XXXXXX: Race, place, and police involved deaths

**N words (4805)**

## Abstract

**Objective.** To estimate mortality due to police-involved deaths by race and place in the United States.

**Methods.** We use crowdsourced police-involved fatality data collected between January 1, 2013 and May 8, 2017 to construct multilevel, Bayesian negative binomial models. We use these models to estimate fatality risk for the Blacks, Hispanics and Whites for all counties in the US.

**Results.** We estimate that police in the US. are involved, on average, in 4.5 deaths per day. Model results show that Black fatality risk is between 0.88 and 1.12 deaths per 100,000 per year, Hispanic risk is between 0.40 and 0.61, White fatality risk is between 0.36 and 0.42, and total fatality risk is between 0.36 and 0.42 deaths per 100,000 per year. This risk varies substantially across US regions and metro types.

**Conclusions.** The risk of death in an encounter with police is highly sensitive to race and place, and policing is an important social determinant of health. Despite the lack of reliable official statistics, new methods can quantify fatality risk and uncertainty with relatively sparse data that characterizes US police-involved fatality data.

**Policy Implications.** Efforts to address unequal exposure to police violence should take regional and local variation into account. Such efforts can lead to more targeted place-based interventions to reduce racial disparities in police-involved deaths. MORE?

## INTRODUCTION

Violent interactions between law enforcement and civilians are a persistent feature of American social life. 1,2 Indeed, in the United States (US), instances of police-involved mortality (i.e., deaths of civilians resulting from interactions with law enforcement) are estimated to be several-times greater than in many, economically similar countries. (CITATION NEEDED)

At the forefront of the conversation on the US’s relatively high police-involved mortality rate is race. Communities of color have argued that their members are—as evidenced by the deaths of Michael Brown, Sandra Bland, Renee Davis, Philando Castille, Tamir Rice, Laquan McDonald, Daniel Covarrubias, Eric Garner, Charleena Lyles, and many others— at disproportionate risk of police-related harm than Whites. 13,14 This claim has been borne-out in empirical studies, which (generally) show that people of color are—and have for some time been—at greater risk of experiencing police-involved harm than Whites. 8,15,16, Between 1965 and 2015, for instance, Blacks are estimated to have been between 7.5 to 2.5 times more likely than Whites to be killed in interactions with police.3

In this paper, we add to the collective project of explicating racial-disparities in police-involved deaths by describing how place factors into this social phenomenon. That is, law enforcement agencies, and their relationships with communities of color, are contingent upon the broader institutional, cultural, and legal environments in which they reside.11,12,18 In this way, place-based variation in (social-)environmental context has been shown to translate into place-based variation in police practices, behaviors, regimes, and, consequentially, outcomes. 11,12,18 We predict that racial disparities in police-involved mortality are, like other police-related outcomes, tightly coupled with geography.

To provide estimates of how geography and race interact to produce variable risks of police-involved deaths, we utilize non-traditional, crowdsourced data--which explicitly address several shortcomings of federal efforts to document deaths involving police3,4—as well as a methodological approach that allows for predictive precision of relatively rare events. Our results suggest that race and place may interact in important ways to generate risks of mortality due to police-involved deaths.

## DATA

Past work on police-involved mortality has been limited by the absence of systematic, national data on deaths involving law-enforcement.3 Law enforcement data—primarily collected through the Bureau of Justice Statistics’ (BJS) Arrest Related Deaths program or the Federal Bureau of Investigation’s (FBI) Uniform Crime Report’s Supplementary Homicide Report—are widely acknowledged to undercount the true number of deaths involving police in the US.3,19,20 To circumvent these limitations, public health scholars often utilize data from the National Center for Health Statistics’ mortality files; the National Violent Death Reporting System; the US Centers for Disease Control and Prevention’s mortality files; and various emergency department surveys.3,21–23 Though these sources offer more complete coverage of police-involved deaths than do systems that rely on voluntary police agency reporting, such as those produced by the FBI and BJS, they still suffer from under-reporting and limited geographic coverage.3

In response to the shortcomings of official data sources, journalists, activists and researchers have constructed a series of public data collection efforts that count police-involved deaths using a combination of public records and media accounts. These crowdsourced efforts are typically more comprehensive than government sources. These methodologies have been endorsed by the BJS as producing more comprehensive data on police-involved mortality, and the Bureau has proposed a re-design of the Arrested-Related Deaths Program that closely matches the design of these public and crowdsourced efforts.24

We rely on data from one of these non-traditional sources*. Fatal Encounters* is a journalist-led project that seeks to document all episodes of fatal police-civilian interactions in the United States.4 The project relies on contributions of professional and volunteer researchers compiled from media reports and public records. The universe of cases in *Fatal Encounters* is broader than similar projects, such as *The Washington Post's* compilation of data on police shootings, and has a greater temporal coverage than *The Guardian's* dataset on police-involved deaths. We use data from those dates that *Fatal Encounters* reports as complete. As of the date of access, May 8, 2017, *Fatal Encounters* reported complete data for all states between January 1, 2013 and the date of access.4 We rely on data from the 2009 - 2014 American Community Survey 5-year sample for population estimates by race/ethnicity and county.

## MEASURES

To provide a more refined examination of how race and place relate to police-involved deaths, we produce estimates of all deaths involving police recorded in *Fatal Encounters* by race/ethnicity, region, and county metro type for all 3140 U.S. counties. We include the 1588 days of data reported as complete on the date of access, and standardize all reported rate estimates to deaths per 100,000 persons in the population per year.

We utilize three categories for race and ethnicity, Black/African American, White, and Hispanic*.* Because the race/ethnicity of a victim is sometimes excluded from news reports and public records, this information is not available for all subjects in the data. For those cases with missing race information, we use surname, county of residence and a method developed by Imai and Khanna26 to predict the race and Hispanic ethnicity of a victim.[[1]](#footnote-1)

We specify place using two categorical measures. The Census Bureau groups states into nine divisions based on similarities in physical and cultural geography, as well as historical development and economics (see Appendix Table 1 for a complete list). We also use the National Center for Health’s Urban-Rural Classification Scheme, which groups all US counties into 6 categories based on population size and membership in a Metropolitan Statistical Area (see Appendix Table 2, for more information). In using this county-level approach that includes state division and county metro type classifications, we seek to maximize our ability to extract meaningful information that accounts for both variation in incidence across distinct parts of the county and across communities within geographic regions using these relatively sparse data.

## STATISTICAL MODELS

We estimate Bayesian multilevel negative binomial regression models of police-involved deaths, as a function of metropolitan-type, Census-division, and race/ethnicity. We incorporate prior information on rates of police-involved mortality produced by Krieger and colleagues (0.37 per 100,000 White mortality rate, 0.94 per 100,000 Black mortality rate) for national race-specific mortality rates to regularize estimates of mortality in the context of improved, but still sparse, data.[[2]](#footnote-2) In counties with small populations, any occurrence of police-involved mortality can dramatically inflate per-capita rates. Likewise, there are many places with small populations that did not record any police-involved deaths during the time period covered by available data, though the true risk of mortality is almost certainly non-zero. Direct estimates from observed data may also inaccurately represent risk for places with large populations, because we have a relatively small number of years available in current data. These Bayesian multilevel models produce reasonable estimates of mortality rates -- and uncertainty in mortality rates -- by both explicitly incorporating prior information about national mortality risk and by partially pooling information on mortality risk across counties.

## RESULTS

In the 4.4 years between January 1, 2013 and May 8, 2017, *Fatal Encounters* reports 7,118 police-involved deaths, an average of approximately 4.5 deaths per day or a rate of 0.52 per 100,000 population per year. Of the victims during this time period, 1,716 were Black (0.99 per 100,00 per year), 1,138 were Hispanic (0.48 per 100,000 per year), 3,306 were White (0.39 per 100,00 per year), and 958 were from another group or could not be classified using our methods.Our models estimate, with 95% certainty that the risk of mortality in interactions with law enforcement in the U.S. is between 0.49 and 0.58 per 100,000 population per year. Among African Americans, we estimate a risk between 0.88 and 1.11 deaths per 100,000 per year, that Hispanic risk is between 0.40 and 0.61, and that risk for Whites is between 0.36 and 0.42 per year per 100,000. At 2015 population levels, our models predict between 1538 and 1823 total police-involved deaths in a year, between 352 and 445 African American deaths, between 216 and 330 Hispanic deaths, and between 717 and 829 White deaths .

Table 1 displays data on police-involved deaths by Census-division and metropolitan type as recorded in *Fatal Encounters*, and suggests that experiences of police-involved mortality vary by place. For example, Large fringe metros – suburban counties in metropolitan statistical areas (MSA) with populations above 1 million that do not contain the MSA’s principle city (such as Pierce County, which houses Tacoma, WA, in the Seattle-Tacoma MSA) -- have the lowest rates of police-related fatalities among all metropolitan-types. Note that while the absolute mortality rate among this metro-type varies by division -- from 0.17 per 100,000 in the Middle Atlantic, to 0.66 per 100,000 in the West South Central --- its relative, within division rank remains approximately the same in all cases. Additionally, Large central metros (counties in MSAs of over 1 million population that contain, all or a plurality of, the MSA’s principle city, such as King County, which houses Seattle, WA, in the Seattle-Tacoma MSA) typically have near division-average rates, while medium metro-type (counties in MSAs of between 250,000 and 1,000,000 population, such as Spokane County, WA) and smaller, often, have the highest rates of police-related fatalities. Observed mortality rates vary dramatically between Census divisions: Pacific division counties, for example, have rates that are 1.5 to 2 times larger than equivalent New England counties.

The geographic heterogeneity displayed in Table 1 demonstrates that places vary substantially in rates of observed police-involved deaths. To assess how race interacts with place to create geographically variable risk, Figure 1 plots our model-based estimates for mortality rates for each racial group, metropolitan type, and Census-division.[[3]](#footnote-3) These model-based predictions provide more plausible estimates of mortality risk than those derived directly from the observed data. By regularizing estimates through the incorporation of prior information on mortality risk and by partially pooling estimates across counties, we produce risk estimates that smooth implausibly low or high estimates of risk produced by observations of a relatively rare event over a wide geography and relatively short time window.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Table 1.** Police-involved deaths in the U.S. by metro type and Census division, January 1, 2013 through May 8, 2017, count and annual rate per 100,000 population | | | | | | | |
| Census Division | Large Central Metro | Large Fringe Metro | Medium Metro | Small Metro | Micro-politan | Noncore | *Total* |
| East North Central | 323  (0.58) | 139  (0.26) | 127  (0.39) | 75  (0.33) | 81  (0.32) | 39  (0.31) | 784  (0.39) |
| East South Central | 84  (0.64) | 39  (0.35) | 120  (0.60) | 83  (0.80) | 82  (0.59) | 97  (0.76) | 505  (0.62) |
| Middle Atlantic | 166  (0.26) | 111  (0.17) | 110  (0.41) | 23  (0.23) | 23  (0.25) | 10  (0.28) | 443  (0.25) |
| Mountain | 240  (0.71) | 57  (0.52) | 188  (0.75) | 110  (0.85) | 76  (0.68) | 39  (0.67) | 710  (0.71) |
| New England | 23  (0.23) | 41  (0.18) | 54  (0.27) | 16  (0.45) | 13  (0.27) | 13  (0.46) | 160  (0.25) |
| Pacific | 685  (0.58) | 179  (0.51) | 309  (0.68) | 98  (0.75) | 58  (0.67) | 21  (0.68) | 1350  (0.60) |
| South Atlantic | 309  (0.57) | 394  (0.42) | 392  (0.61) | 115  (0.45) | 108  (0.62) | 75  (0.51) | 1393  (0.52) |
| West North Central | 107  (0.90) | 91  (0.44) | 123  (0.79) | 64  (0.45) | 59  (0.43) | 63  (0.43) | 507  (0.56) |
| West South Central | 476  (0.80) | 181  (0.66) | 283  (0.76) | 93  (0.69) | 120  (0.81) | 113  (0.90) | 1266  (0.77) |
| *Total* | 2413  (0.57) | 1232  (0.36) | 1706  (0.59) | 677  (0.54) | 620  (0.52) | 470  (0.57) | 7118  (0.52) |
| *Note:* Data from *Fatal Encounters*, accessed 5/9/17 | | | | | | | |

Figure 1 displays model-based posterior predictions for police-involved mortality risk by Census division for African Americans, Hispanics, and Whites, along with point estimates calculated from the observed *Fatal Encounters* data. For all Census divisions, both the observed data and model-based estimates show that African Americans are at higher risk of police-involved mortality than are either Whites or Hispanics. While the median mortality rate for African Americans is higher than the median rate for Whites across all divisions, the distribution of predicted Black mortality rates reveals a both a high median and a very high degree of uncertainty in underlying risk. For example, our models estimate a risk of police-involved mortality for African Americans in the Pacific region of between 0.68 and 2.71 per 100,000 per year with 95 percent posterior certainty, compared to a 95 percent interval of 0.31 and 0.8 for White mortality in Pacific states. The coefficient of variation of simulated mortality rates for African Americans in Pacific states is about 3 times greater than the coefficient of variation of simulated White mortality rates. While White mortality rates within Census divisions are relatively stable, these right-skewed distributions illustrate that Black mortality rates are often exceptionally high.

Predicted Hispanic mortality rates have less pronounced, but still substantial right tails in their distributions for the West South Central, Mountain, and New England regions. In these regions, the median expectation of Hispanic mortality is near the median expectation of White mortality, but the models often predict rates of mortality that are substantially higher than White rates. For example, in the West South Central region, our models often predict very high rates of Hispanic police-involved mortality, with a 95 percent interval of between 0.37 and 1.48 expected deaths per 100,000 per year. Whites are at their highest risk of police-involved mortality in the West South Central, where the median estimated mortality rate for Whites is greatest, our models predict between a White mortality risk of between 0.42 and 0.94 per 100,000. In the South Atlantic and East South Central regions, both the observed data and our model results suggest that Hispanics are at lower risk of police-involved mortality than are Whites.

Figure 2 illustrates both predicted and observed rates of police-involved mortality across county types. Variation across regions is more pronounced than is variation across county metro types, particularly for African Americans. Large central, medium, and noncore rural metros both high observed and predicted rates of police-involved mortality. We predict that large central metro counties will have between 0.57 and 1.28 law enforcement involved deaths per 100,000 population per year, while medium metros will have a rate of mortality between 0.59 and 1.25 per 100,000 and noncore (rural) counties will have between 0.57 and 1.22 deaths per 100,000. While racial/ethnic differences are pronounced, the basic substantive pattern of a stable and lower White rate, a low but dispersed Hispanic rate, and a high and dispersed Black rate holds for all county metro types. Our models suggest that, in general, variation in mortality risk across Census divisions is more pronounced than is variation across county metro types. The variance of model estimated intercepts for Census divisions is much greater than the variance of estimated intercepts for county metro types for all groups except for African Americans, for whom the magnitude of variance in mortality risk across county types and Census divisions are nearly equal.

Figure 3 illustrates the combined relationships between racial inequalities in police-involved mortality, region, and county metro type. We display the ratio of Black/White and Hispanic/White police involved mortality rates by Census division and county metro type, and indicate whether the 95 percent posterior prediction interval for these rate ratios include one (equal mortality risk). We estimate a median expectation of Black/White inequality for all U.S. counties. Posterior prediction intervals for the ratio of Black/White mortality risk do not include 1 in large central metros in the East North Central, Middle Atlantic, New England, and West North Central divisions, and in medium metros in the East North Central, Middle Atlantic, and West North Central divisions. In each of these metro groups, our models estimate a median risk of Black police-involved mortality that is five times greater than the risk of White police involved mortality. The distribution of these predictions have exceptionally long right tails; the 95 percent posterior prediction interval for Black/White mortality risk in large central metros in the East North Central division is bounded by 1.4 and 21.7. We estimate Hispanic mortality risk to be similar to White mortality risk in the East North Central, Middle Atlantic, Pacific, West North Central, and West South Central divisions. In the East South Central and South Atlantic, our median expectation is for a Hispanic/White mortality rate ratio less than one, and in New England and Mountain divisions, we predict a median Hispanic/White mortality rate ratio greater than one for all metro types. No metro/division combination has a predicted Hispanic/White mortality rate ratio with a 95 percent posterior prediction interval that excludes one.

|  |
| --- |
| **Figure 1.** Police-involved mortality rates by Census division and race/ethnicity, density of posterior predictions and observed values (points) |
|  |

|  |
| --- |
| **Figure 2.** Police-involved mortality rates by county metro type and race/ethnicity, density of posterior predictions and observed values (points) |
|  |

|  |
| --- |
| **Figure 3.** Mortality rate ratio by race/ethnicity, Census division, and county metro type. Large points indicate the 90 percent posterior prediction interval does not include 1. |
|  |

## DISCUSSION

I LEAVE REVISION OF THE DISCUSSION TO YOU ALL, BUT HERE’S MY EFFORT AT A REVISION

1. UPDATE PRIORS

Our results largely conform to prior estimates of mortality risk produce by Krieger, Kiang Chen and Waterman (CITE). Using mortality files, they estimated a 2005 mortality rate of 0.94 per 100,000 for African Americans, and a 0.37 per 100,000 mortality rate for Whites. Using data from 2013 through 2017, we estimate with 95 percent posterior certainty that the risk of police-involved death at the national-level lies between 0.88 and 1.11 per 100,000 for African Americans, 0.36 and 0.42 for Whites, 0.40 and 0.61 for Hispanics and 0.49 and 0.58 for the full population.

Our models estimate, with 95% certainty that the risk of mortality in interactions with law enforcement in the U.S. is between 0.49 and 0.58 per 100,000 population per year. Among African Americans, we estimate a risk between 0.88 and 1.11 deaths per 100,000 per year, that Hispanic risk is between 0.40 and 0.61, and that risk for Whites is between 0.36 and 0.42 per year per 100,000

1. ESTIMATE UNCERTAINTY, ML AND BAYES AS USEFUL METHODS
2. GEO HETEROGENEITY
3. INEQUALITY
4. POLICY?

STATE MAIN FINDINGS: AF AM AND LATINO AT HIGHER RISK OF DEATH. RISK IS HIGHEST IN X. Using novel data from *Fatal Encounters*, in conjunction with a modeling approach that can better account for uncertainty in estimates of rare cases, we show that race and place interact to generate heterogeneous risks of police-involved deaths. ADD COMPARISON TO OBSERVED RATES. Latinos are most vulnerable to police-involved death in rural counties and medium-sized urban and suburban counties, and in a contiguous set of states in the Southwest and Mountain West. Similarly, White risk appears to be highest in rural, Mountain and Southwest states, while African-American risk is highest in cities and in West coast and Midwestern states.

Our results further show that racial disparities in police-involved deaths vary by place. Relative to Whites, Black rates of police involved deaths are particularly outsized in medium and large central metros, in Midwestern and East Coast states. Latinx/White rate ratios vary much less significantly across the nation. In sum, when understanding police-involved fatality risk we must consider both race and place simultaneously.

These results raise provocative questions about how local and regional policing regimes may affect mortality risk. Indeed, prior research has shown that Geography/environment/place is known to be a social determinant of health; where one lives dictates access/what risks one is exposed too (CITE). However, in the majority of empirical studies, “place matters” is often realized as distribution of physical resources (e.g., access to doctors; healthy food) or disease/illness giving environmental factors (e.g., power plants; lead). Important, of course, but it is also helpful to take up call, and examine how variation in social/cultural environment impacts health, particularly for vulnerable/minority populations. There are examples of research that have been able to link social and policy environments to health outcomes. For example, multiple dimension of the social environment have been linked to suicide Attempts in Lesbian, Gay, and Bisexual Youth (CITE Hatzenbueler papers). Especially when trying to understand race---and racial disparities---as it relates to population health; structural forces/logic that dictate experience of race vary by place; can (may) have important implications for how we understand race in (a cite for someone doing work like this). WE NEED TO INSERT A GOOD POLICING PRACTICES EXAMPLE HERE. Lots of prior work shows that variation in policing regimes, and relationship to communities of color, vary according to local, racial/racialized logic; our paper shows that similar heterogeneity exists in health outcome.

* Lesson in disaggregating

-Discussion of limitations and how our work is still a contribution despite limitations (need for better data in future, etc.)

Our findings suggest that there may be a need for more targeted place-based interventions to reduce racial disparities in police-involved deaths. Policies and interventions that better able to account for heterogeneity across states and metropolitan areas may work better to reduce absolute and racial disparities in police deaths. {If this runs contrary to proposal by Black Lives Matter etc., we need to speak to that. ENGAGE MOVEMENT FOR BLK LIVES PLATFORM? ENGAGE OTHER ACTIVE REFORM EFFORTS}. For example, XXXX. Finally, researchers need to take serious consideration of police fatality estimates that are rare, to avoid overstating or understating patterns of death that have serious consequences for public opinion and public safety.

## References

1. James J, ed. *Warfare in the American Homeland: Policing and Prison in a Penal Democracy*. Durham: Duke University Press; 2007.

2. Alang S, McAlpine D, McCreedy E, Hardeman R. Police Brutality and Black Health: Setting the Agenda for Public Health Scholars. *Am J Public Health*. 2017;107(5):662-665. doi:10.2105/AJPH.2017.303691.

3. Krieger N, Chen JT, Waterman PD, Kiang MV, Feldman J. Police Killings and Police Deaths Are Public Health Data and Can Be Counted. *PLOS Med*. 2015;12(12):e1001915. doi:10.1371/journal.pmed.1001915.

4. Burghart DB. Fatal encounters. http://www.fatalencounters.org. Published 2015. Accessed May 9, 2017.

5. Cooper HLF, Fullilove M. Editorial: Excessive Police Violence as a Public Health Issue. *J Urban Health*. 2016;93(1):1-7. doi:10.1007/s11524-016-0040-2.

6. Crosby AE, Lyons B. Assessing Homicides by and of U.S. Law-Enforcement Officers. *N Engl J Med*. 2016;375(16):1509-1511. doi:10.1056/NEJMp1609905.

7. Furtado K, Banks KH. A Research Agenda for Racial Equity: Applications of the Ferguson Commission Report to Public Health. *Am J Public Health*. 2016;106(11):1926-1931. doi:10.2105/AJPH.2016.303390.

8. Krieger N, Kiang MV, Chen JT, Waterman PD. Trends in US deaths due to legal intervention among black and white men, age 15–34 years, by county income level: 1960–2010. *Harv Public Health Rev*. 2015;3:1–5.

9. Wildeman C, Noonan ME, Golinelli D, Carson EA, Emanuel N. State-level variation in the imprisonment-mortality relationship, 2001- 2010. *Demogr Res*. 2016;34:359–372.

10. Dwyer-Lindgren L, Bertozzi-Villa A, Stubbs RW, et al. Inequalities in Life Expectancy Among US Counties, 1980 to 2014: Temporal Trends and Key Drivers. *JAMA Intern Med*. May 2017. doi:10.1001/jamainternmed.2017.0918.

11. Capers IB. Policing, race, and place. *Harv Civ Rights-Civ Lib Law Rev*. 2009;44:43-78.

12. Beckett K, Nyrop K, Pfingst L. Race, Drugs, and Policing: Understanding Disparities in Drug Delivery Arrests. *Criminology*. 2006;44(1):105-137. doi:10.1111/j.1745-9125.2006.00044.x.

13. Taylor K-Y. *From #Blacklivesmatter to Black Liberation*. Chicago, IL: Haymarket Books; 2016. http://books.google.com/books?hl=en&lr=&id=kB6GCwAAQBAJ&oi=fnd&pg=PP1&dq=info:yeks29K\_9EsJ:scholar.google.com&ots=7nFWOwQAmI&sig=AoZajxVueZ3-TeIrHroAbuKY-WE.

14. Losier T. “The Public Does Not Believe the Police Can Police Themselves”: The Mayoral Administration of Harold Washington and the Problem of Police Impunity. *J Urban Hist*. May 2017:0096144217705490. doi:10.1177/0096144217705490.

15. DeGue S, Fowler KA, Calkins C. Deaths Due to Use of Lethal Force by Law Enforcement: Findings From the National Violent Death Reporting System, 17 U.S. States, 2009–2012. *Am J Prev Med*. 2016;51(5, Supplement 3):S173-S187. doi:10.1016/j.amepre.2016.08.027.

16. Miller TR, Lawrence BA, Carlson NN, et al. Perils of police action: a cautionary tale from US data sets. *Inj Prev*. 2017;23(1):27-32. doi:10.1136/injuryprev-2016-042023.

17. Ross CT. A Multi-Level Bayesian Analysis of Racial Bias in Police Shootings at the County-Level in the United States, 2011–2014. *PLOS ONE*. 2015;10(11):e0141854. doi:10.1371/journal.pone.0141854.

18. Barker V. *The Politics of Imprisonment: How the Democratic Process Shapes the Way America Punishes Offenders*. New York, NY: Oxford University Press; 2009.

19. Planty M, Burch AM, Banks D, Couzens L, Blanton C, Cribb D. *Arrest-Related Deaths Program: Data Quality Profile*. Washington, DC: U.S. Department of Justice, Office of Justice Programs, Bureau of Justice Statistics; 2015. https://www.publicsafety.gc.ca/lbrr/archives/cnmcs-plcng/cn33640-eng.pdf.

20. Klinger D, Rosenfeld R, Isom D, Deckard M. Race, Crime, and the Micro-Ecology of Deadly Force. *Criminol Public Policy*. 2016;15(1):193-222. doi:10.1111/1745-9133.12174.

21. Feldman JM, Chen JT, Waterman PD, Krieger N. Temporal Trends and Racial/Ethnic Inequalities for Legal Intervention Injuries Treated in Emergency Departments: US Men and Women Age 15–34, 2001–2014. *J Urban Health*. 2016;93(5):797-807. doi:10.1007/s11524-016-0076-3.

22. Kaufman EJ, Karp DN, Delgado MK. US Emergency Department Encounters for Law Enforcement–Associated Injury, 2006-2012. *JAMA Surg*. April 2017. doi:10.1001/jamasurg.2017.0574.

23. Barber C, Azrael D, Cohen A, et al. Homicides by Police: Comparing Counts From the National Violent Death Reporting System, Vital Statistics, and Supplementary Homicide Reports. *Am J Public Health*. 2016;106(5):922-927. doi:10.2105/AJPH.2016.303074.

24. Banks D, Ruddle P, Kennedy E, Planty M. *Arrest-Related Deaths Program Redesign Study, 2015-216: Preliminary Findings*. Washington, DC: U.S. Department of Justice, Office of Justice Programs, Bureau of Justice Statistics; 2016. https://www.bjs.gov/content/pub/pdf/ardprs1516pf.pdf. Accessed May 8, 2017.

25. Ruggles SJ, Alexander JT, Genadek K, Goeken R, Schroeder MB, Sobek M. *Integrated Public Use Microdata Series: Version 5.0 [Machine-Readable Database]*. Minneapolis, MN: University of Minnesota; 2010.

26. Imai K, Khanna K. Improving ecological inference by predicting individual ethnicity from voter registration records. *Polit Anal*. 2016;24(2):263–272.

## Appendix

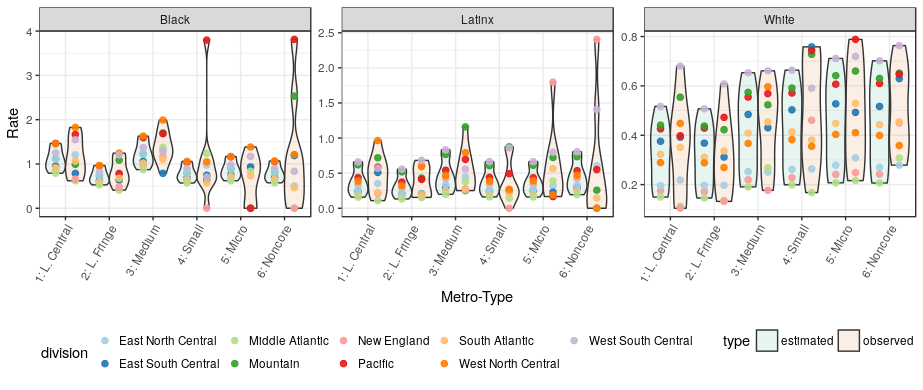
|  |  |
| --- | --- |
| Appendix Table 1. States in Census Divisions | |
| Division Name | States Included |
| East North Central | IL, IN, OH, MI, WI |
| East South Central | AL, KY, MS, TN |
| Middle Atlantic | NJ, NY, PA |
| Mountain | AZ, CO, ID, MT, NM, NV, UT, WY |
| New England | CT, MA, ME, NH, VT |
| Pacific | AK, CA, HI, OR, WA |
| South Atlantic | DE, FL, GA, MD, NC, SC, VA, WV |
| West North Central | IA, KS, MN, MO, ND, NE, SD |
| West South Central | AR, LA, OK, TX |
| ADD CITATION | |

|  |  |  |
| --- | --- | --- |
| Appendix Table 2. Description of NCHS Urban-Rural County Classification | | |
| County Type | Description | Number of Counties |
| Large Central Metro | counties in MSA of 1 million population that: 1) contain the entire population of the largest principal city of the MSA, or 2) are completely contained within the largest principal city of the MSA, or 3) contain at least 250,000 residents of any principal city in the MSA. | 68 |
| Large Fringe Metro | counties in MSA of 1 million or more population that do not qualify as large central | 368 |
| Medium Metro | Medium metro counties in MSA of 250,000-999,999 population. | 372 |
| Small Metro | Small metro counties are counties in MSAs of less than 250,000 population. | 358 |
| Micropolitan | Nonmetropolitan counties: Micropolitan counties in micropolitan statistical area | 641 |
| Noncore | Noncore counties not in micropolitan statistical areas | 1333 |
| Citation: https://www.cdc.gov/nchs/data/series/sr\_02/sr02\_166.pdf | | |

|  |  |  |  |
| --- | --- | --- | --- |
| Appendix Table 3. Posterior police related mortality by race/ethnicity, census region, and metro type, 95 percent credible intervals | | | |
| **County Name** | **Black** | **Latinx** | **White** |
| East North Central |  |  |  |
| - Large Central Metro | 1.1 (0.4, 2.4) | 0.3 (0, 0.8) | 0.2 (0.1, 0.5) |
| - Large Fringe Metro | 0.7 (0.2, 1.6) | 0.2 (0, 0.7) | 0.2 (0.1, 0.4) |
| - Medium Metro | 1.2 (0.4, 2.7) | 0.3 (0.1, 1) | 0.3 (0.1, 0.6) |
| - Small Metro | 0.8 (0.3, 1.8) | 0.3 (0, 0.8) | 0.3 (0.1, 0.6) |
| - Micropolitan | 0.9 (0.3, 2) | 0.3 (0.1, 0.9) | 0.3 (0.1, 0.6) |
| - Noncore | 0.8 (0.3, 1.8) | 0.3 (0.1, 1) | 0.3 (0.1, 0.6) |
| East South Central |  |  |  |
| - Large Central Metro | 0.9 (0.3, 2.1) | 0.2 (0, 0.8) | 0.4 (0.1, 0.9) |
| - Large Fringe Metro | 0.6 (0.2, 1.4) | 0.2 (0, 0.7) | 0.4 (0.1, 0.8) |
| - Medium Metro | 1.1 (0.4, 2.3) | 0.3 (0.1, 1) | 0.5 (0.2, 1.1) |
| - Small Metro | 0.7 (0.2, 1.6) | 0.2 (0, 0.8) | 0.5 (0.2, 1.1) |
| - Micropolitan | 0.8 (0.3, 1.7) | 0.2 (0, 0.8) | 0.5 (0.2, 1.2) |
| - Noncore | 0.7 (0.2, 1.6) | 0.3 (0.1, 1) | 0.5 (0.2, 1.2) |
| Middle Atlantic |  |  |  |
| - Large Central Metro | 0.8 (0.3, 1.8) | 0.2 (0, 0.5) | 0.1 (0.1, 0.3) |
| - Large Fringe Metro | 0.5 (0.2, 1.2) | 0.1 (0, 0.4) | 0.1 (0.1, 0.3) |
| - Medium Metro | 0.9 (0.3, 2) | 0.2 (0, 0.6) | 0.2 (0.1, 0.4) |
| - Small Metro | 0.6 (0.2, 1.3) | 0.2 (0, 0.5) | 0.2 (0.1, 0.5) |
| - Micropolitan | 0.6 (0.2, 1.5) | 0.2 (0, 0.5) | 0.2 (0.1, 0.5) |
| - Noncore | 0.6 (0.2, 1.4) | 0.2 (0, 0.6) | 0.2 (0.1, 0.5) |
| Mountain |  |  |  |
| - Large Central Metro | 1.1 (0.4, 2.6) | 0.6 (0.1, 1.7) | 0.4 (0.2, 1) |
| - Large Fringe Metro | 0.7 (0.2, 1.7) | 0.5 (0.1, 1.5) | 0.4 (0.1, 1) |
| - Medium Metro | 1.2 (0.4, 2.8) | 0.8 (0.2, 2.2) | 0.6 (0.2, 1.3) |
| - Small Metro | 0.8 (0.3, 1.9) | 0.6 (0.1, 1.8) | 0.6 (0.2, 1.3) |
| - Micropolitan | 0.9 (0.3, 2.1) | 0.6 (0.1, 1.8) | 0.6 (0.2, 1.4) |
| - Noncore | 0.8 (0.3, 2) | 0.7 (0.1, 2.2) | 0.6 (0.2, 1.4) |
| New England |  |  |  |
| - Large Central Metro | 0.9 (0.3, 2) | 0.3 (0.1, 1.1) | 0.2 (0.1, 0.4) |
| - Large Fringe Metro | 0.6 (0.2, 1.4) | 0.3 (0.1, 0.9) | 0.2 (0.1, 0.4) |
| - Medium Metro | 1 (0.3, 2.3) | 0.4 (0.1, 1.3) | 0.2 (0.1, 0.5) |
| - Small Metro | 0.6 (0.2, 1.5) | 0.3 (0.1, 1.1) | 0.2 (0.1, 0.5) |
| - Micropolitan | 0.7 (0.2, 1.6) | 0.3 (0.1, 1.1) | 0.2 (0.1, 0.6) |
| - Noncore | 0.6 (0.2, 1.5) | 0.4 (0.1, 1.4) | 0.2 (0.1, 0.6) |
| Pacific |  |  |  |
| - Large Central Metro | 1.5 (0.5, 3.2) | 0.4 (0.1, 1.3) | 0.4 (0.1, 1) |
| - Large Fringe Metro | 1 (0.3, 2.1) | 0.4 (0.1, 1) | 0.4 (0.1, 1) |
| - Medium Metro | 1.6 (0.5, 3.6) | 0.5 (0.1, 1.6) | 0.6 (0.2, 1.3) |
| - Small Metro | 1 (0.4, 2.4) | 0.4 (0.1, 1.2) | 0.6 (0.2, 1.3) |
| - Micropolitan | 1.2 (0.4, 2.7) | 0.4 (0.1, 1.3) | 0.6 (0.2, 1.4) |
| - Noncore | 1.1 (0.4, 2.5) | 0.5 (0.1, 1.6) | 0.6 (0.2, 1.4) |
| South Atlantic |  |  |  |
| - Large Central Metro | 0.9 (0.3, 2) | 0.2 (0, 0.6) | 0.3 (0.1, 0.7) |
| - Large Fringe Metro | 0.6 (0.2, 1.3) | 0.2 (0, 0.5) | 0.3 (0.1, 0.7) |
| - Medium Metro | 1 (0.3, 2.2) | 0.2 (0.1, 0.8) | 0.4 (0.1, 0.9) |
| - Small Metro | 0.7 (0.2, 1.5) | 0.2 (0, 0.6) | 0.4 (0.1, 0.9) |
| - Micropolitan | 0.7 (0.2, 1.6) | 0.2 (0, 0.6) | 0.4 (0.2, 1) |
| - Noncore | 0.7 (0.2, 1.5) | 0.3 (0, 0.7) | 0.4 (0.2, 1) |
| West North Central |  |  |  |
| - Large Central Metro | 1.4 (0.5, 3.3) | 0.4 (0.1, 1.2) | 0.3 (0.1, 0.6) |
| - Large Fringe Metro | 1 (0.3, 2.2) | 0.3 (0.1, 1) | 0.3 (0.1, 0.6) |
| - Medium Metro | 1.6 (0.5, 3.8) | 0.5 (0.1, 1.4) | 0.4 (0.1, 0.8) |
| - Small Metro | 1.1 (0.4, 2.4) | 0.4 (0.1, 1.1) | 0.4 (0.1, 0.8) |
| - Micropolitan | 1.2 (0.4, 2.6) | 0.4 (0.1, 1.2) | 0.4 (0.1, 0.9) |
| - Noncore | 1.1 (0.3, 2.5) | 0.5 (0.1, 1.4) | 0.4 (0.1, 0.9) |
| West South Central |  |  |  |
| - Large Central Metro | 1.2 (0.4, 2.7) | 0.7 (0.1, 1.9) | 0.5 (0.2, 1.1) |
| - Large Fringe Metro | 0.8 (0.3, 1.8) | 0.6 (0.1, 1.6) | 0.5 (0.2, 1.1) |
| - Medium Metro | 1.4 (0.5, 3.1) | 0.8 (0.2, 2.3) | 0.7 (0.2, 1.4) |
| - Small Metro | 0.9 (0.3, 2) | 0.7 (0.1, 2) | 0.7 (0.2, 1.5) |
| - Micropolitan | 1 (0.3, 2.2) | 0.7 (0.1, 1.9) | 0.7 (0.2, 1.6) |
| - Noncore | 0.9 (0.3, 2.1) | 0.8 (0.2, 2.4) | 0.7 (0.2, 1.6) |

**Bayesian Utility**

Figure A1 gives violin plots of (both observed and model-estimated) race-specific police-involved mortality rates, for each metropolitan-type and division:



***Figure A1.*** *Violin plots of observed and model estimated race-specific police-related fatalities by metro-type and Census-divisions. Note: rates are per year, per 100,000 population*.

Figure A1 illustrates the effects/utility our Bayesian approach. Consider the difference between the observed and estimate rates of police-related mortality among Blacks in Pacific, noncore metros (approximately 3.8 and 1.1 per year, per 100,000, respectively). Here, the, extremely, high observed mortality rate is the product of a sparse Black population/mortality count: Pacific noncore metros had, in sum, a Black population of 6,045 individuals, 1 of whom was killed by police. While this outcome is striking, and the circumstances that generated it are certainly worth further consideration---especially given that only 10 Black individuals lived in the county where the lone individual was killed---there is uncertainty around whether this observed rate is a product of a “true” underlying risk of mortality. The model predicted rates attempt to account for this, by pulling weakly supported points back to our prior beliefs (national averages). In places where more data exists---e.g., in Large Fringe or Medium Metros of all division---we have more trust that data reflects true underlying risks, and so predicted values are more similar to the observed data.

1. This approach fails to classify about 10 percent of victims, using a 75 percent posterior inclusion threshold. These unclassified cases are excluded from race-specific calculations but are included in estimates and models of total mortality. [↑](#footnote-ref-1)
2. Priors for model intercepts are specified for White and Hispanic mortality risk as: and for Black mortality risk as: . [↑](#footnote-ref-2)
3. Full model predictions, which include more granular race by division by metro type estimates, are provided in Appendix Table 3. [↑](#footnote-ref-3)