. In May 2020, Baltimore City reported 6 cases per 1,000 population and 28 deaths per 100,000 population, which was lower than 43 of 326 counties (13th percentile) and 66 of 326 counties (20th percentile), respectively. A second period of relatively high burden was observed between March and May 2021. In April 2021, Baltimore City had 11 cases per 1,000 population and 15 deaths per 100,000 population, which was lower than 2 of 326 counties (1st percentile) and 67 of 326 counties (21st percentile), respectively. Between July 2020 to October 2020 and November 2020 to February 2021, Baltimore City reported fewer cases and deaths per population than at least 50% of all counties.

Compared to other counties, Baltimore City consistently reported higher vaccination coverage over time (**Figure 5**). As of 30 June 2021, 60% of the population 12+ years in Baltimore City were vaccinated, which was higher than 317 of 326 counties (97th percentile). Higher percentiles represent higher vaccine coverage.

Discussion

The primary purpose of this analysis was to compare Baltimore City with counties with similar sociodemographic characteristics, regardless of population size. Overall, our findings suggest Baltimore City has fared better than most counties with similar sociodemographic characteristics, as measured by COVID-19 cases, COVID-19 mortality, and COVID-19 vaccination per population. Baltimore did particularly well after the initial surge prior to June 2020, with the exception of a recent increase in cases and deaths between March and May 2021. Compared to other counties, Baltimore City excelled in providing COVID-19 vaccinations. By June 2021, 60% of the population 12+ years in Baltimore City received at least one dose of COVID-19 vaccine.

There are several limitations. First, dates used in this analysis are dates of reporting rather than dates of positive COVID-19 tests and dates of death. Timing of reporting may be systematically different between counties, although this likely will not have substantial impact when considering the duration of the pandemic. Second, we redistributed deaths reclassified on 27 May 2021 [4] to avoid an artificially high mortality rate in May 2021. Other counties may have experienced similar reclassification events which were not considered in this analysis. Given the large number of counties included in this analysis, we do not expect any changes in our findings due to uncommon reclassification events.

Third, although age was originally used to group counties into sociodemographic groups, age-adjusted rates would have been optimal in this comparison given the strong association between age and risk of COVID-19 death. Fourth, our analysis does not consider COVID-19 testing capacity, which drives case identification. Fifth, we did not directly examine the role of healthcare systems on COVID-19 mortality. County-specific testing and healthcare data were not publicly available for all counties. Given these limitations, we examined the case fatality ratio, a key metric which is influenced by both testing and healthcare performance. Sixth, and finally, we did not seek to assess the reasons for the differences in outcomes between counties. Further research could assess the importance of differences in policy, health system capacity, public health interventions, and other response efforts.

Figures and Tables

Table 1. Baltimore City cumulative estimates and county rank as of 30 June 2021. Higher percentiles represent lower rates, lower ratio, and higher vaccine coverage.

Indicator	Cumulative Estimate	County Rank (Percentile)
Incidence rate	89 per 1,000 population	266/326 (81st)
Mortality rate	210 per 100,000 population	238/326 (73rd)
Case fatality ratio	2.4 per 100 cases	184/326 (56th)
Population 12+ years with at least one dose of COVID-19 vaccine	60%	318/326 (97th)

Figure 1. Cumulative confirmed COVID-19 positive cases per 1,000 population, by date of reporting, January 2020 to June 2021. Purple line represents Baltimore City. Grey lines represent 325 other counties with similar sociodemographic profiles.
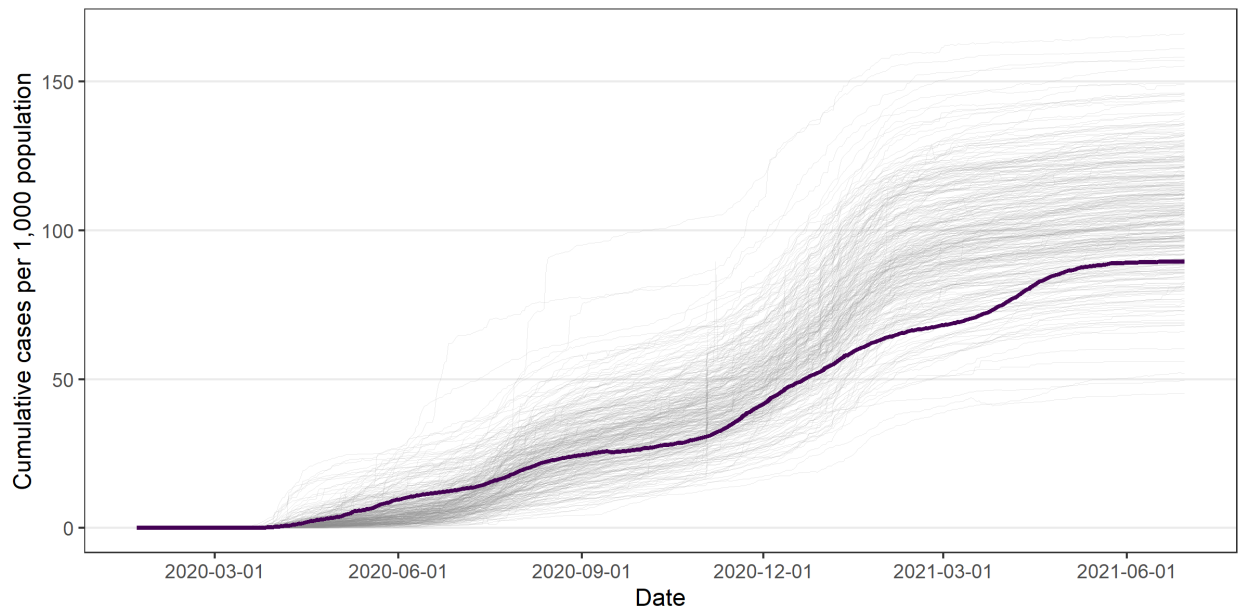
Figure 2. Confirmed COVID-19 positive cases per 1,000 population, by month of reporting, January 2020 to June 2021. Purple dots represent Baltimore City. Grey dots represent 325 other counties with similar sociodemographic profiles. Yellow horizontal line represents the median of counties by month.
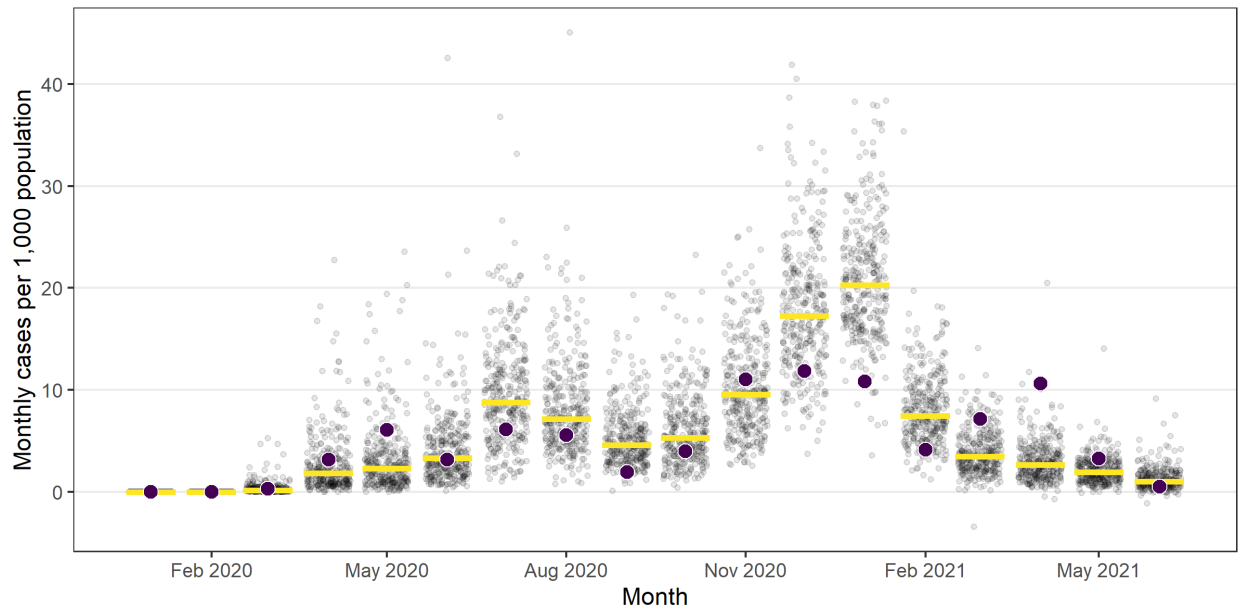

Figure 3. Cumulative confirmed COVID-19 deaths per 100,000 population, by date of reporting, January 2020 to June 2021. Purple line represents Baltimore City. Grey lines represent 325 other counties.
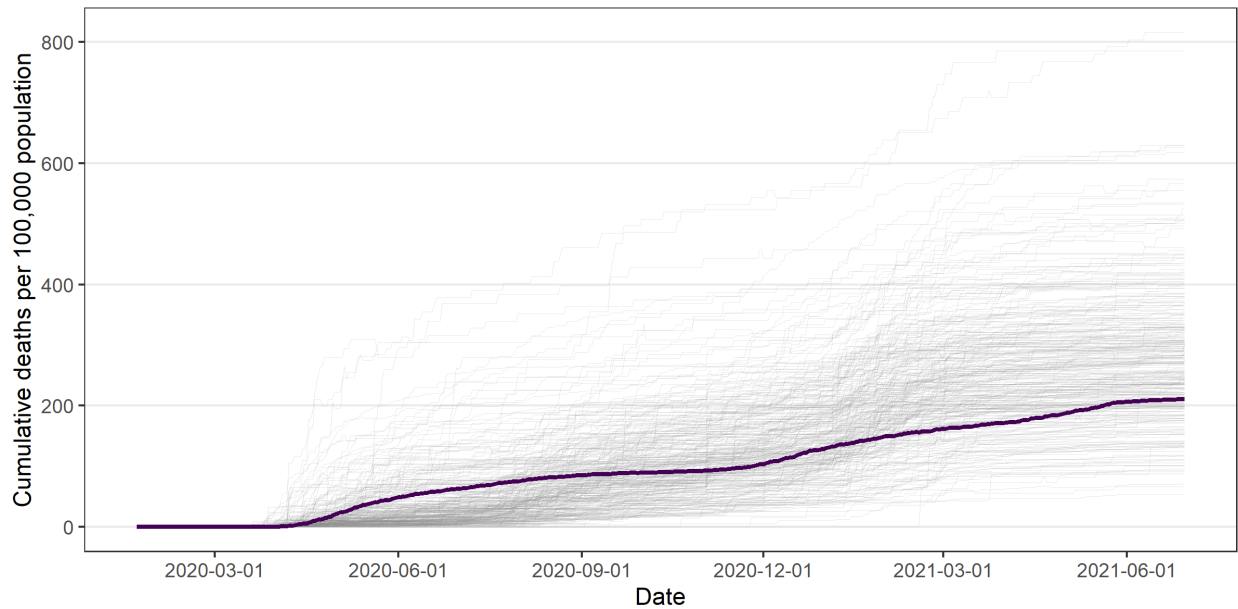
Figure 4. Confirmed COVID-19 deaths per 100,000 population, by month of reporting, January 2020 to June 2021. Purple dots represent Baltimore City. Grey dots represent 325 other counties with similar sociodemographic profiles. Yellow horizontal line represents the median of counties by month.
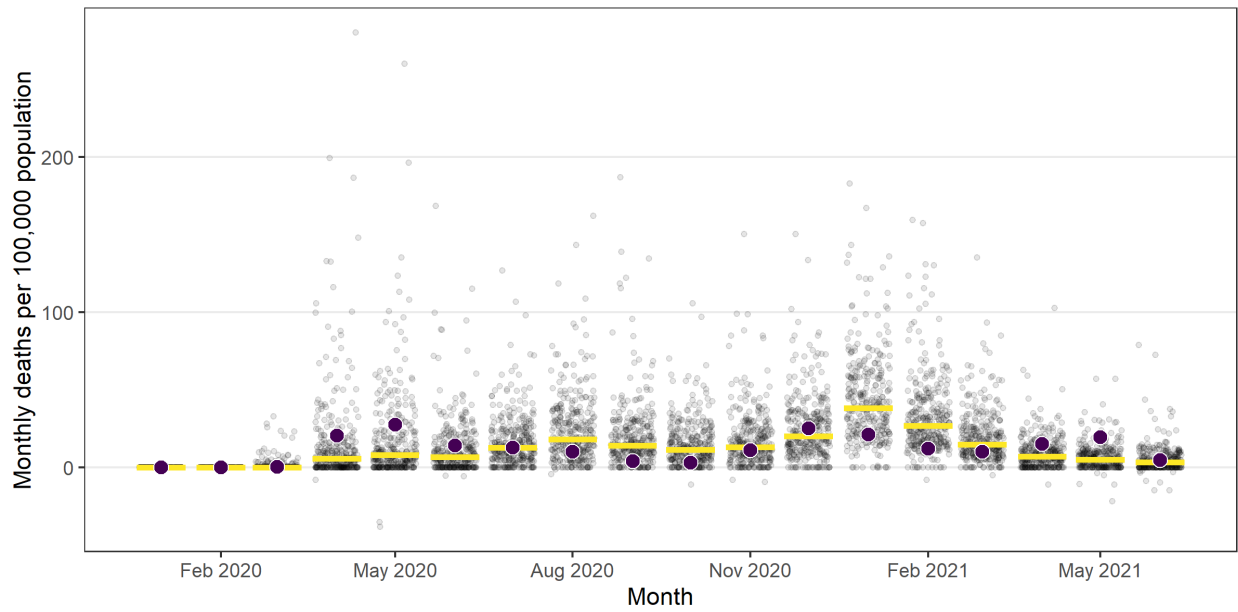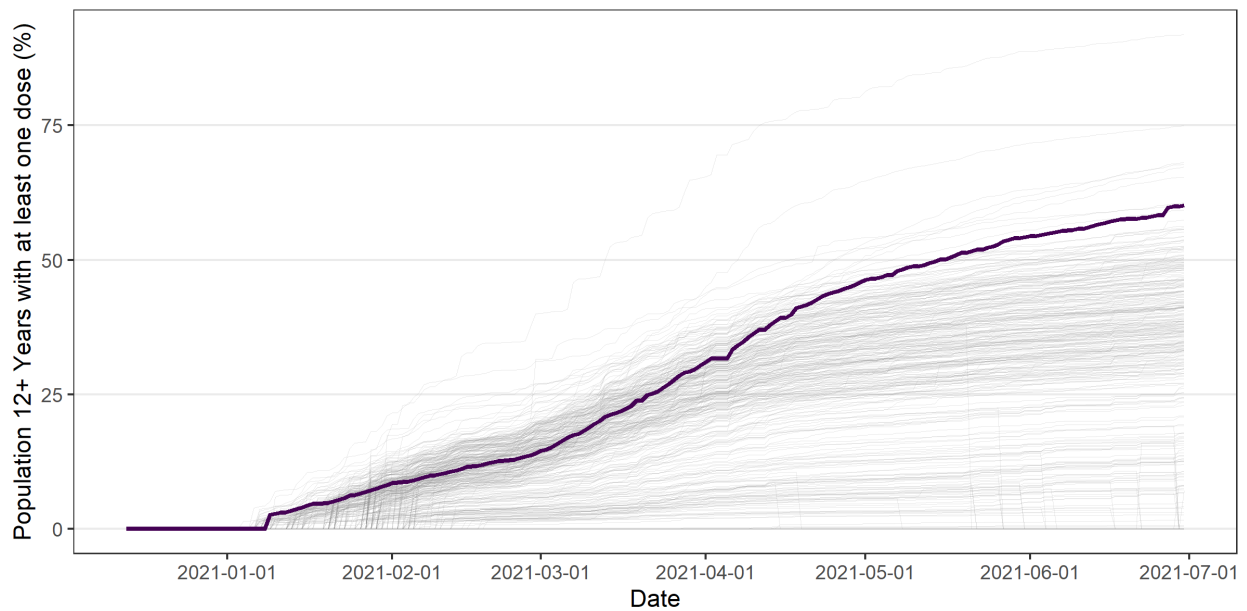

Figure 5. Proportion of population 12+ years with at least one dose of COVID-19 vaccine, January to June 2021. Purple line represents Baltimore City. Grey lines represent 325 other counties with similar sociodemographic profiles.

References

1. Wallace M, Sharfstein JM, Kaminsky J, Lessler J. Comparison of US County-Level Public Health Performance Rankings With County Cluster and National Rankings: Assessment Based on Prevalence Rates of Smoking and Obesity and Motor Vehicle Crash Death Rates. JAMA Netw Open. 2019;2: e186816. doi:10.1001/jamanetworkopen.2018.6816
2. Dong E, Du H, Gardner L. An interactive web-based dashboard to track COVID-19 in real time. Lancet Infect Dis. 2020;20: 533–534. doi:10.1016/S1473-3099(20)30120-1
3. US Census Bureau. Population and Housing Unit Estimates Datasets. In: The United States Census Bureau [Internet]. [cited 22 Jun 2021]. Available: https://www.census.gov/programs-surveys/popest/data/data-sets.html
4. Miller MC Alex Mann, Hallie. Maryland officials reclassify 517 deaths as COVID fatalities, bringing death toll to over 9,300. In: Baltimore Sun [Internet]. 27 May 2021 [cited 27 Jul 2021]. Available: https://www.baltimoresun.com/coronavirus/bs-md-covid-numbers-20210527-icecj6mj6rc2bjld7b7vc7i2xq-story.html
5. US Centers for Diseases Control and Prevention. COVID-19 Vaccinations in the United States, County. In: COVID-19 Vaccinations in the United States,County [Internet]. 29 Aug 2021 [cited 31 Aug 2021]. Available: https://data.cdc.gov/Vaccinations/COVID-19-Vaccinations-in-the-United-States-County/8xkx-amqh

Data used in the report are publicly available:

1. COVID-19 Data Repository by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University: https://github.com/CSSEGISandData/COVID-19
2. CDC COVID-19 Vaccinations in the United States, County: https://data.cdc.gov/Vaccinations/COVID-19-Vaccinations-in-the-United-States-County/8xkx-amqh
3. FIPS list for counties included in the analysis: https://github.com/qhanlee/baltimore_covid19