Person, Place, Time and COVID-19 Inequities

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The data underlying this article are available in the 2019 Novel Coronavirus Visual Dashboard operated by the Johns Hopkins University Center for Systems Science and Engineering (JHU CSSE), at https://github.com/CSSEGISandData/COVID-19.

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Abstract: In their commentary, Zalla et al. argue that the approach taken by Centers for Disease Control (CDC) comparing the proportion of COVID-19 deaths by race/ethnicity to a weighted population distribution ignores how systemic racism structures the composition of places. While the CDC has abandoned their measure, they do so because of the changing geographic distribution of COVID-19, not because the measure underestimates racial disparities. We further Zalla et al.'s argument, advocating for a relational approach to estimating COVID-19 racial inequities that integrates the reciprocal relationship between context and composition through the interaction of places and people over time. To support our argument, we present a series of figures exploring the heterogeneous relationships between places, people, and time, using US county-level publicly available COVID-19 mortality data from February to December 2020 from Johns Hopkins University. Longitudinal and more geographically granular data that allows for disaggregation by person, place, and time will improve our estimation and understanding of inequities in COVID-19.

Keywords: COVID-19, health disparities, health equity, geography

Abbreviations

CDC: Centers for Disease Control and Prevention

COVID-19: Coronavirus disease 2019

In their article, "*A Geography of Risk: Structural Racism and COVID-19 Mortality in the United States,"* Zalla et al. present a critique of the Centers for Disease Control and Prevention's (CDC) approach to estimating provisional death counts and racial/ethnic inequities in Coronavirus disease deaths(1). The CDC estimates the percentage of COVID-19 deaths by race/ethnicity as the proportion of total deaths in a given county, compared to a weighted distribution of the county racial/ethnic population in which deaths have occurred. Complementing the methodological critique of the CDC approach by Cowger et al.(2), Zalla and co-authors highlight the need to take an historical approach to understanding the geography of racial inequities in COVID-19. Their discussion of the history and continued effects of racism helps to concretely demonstrate the deeply problematic implications of "race-neutral" methodological and policy decisions and need to consider how racism structures risk. Summarizing their argument, racism leads to inequitable residential contexts with disparate exposure risks, and so adjusting for geography "bakes in" inequities, treating racism as a confounder rather than an exposure itself(1).

While the method is no longer in use by CDC(3), we believe further discussion is important to improve the monitoring of inequities in COVID-19 and other diseases. The key argument of Zalla et al. is that racism shapes the distribution of people by race, both within and between local areas. We believe that the CDC methodology also ignores the interconnected nature of context and composition. We propose adopting a relational approach, integrating the reciprocal relationship between context and composition through the interaction of places and people over time(4). Places and populations are not socially, politically, or environmentally neutral or isolated(5), so treating them as inconsequential beyond composition reinforces a false and ahistorical approach to measuring inequities. We argue here for the importance of considering mutually reinforcing and dynamic COVID-19 disparities across and between people, places, and time(6). To support our argument, we explore the heterogeneous relationships between populations defined by place, people, and time, throughout the COVID-19 pandemic in the US.

Given the limited availability of reliable longitudinal data on the racial and ethnic composition of COVID-19 cases and deaths, we take an ecological approach, using publicly available COVID-19 data from February to December 2020 from Johns Hopkins University(7), and assign deaths to counties according to the majority (>60%) racial/ethnic group. Our approach obscures within county inequities (mostly expressed through residential segregation within cities) and is not meant to imply that county racial composition reflects the race/ethnicity of individual cases. We additionally classify geographies as urban, suburban, or rural(8), based on the Rural Urban Continuum Code(9).

People and Places

We begin with a consideration of the relational role of contextual and compositional factors in independently producing variation in COVID-19 outcomes, and in bi-directionally impacting one another. Zalla et al explicates the ways in which current and historical contextual and structural features of places, especially racial residential segregation, shape the composition of a population by determining where individuals live and work, and thereby determine risk of exposure to COVID-19(1). Segregation specifically shapes the housing availability and racial and socioeconomic composition of cities and suburbs, and available occupations by place, by stratifying housing and occupational opportunity that concentrates Black and Latinx populations in areas with few high-wage employment opportunities (10).

The urban-suburban-rural divide reflects another important geographic level in which we can see both compositional and contextual determinants of inequities in COVID-19. Contextual factors associated with COVID-19 variation, such as the location of specific industries (e.g. agriculture, meat packing(1, 11)), overcrowding, political ideology(12), preexisting policy environments(13), and health care resources(14) differ substantially between urban, suburban, and rural places. Similarly, the composition of these geographies differs substantially: cities have younger populations than other geographies; larger immigrant populations live in urban and suburban areas than rural(15); rural residents have higher rates of chronic disease(16); and consistently rural areas vote conservative, suburbs increasingly lean democratic, and urban areas reliably vote democratic(17), although this may also reflect voter suppression and disengagement rather than composition (18).

We further argue, following Cummins(4), that the composition of a place shapes the contextual conditions in which people reside. As an example, we consider the city of San Francisco, California. Since the 2000's, San Francisco has been home to an agglomeration of technology companies. Technology organizations quickly shifted to remote work environments(19), allowing many tech employees to work without risking COVID-19 exposure. The shifts in the composition of people with limited occupational exposure risk may have helped to prevent increases in infection rates in the Bay Area(19), despite early introduction of the disease in the region.

While much of the coverage on COVID-19 has focused on urban areas, both suburbs and rural areas have been severely impacted by the pandemic(8, 20). In **Figure 1** we show national differences in COVID-19 deaths by geography (urban, suburban, rural) and racial/ethnic classification (by county racial composition). While urban areas have had the highest absolute number of deaths, rates have generally been higher in suburban and rural areas. Specifically, mortality rates have been highest in suburban counties with a majority Native American population, followed by suburban and rural counties with a majority Black population and rural counties with a majority Hispanic population. Majority white areas had the lowest mortality rates within each geography and showed no clear urban-suburban-rural pattern. In summary, there is a disproportionate impact of COVID-19 mortality in suburban and rural communities of color.

Time and People, Time and Places

Figure 2 shows rates of COVID-19 deaths over time by the majority racial composition of counties. The initial spike in COVID-19 death occurred in mixed and majority Black areas (21). While majority Hispanic and Native American/Alaska Native communities experienced among the lowest rates at the beginning of the pandemic, these grew substantially over the spring and summer to become the highest, peaking in the late Spring and late fall for majority Native American areas and in the summer for majority Hispanic areas. Overall, majority white communities have experienced among the lowest rates at all points other than recent increases in the late fall, when majority white communities had some of the highest rates.

As shown in **Figure 3**, while the first wave of COVID-19 mostly affected urban areas, the second wave impacted urban, suburban, and rural areas similarly during the summer. However, the third wave in the fall had a disproportionate impact on suburban and rural areas.

Time, Places, and People

Figure 4 shows that, although the impact of the pandemic has been widespread, at most stages and across all geographies we see higher rates of impact for majority Black and Brown communities compared with majority white communities. The rise in mortality rates for majority white communities in the fall, as observed in **Figure 2**, is most likely due to increases in rural areas at this same time, which are disproportionately white. However, even within rural areas (Panel C), majority Black communities had some of the highest rates during the summer and early fall, followed by an increase in majority Hispanic and majority Native American rural communities. These communities had higher rates even during the late fall, when mortality rates in majority white rural communities started to increase. For mixed communities, patterns were similar to majority Black urban communities (Panel A), though continued to rise in suburban (Panel B) and rural areas over time.

CDC Weighted Disparities and the Importance of Dynamic and Reciprocal Population Definitions

CDC's weighted disparities analysis is a real-world example of the consequences of defining populations as isolated statistical entities with no intrinsic or extrinsic relationships(5). First, and according to CDC, the key impetus behind using weighted population distributions was that, "in April and May 2020, the majority of COVID-19 deaths in the U.S. occurred in urban areas that have a larger percentage of their populations that are non-Hispanic Black, non-Hispanic Asian, or Hispanic, and a smaller percentage that are non-Hispanic white."(3) While this is factually correct, it ignores, as posited by Zalla(1), that this distribution of the population is not random, and that the initial impact in these urban areas may actually be partially related to their own composition.

Second, while CDC's analysis aimed at controlling for differences in the racial composition of urban areas versus suburban and rural areas, composition is dynamic and historically contingent. Over the past 20 years, the suburbs have increasingly become home to the non-white population, shifting the predominant patterns of Black and Brown cities and predominantly white suburbs produced by residential racial segregation(22). Due to gentrification, increasing immigration, and middle-class Black and Brown families choosing to (or being forced to) relocate to suburbs, by 2010 the suburbs were home to more than 50% of the non-white population and of all immigrants(23). These shifts suggest that the context and composition of suburban areas have shifted over the last 20 years, in ways that likely produce meaningful differences for rates of COVID-19, by changing many of the aforementioned contextual and compositional factors (e.g. housing conditions, political ideology, industry, racial/ethnic and age composition, etc.). In summary, current COVID-19 patterns are contingent on contemporary contextual and compositional factors that are themselves dependent on historical features of places and people. Treating populations as isolated statistical entities(5), or mere aggregations of individuals, obscures our understanding of COVID-19 patterns.

Implications

Our analysis emphasizes the importance of the theoretical linkage between person and place, context and composition, and heterogeneity of impacts over time(4). Using the CDC analysis as a real-world example, we consider the implications of defining populations as isolated statistical entities defined exclusively by composition(5). While the CDC attempted to present a measure that considered differences in composition; the measure oversimplified the complex dynamics of a country with geographic and compositional disparities, produced by 400 years of socioeconomic inequity and racism. Rather than attempting to weight away compositional differences, operationalizing a relational population approach would instead explicitly examine place, people, and time effects and their interactions. While there are numerous complex qualitative and quantitative methodological approaches to integrate relational approaches into empirical analysis(4) we propose a simple strategy that recognizes complexity and is common to presenting interaction effects: present multiple stratified analysis – across place, people, and time-- alongside summary measures. For example, comparing **Figure 3** to **Figure 4**, we miss the rise in urban Hispanic rates without inclusion of geography; or comparing **Figure 1 to 3**: we lose understanding of the important inversion in July between urban and rural/suburban areas in geographic concentration of COVID-19 deaths without a consideration of time. We do acknowledge that our very description, by grouping places by composition, is limited. This highlights another challenge of understanding inequities in COVID-19, the lack of readily available longitudinal data that allows for cross-examinations of population subgroups at different locations.

Identifying disparities often necessitates incorporation of complexity rather than attempts to control it away(24). Here we only approach questions of inequities by race/ethnicity, but measurement of inequities for other population groups (e.g., occupational categories or immigration status) should integrate how the composition of populations shape places, and contribute to how we conceptualize, define, and measure places(4, 6). For example, if we were to try to understand how differences in governance relates to COVID-19 disparities (e.g.: do cities that are not pre-empted from keeping indoor dining closed have lower disparities?), we may need to consider geographical units that reflect differences in governance between states(13), rather than just urbanicity.

Future calculations of overall estimates of racial disparities in mortality burden, for COVID-19 and other disease monitoring, should incorporate the complexity of our inequitable history and present. To monitor inequities in cases and deaths at multiple levels and to ensure equitable access to testing, treatments, and vaccines, researchers and decision makers need longitudinal and more geographically granular data that allows for disaggregation. History tells us that the places and populations that bear the burden of social inequality are most vulnerable to adverse outcomes in times of emergency and crisis(25); our measures must also embody these preexisting inequities.

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Figure titles and legends

Figure 1: COVID-19 Mortality Rates by Place (Geography) and Person (Racial/Ethnic Composition) in the US, cumulatively through December 31st, 2020

Legend: Black fill indicates majority Black counties, dark grey majority Hispanic counties, light grey majority Native American counties, white majority white counties, and striped mixed (no majority) counties.

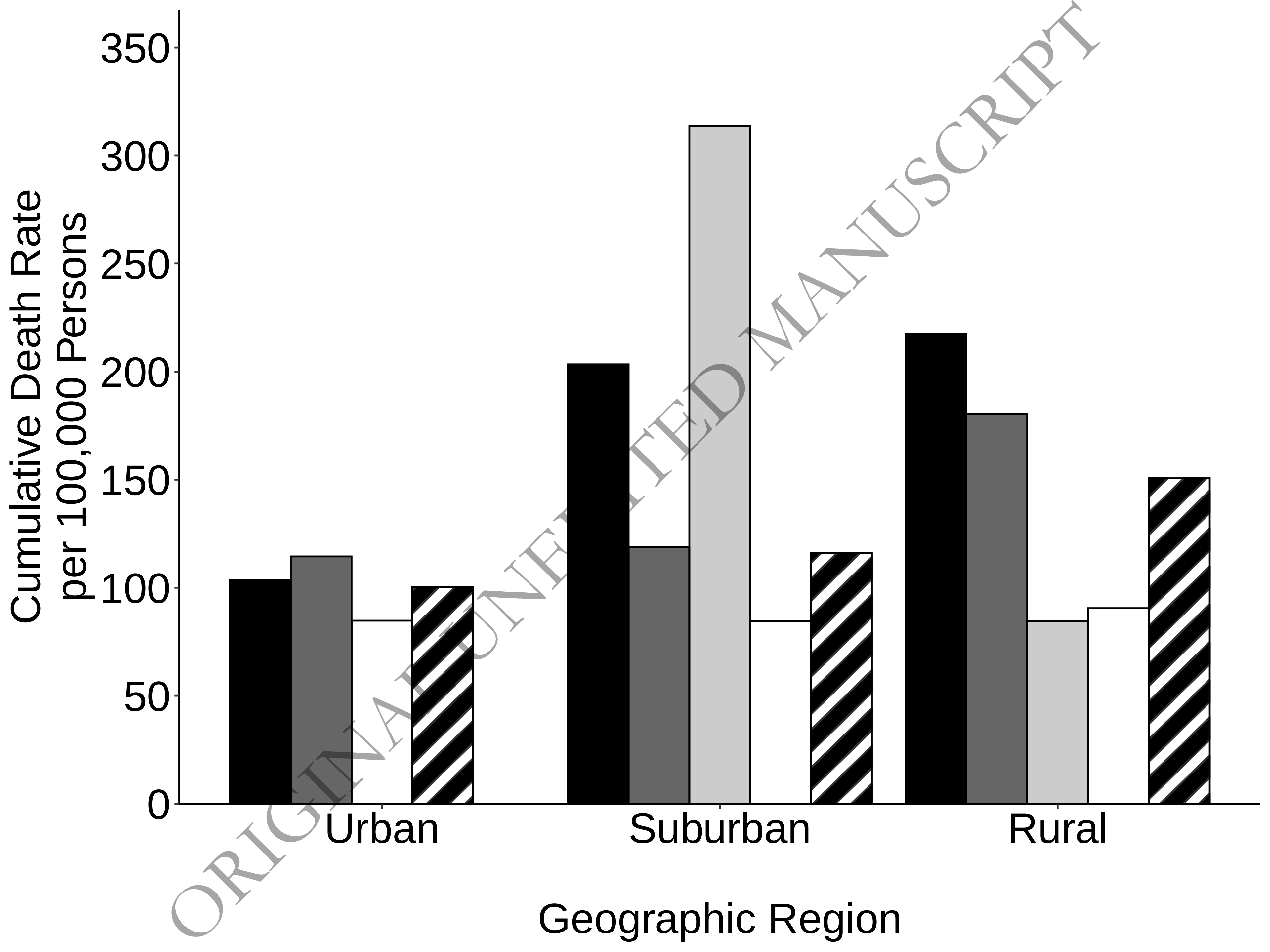
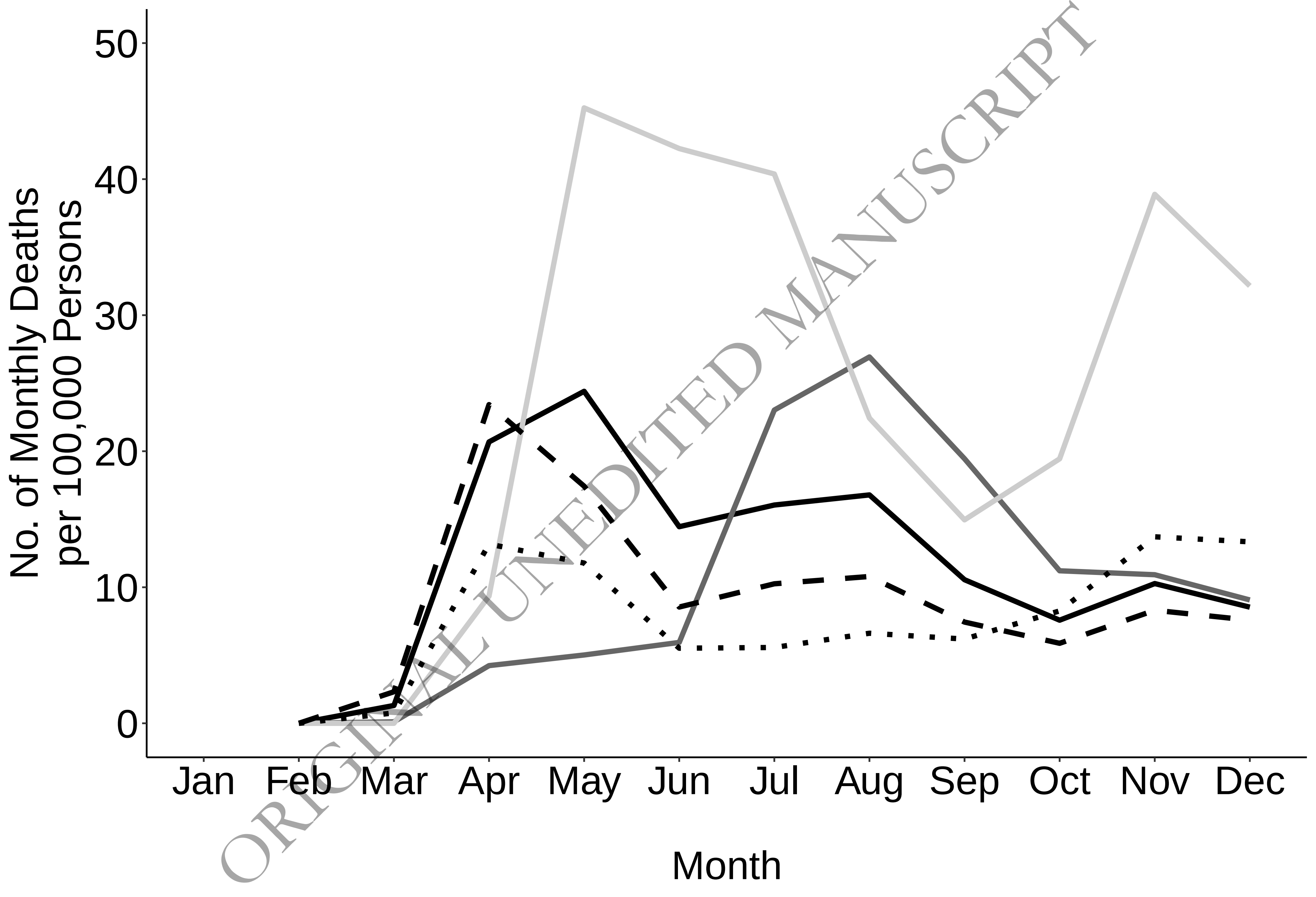

Cumulative Death Rate
per 100,000 Persons
350
300
250
200
150
100
50
0
Urban
Suburban
Rural
Geographic Region

Figure 2: COVID-19 Mortality Rates by Time and Person (Racial/Ethnic Composition) in the US, from January to December 2020

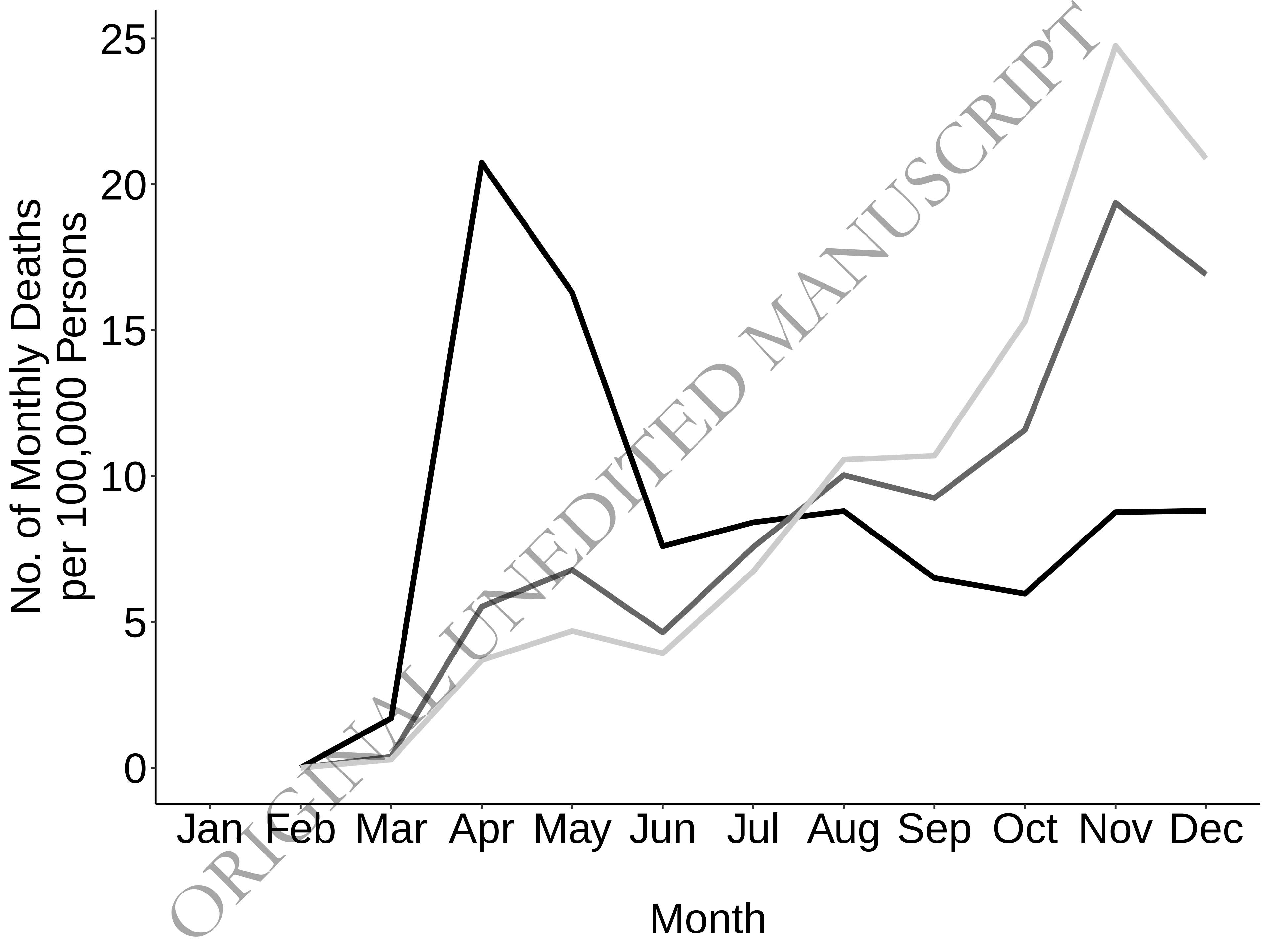
Legend: Black line indicates majority Black counties, dark grey majority Hispanic counties, light grey majority Native American counties, dots majority white counties, and dashes mixed (no majority) counties.



No. of Monthly Deaths per 100,000 Persons
0
10
20
30
40
50
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

Figure 3: COVID-19 Mortality Rates by Place (Geography) and Time in the US, from January to December 2020

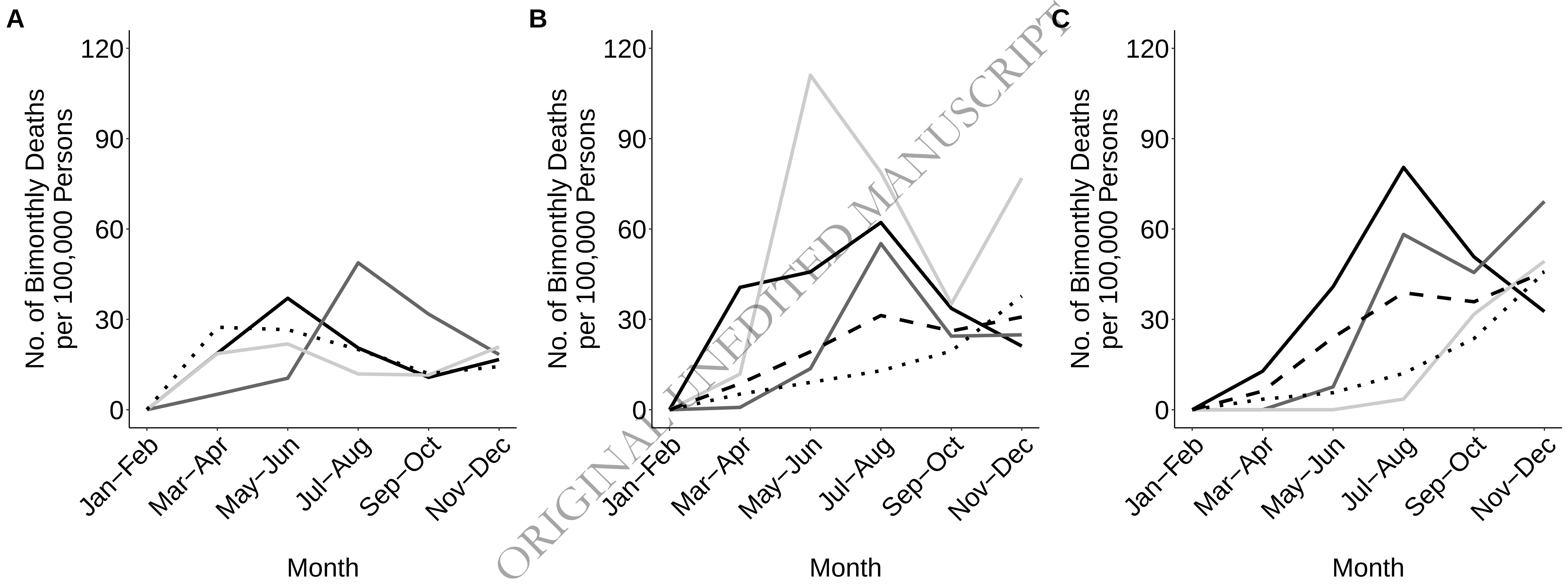
Legend: Black line indicates urban, dark grey suburban, and light grey rural geographic regions.



No. of Monthly Deaths
per 100,000 Persons
0
5
10
15
20
25
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

Figure 4: COVID-19 Mortality Rates by Place (Geography), Person (Racial/Ethnic Composition), and Time in the US, from January to December 2020

Legend: Panel A displays urban, panel B displays suburban, and panel C displays rural geographic regions. Black line indicates majority Black counties, dark grey majority Hispanic counties, light grey majority Native American counties, dots majority white counties, and dashes mixed (no majority) counties.


A
B
C
No. of Bimonthly Deaths per 100,000 Persons
0
30
60
90
120
Jan–Feb
Mar–Apr
May–Jun
Jul–Aug
Sep–Oct
Nov–Dec
Month