

# Nonmetropolitan COVID-19 Incidence and Mortality Rates Surpassed Metropolitan Rates Within the First 24 Weeks of the Pandemic Declaration: United States, March 1–October 18, 2020

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[Correction added on April 1, 2021 after first online publication: this section was added.]

## Abstract

**Purpose:** This report compares COVID-19 incidence and mortality rates in the nonmetropolitan areas of the United States with the metropolitan areas across three 11-week periods from March 1 to October 18, 2020.

**Methods:** County-level COVID-19 case, death, and population counts were downloaded from USAFacts.org. The 2013 NCHS Urban-Rural Classification Scheme was collapsed into two categories called metropolitan (large central, large fringe, medium, and small metropolitans) and nonmetropolitan (micropolitan/noncore). Daily COVID-19 incidence and mortality rates were computed to show temporal trends for each of these two categories. Maps showing the ratio of nonmetropolitan to metropolitan COVID-19 incidence and mortality rates by state identify states with higher rates in nonmetropolitan areas than in metropolitan areas in each of the three 11-week periods.

**Findings:** In the period between March 1 and October 18, 2020, 13.8% of the 8,085,214 confirmed COVID-19 cases and 10.7% of the 217,510 deaths occurred among people residing in nonmetropolitan counties. The nonmetropolitan incidence and mortality trends steadily increased and surpassed those in metropolitan areas, beginning in early August.

**Conclusions:** Despite the relatively small size of the US population living in nonmetropolitan areas, these areas have an equal need for testing, health care personnel, and mitigation resources. Having state-specific rural data allow the development of prevention messages that are tailored to the sociocultural context of rural locations.

## KEYWORDS

COVID-19, geographic information system, incidence, mortality, rural

## PURPOSE

Approximately 46 million (one in seven) Americans resided in one of the 1976 counties designated as *micropolitan* or *noncore* by the 2013 National Center for Health Statistics (NCHS) Urban-Rural Classification Scheme for Counties in 2018.<sup>1</sup> Rural communities in America face complex challenges as they respond to the COVID-19 pandemic. Rural residents tend to be older, poorer,<sup>2</sup> and are more likely to have chronic conditions associated with severe COVID-19 than urban residents.<sup>3,4</sup> Rural health care infrastructure is strained by hospital closures<sup>5</sup> and health professional shortages, which limit access to primary and specialty care.<sup>6</sup> Half of rural residents are at high risk of serious illness due to COVID-19, creating stress on rural hospitals,<sup>7</sup> and COVID-19 is exacerbating inequalities in chronic disease outcomes already present in rural populations.<sup>8-10</sup> However, some rural communities are more resilient in coping with the strains associated with COVID-19 than others.<sup>11</sup>

This report details COVID-19 incidence and mortality in nonmetropolitan America in the 33-week period from March 1 to October 18, 2020. State-level maps provide a visual assessment of the changing impact that COVID-19 has had on nonmetropolitan populations in three 11-week periods. The trends and maps illustrate the observation that nonmetropolitan populations are in need of substantive public health interventions despite their small and geographically dispersed populations.

## METHODS

We obtained data pertaining to COVID-19 cases, deaths, and total population per county from USAFacts.org,<sup>12</sup> which collects daily county-level case and death counts by web scraping or manual entry from a table, dashboard, or report on state public health websites.<sup>13</sup> The county-level population data source is the 2019 US Census Bureau population estimates.<sup>14</sup> We classified each county as metropolitan or nonmetropolitan using the 2013 National Center for Health Statistics (NCHS) Urban-Rural Classification Scheme for Counties. This scheme classifies all counties in the United States into one of six metropolitan categories (four metropolitan, one micropolitan, and one noncore).<sup>1</sup> A metropolitan county has one or more adjacent counties with at least one urban core area of at least 50,000 population. A micropolitan county has one or more adjacent counties with one or more urban cores between 10,000 and 50,000 residents. Noncore counties are all other counties that are neither metropolitan nor micropolitan. We collapsed the four metropolitan categories (large central, large fringe, medium, and small metropolitans) into a single “metropolitan” category and the micropolitan and noncore categories into a single “nonmetropolitan” category. We use the nonmetropolitan categories as a proxy for rurality. Of the 3143 counties in the United States, 1976 (63%) are classified as nonmetropolitan.

We calculated aggregated daily COVID-19 incidence and mortality rates and displayed them as a trend line stratified by the two metropolitan categories. Here, rates are defined as the number of people among a population who tested positive for COVID-19, or died from it, dur-

ing a specified period per 100,000 persons. Daily rates used the case or death counts for a given date as the numerator and the Census population estimates for 2019 as the denominator. Crude rates are shown because age-specific COVID-19 data were not available in county-level data. We also calculated average daily COVID-19 incidence and mortality rates for the three 11-week periods using the number of cases (or deaths) in each period as the numerator and the 2019 population estimates as the denominator. To make the period-specific rates comparable to the daily rates, we divided them by 77, which is the number of days in each period.

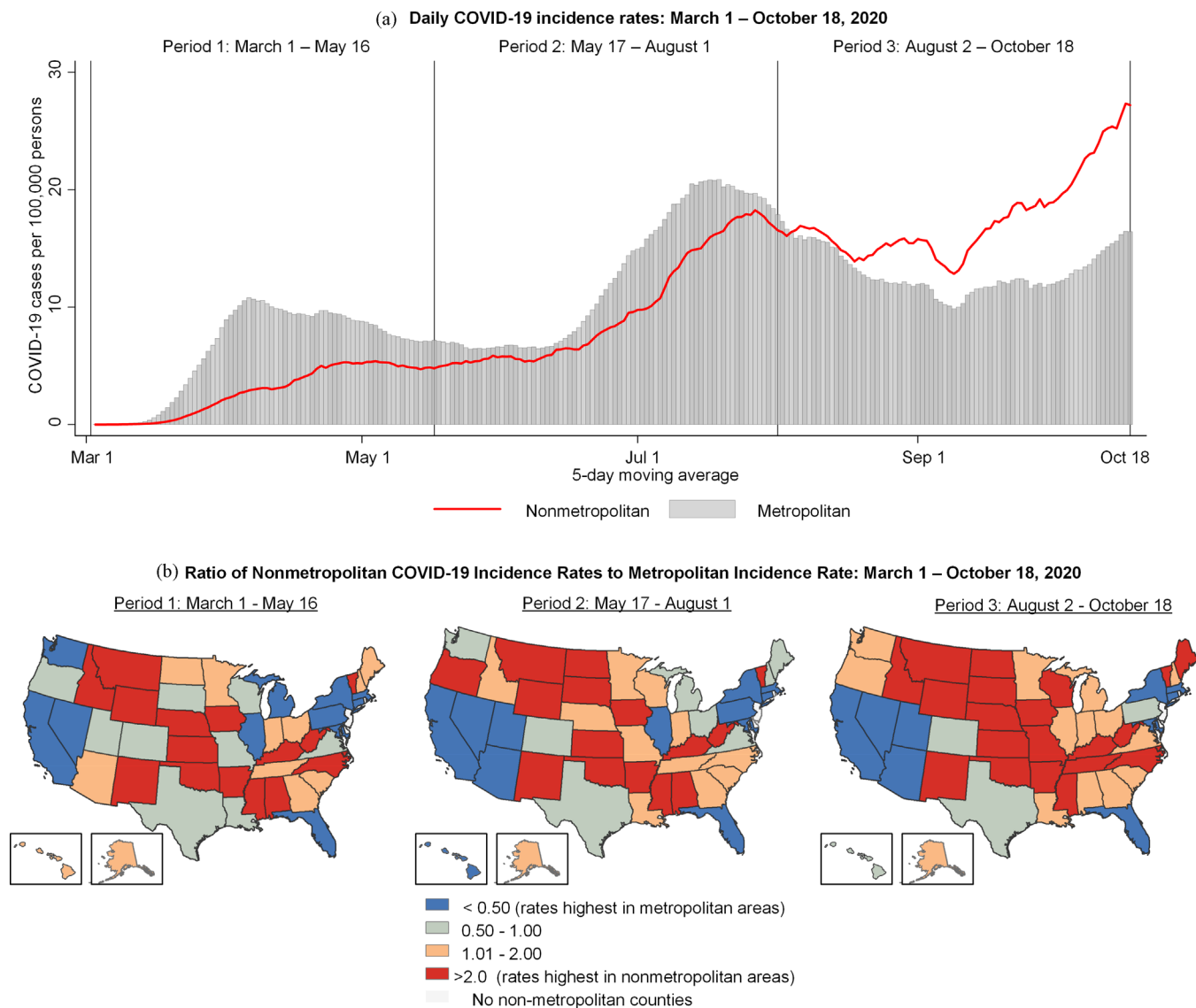
We created state incidence rate and mortality rate ratio (nonmetropolitan to metropolitan) maps for three 11-week periods: March 1 to May 16 (period 1), May 17 to August 1 (period 2), and August 2 to October 18 (period 3). To calculate these rates, we summed case and death counts for each metropolitan category within the state, then calculated COVID-19 incidence and mortality rates using the counts as the numerators and the 2019 population estimates as the denominator. We then created incidence maps and mortality maps that show the rate ratios of nonmetropolitan to metropolitan by state. These maps identify whether the rates were higher in the nonmetropolitan or metropolitan areas. States that have rate ratios greater than 1 are shown in red and have higher nonmetropolitan rates than metropolitan rates. States that have rate ratios less than 1 are shown in blue and have higher metropolitan rates than nonmetropolitan rates. We used STATA 16.1 (StataCorp, College Station, TX) to calculate the incidence and mortality rates, and rate ratios, and to visualize the temporal trends by metropolitan category. We used geographic information system (GIS) software (ESRI ArcGIS 10.5, Redlands, CA) to map the COVID-19 incidence and mortality rates.

## RESULTS

Between March 1 and October 18, 2020, 13.8% of the 8,085,214 confirmed COVID-19 cases and 10.7% of the 217,510 deaths occurred among people residing in nonmetropolitan counties in the United States. There was an upward trend in the percent of cases that resided in nonmetropolitan areas over time: 2.2% in period 1, 2.8% in period 2, and 5.7% in period 3. There was also an upward trend in the percent of deaths reported in nonmetropolitan areas: 1.3% in period 1, 4.7% in period 2, and 7.9% in period 3.

The average daily COVID-19 *incidence* rate over the entire period was 9.8 cases per 100,000 persons and the average daily *mortality* rate was 0.19 deaths per 100,000 persons. In period 1, the metropolitan *incidence* rate was 5.70 and the nonmetropolitan rate was 2.73. The metropolitan *mortality* rate in this period was 0.32 and the nonmetropolitan rate was 0.09. In period 2, the metropolitan *incidence* rate was 11.6 and the nonmetropolitan rate was 9.74. The metropolitan *mortality* rate in this period was 0.25 and the nonmetropolitan rate was 0.17. In period 3, the metropolitan *incidence* rate was 12.08 and the nonmetropolitan rate was 16.43. The metropolitan *mortality* rate in this period was 0.22 and the nonmetropolitan rate was 0.32.

Trends in the COVID-19 incidence (Figure 1A) and mortality (Figure 2A) rates in nonmetropolitan America were lower than

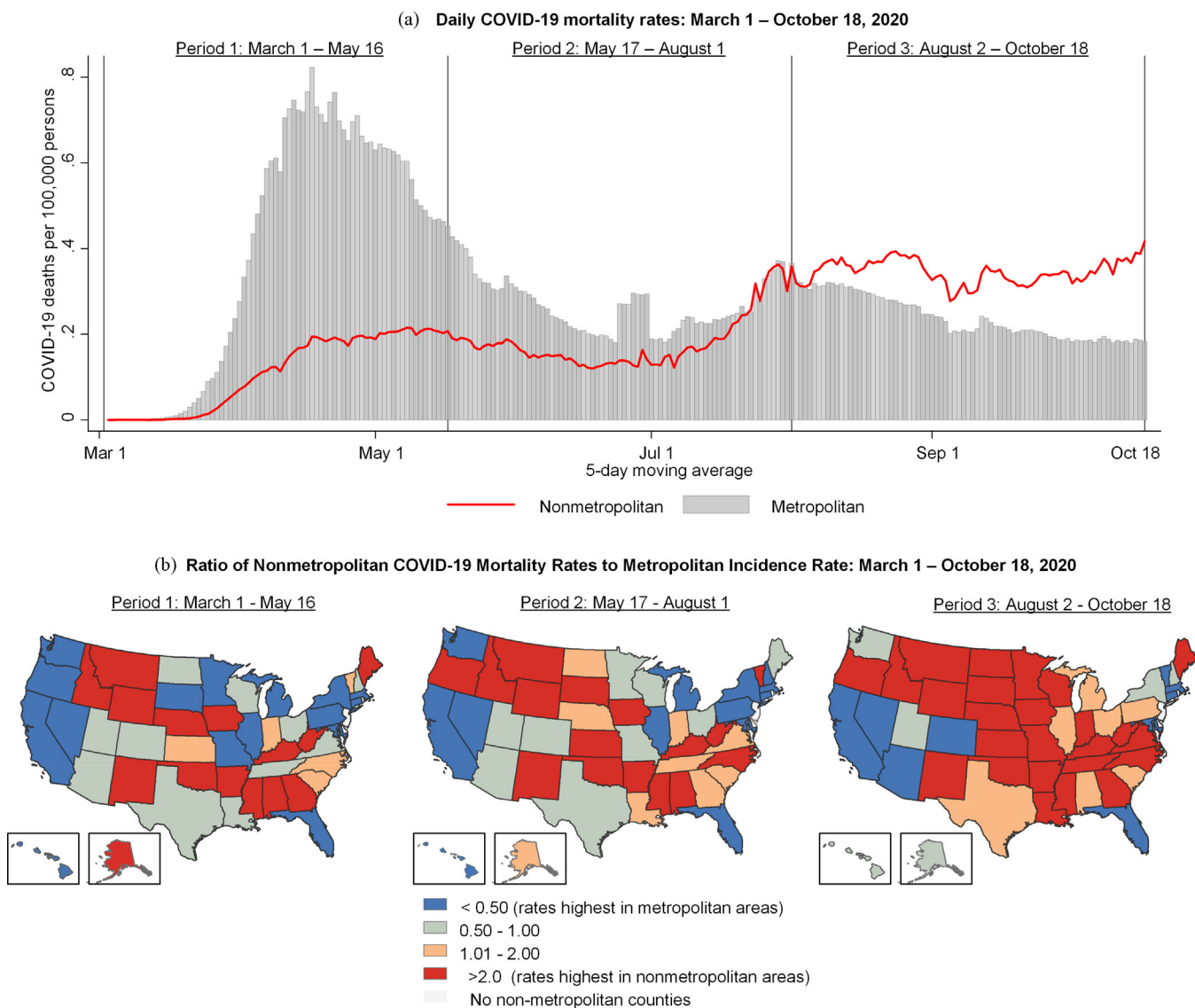


**FIGURE 1** (a) Daily COVID-19 incidence rates: March 1–October 18, 2020. (b) Ratio of nonmetropolitan COVID-19 incidence rates to metropolitan incidence rate: 1–October 18, 2020. In the period between March 1 and October 18, 2020, 13.8% of the 8,085,214 COVID-19 cases occurred in nonmetropolitan areas of the United States. Incidence rates were calculated by tabulating county-level case and population counts into the metropolitan and nonmetropolitan parts of the United States. The numerator was the case counts and the denominator was the population counts. The National Center for Health Statistics Urban-Rural Classification Scheme for Counties was used to define metropolitan (large central, large fringe, medium, and small) and nonmetropolitan (micropolitan and noncore) areas. (A) Trends show national nonmetropolitan and metropolitan incidence rates; nonmetropolitan rates first exceeded the metropolitan rates in early August, surpassed the peak (July) metropolitan rate in early October, and continues to accelerate at a faster pace at the end of the third period. (B) Nonmetropolitan to metropolitan incidence rate ratio maps identify whether the rates were higher in the nonmetropolitan or metropolitan areas of each states. Rate ratios  $\geq 1$  (red) have higher nonmetropolitan rates than metropolitan rates and rate ratios  $< 1$  (blue) have higher metropolitan rates than nonmetropolitan rates. State maps of nonmetropolitan to metropolitan incidence rate ratios in three periods show that the highest COVID-19 incidence rates had shifted to the nonmetropolitan areas in many ( $n = 9$ ) states during period 3

metropolitan rates during the first period, but case and death rates in nonmetropolitan counties surpassed those of metropolitan counties at the beginning of August. The metropolitan trends followed the national-level incidence rates,<sup>15</sup> which peaked in April, declined and plateaued for several weeks in May and early June, and began to rise again in late June. However, COVID-19 incidence rates for nonmetropolitan populations did not follow this trend (Figure 1A). Not only was incidence higher in nonmetropolitan counties than those in the metropolitan counties beginning in the third period, the

nonmetropolitan rates were accelerating faster. It appears that the nonmetropolitan incidence rates began accelerating faster than the metropolitan rates beginning in mid-September. In late September, the COVID-19 incidence rate in nonmetropolitan America surpassed the highest metropolitan rate in early July.

Trends in the mortality rates (Figure 2A) showed that the COVID-19 mortality rate was initially low in nonmetropolitan populations as compared to that in metropolitan populations, but it steadily increased and surpassed the metropolitan mortality rate in early August. While



**FIGURE 2** (a) Daily COVID-19 mortality rates: March 1–October 18, 2020. (b) Ratio of nonmetropolitan COVID-19 mortality rates to metropolitan incidence rate: 1–October 18, 2020. In the period between March 1 and October 18, 2020, 10.7% of the 217,510 deaths occurred in nonmetropolitan areas of the United States. Mortality rates were calculated by tabulating county-level case and population counts into the metropolitan and nonmetropolitan parts of the United States. The numerator was the death counts and the denominator was the population counts. The National Center for Health Statistics Urban-Rural Classification Scheme for Counties was used to define metropolitan (large central, large fringe, medium, and small) and nonmetropolitan (micropolitan and noncore). (a) Trends show national metropolitan and nonmetropolitan mortality rates; nonmetropolitan rates first exceeded the metropolitan rates in early August, plateaued for several weeks, and appear to increase again in mid-October. (b) Nonmetropolitan to metropolitan mortality rate ratio maps identify whether the rates were higher in the nonmetropolitan or metropolitan areas of each states. Rate ratios  $\geq 1$  (red) have higher nonmetropolitan rates than metropolitan rates and rate ratios  $< 1$  (blue) have higher metropolitan rates than nonmetropolitan rates. State maps of nonmetropolitan to metropolitan mortality rate ratios in three periods show that the highest COVID-19 incidence rates had shifted to the nonmetropolitan areas in many ( $n = 15$ ) states during period 3

those rates fluctuated for most of period 3, they generally plateaued for this period, while the metropolitan mortality rates declined; the mortality rates in nonmetropolitan America were beginning to increase again toward the end of period 3. The national trend line is not shown because the relative size of the metropolitan population drives the national COVID-19 rates, which makes the trend line appear to overlap the metropolitan rates. Readers can review the Centers for Disease Control and Prevention COVID-19 Data Tracker to see how the

rates in nonmetropolitan America changed after October 18, 2020.<sup>15</sup> These trends are reflected in the COVID-19 incidence rate ratio maps (Figure 1B) and mortality rate ratio maps (Figure 2B) for individual states. In many states, incidence rates shifted from being higher in the metropolitan areas in period 1 to being higher in the nonmetropolitan areas in period 3.

During period 1, the nonmetropolitan *incidence* rates were higher than the metropolitan rates in 26 states. Incidence rates became

higher in nonmetropolitan areas in an additional nine states during period 3, including Illinois, Louisiana, Michigan, Missouri, Oregon, South Dakota, Virginia, Washington, and Wisconsin. However, only two states had *incidence* rates that became greater in the metropolitan areas. During period 1, the nonmetropolitan *mortality* rates were higher than the metropolitan rates in 15 states. Mortality rates became higher in nonmetropolitan areas in an additional 15 states during period 3, including Illinois, Louisiana, Missouri, North Dakota, Oregon, Michigan, Minnesota, Missouri, Ohio, Pennsylvania, South Dakota, Tennessee, Texas, Virginia, and Wisconsin. However, only two states had *mortality* rates that became greater in the metropolitan areas.

## DISCUSSION

The geographic patterns and temporal trends in COVID-19 incidence and mortality varied by metropolitan status over three 11-week periods between March 1 and October 18, 2020. One explanation for the rising rates in nonmetropolitan America is that rural communities may have missed some opportunities to contain the spread of COVID-19 despite factors, such as low population density and limited travel to and from rural locations, which could have resulted in less opportunity for COVID-19 exposure.<sup>4</sup> This may be related to differences in perception of COVID-19 risk among rural residents, who did not initially perceive their risk to be high.<sup>16</sup> This may also be related to the fact that major metropolitan areas were the first impacted by COVID-19, which may have informed public perception that the spread of COVID-19 was primarily an urban problem.<sup>17</sup> In this case, rural populations may not have adopted preventive behaviors, such as social distancing or face-masking, as early as their metropolitan counterparts.

Other researchers have shown geographic patterns of COVID-19 incidence and mortality,<sup>18</sup> including the detection of geographic hotspots<sup>19</sup> and geographic distribution of temporal trends.<sup>20</sup> The geographic patterns shown in our report provide a quick visual assessment of when and whether the burden of COVID-19 affected each state's nonmetropolitan or metropolitan population. One limitation of this study is that access to testing in rural areas was limited, particularly in the earliest months of the pandemic.<sup>21</sup> Lower access may have resulted in undertesting in rural areas, which in turn may have led to underestimation of the observed incidence and mortality rates among nonmetropolitan populations.

## CONCLUSION

These results show that COVID-19 disease burden in many states has shifted from metropolitan to nonmetropolitan areas. Nearly 46 million people, one in seven, reside in nonmetropolitan counties. These populations also have need for testing, health care personnel, and mitigation resources. Rural areas may be disproportionately impacted by COVID-19 due to less robust public health and health care infrastructure and larger proportions of people who are older, have lower

socioeconomic status, and have a higher prevalence of having multiple chronic conditions.<sup>22</sup> This work provides state-specific results that allow prevention messages<sup>23</sup> to be tailored to the sociocultural context of rural locations. Future work should continue to monitor the impact of COVID-19 on rural places and populations and should evaluate the impact of rural-focused public health campaigns on rural trends in COVID-19 incidence and mortality.

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