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Publication Date

2021

DOI

10.1016/j.annepidem.2020.08.014

Peer reviewed

HHS Public Access

Author manuscript

Ann Epidemiol. Author manuscript; available in PMC 2022 January 01.

Published in final edited form as:

Ann Epidemiol. 2021 January ; 53: 42–49.e3. doi:10.1016/j.annepidem.2020.08.014.

Black and unarmed: Statistical interaction between age, perceived mental illness, and geographic region among males fatally shot by police using case-only design

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Abstract

Purpose: We examine whether race and armed status interact to modify the risk of being fatally shot by police within categories of civilian age and mental illness status, and US region.

Methods: Data are from *The Washington Post* online public-use database of all US police-involved shooting deaths. The sample includes Black and White males with known armed status who were killed 1/1/2015 through 12/31/2019 (*N=3,090*). A case-only design is employed to assess multiplicative interaction using adjusted logistic regression.

Results: The fully-adjusted interaction estimate is null (S_{OR}=0.75; 95% CI=0.55–1.04). However, adjusted estimates within strata show that the risk of being armed versus unarmed when fatally shot is smaller for Black compared to White males over age 54 (S_{OR}=0.18; 95% CI=0.06–0.65), those showing mental illness signs (S_{OR}=0.50; 95% CI=0.26–0.98), and those killed in the South (S_{OR}=0.52; 95% CI=0.33–0.83), and that the risk is greater in the Midwest (S_{OR}=2.42; 95% CI=1.11–5.26). Notably, there is no Black-White difference in armed status among younger age groups (S_{OR}≈0.89).

Conclusion: Race and armed status may interact leaving Black males at higher risk of being unarmed compared to White males when fatally shot by police among those over age 54, mentally impaired, and residing in the South. Causal interaction suggests a lower risk for unarmed Blacks in

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MD Thomas, primary investigator, conceptualized the study, coordinated all logistics related to data collection, cleaning, and coding, designed and performed all statistical analyses (and takes responsibility for the integrity of the data analyzed), and took final responsibility for drafting the manuscript; NP Jewell assisted in data analysis and interpretation, and editing and approval of the manuscript; AM Allen assisted with the design of the study, data analysis and interpretation, and editing and approval of the manuscript.

the Midwest. Researchers should further explore the utility of case-only design to study social-environmental interaction.

INTRODUCTION

Following numerous high-profile police shootings in the United States (US), the killing of unarmed Black men at the hands of law enforcement has become a primary focus of public health and social justice concern.[1–17] Establishing whether true disparities exist by racial and gender group has been challenging using government databases due to the under-reporting of deaths from *legal intervention*[18–25]— "injuries inflicted by the police or other law-enforcing agents, including military on duty, in the course of arresting or attempting to arrest lawbreakers, suppressing disturbances, maintaining order, and other legal action." [21] As a result, *The Washington Post* (*WaPo*) and *The Guardian* newspapers began counting the number of people killed by police in 2015, and collecting other concomitant information.[26,27] *The Guardian's* database is substantially more reliable than government systems[21,22] and shows 98% agreement with *WaPo.*[28]

Research using more reliable databases reveal that compared to Whites, Blacks are more likely to be stopped,[29–31] to be arrested,[31,32] to experience police use-of-force,[30,33–35] to experience lethal force,[4,12,15,16,36–38] and to be fatally shot when unarmed.[4,16,39,40] In addition, those killed are overwhelmingly male (96%) and about half are under age 35.[37,39] This growing body of evidence suggests that the intersection between a civilian's perceived race and armed status may modify the risk of being fatally shot by police (i.e., becoming a *case*), and that age and gender are also key, meaning there may be a statistical interaction in play.

Finding an appropriate catchment population, or *controls*, to test for statistical interaction between race and armed status is problematic. Population-level measures are the most robust[41] but, unlike gun ownership,[42] the racial population distribution of *armed status*—those patrolled by police and perceived to have a weapon—is unknown. Law enforcement agencies are not required to collect or report demographic nor armed status information associated with police–civilian encounters.[43] Moreover, because police encounters and arrests are systemically biased against minorities,[29,41,44–46] data collected by agencies and used in research have underestimated or reported "reversed" racial disparities. [41] This type of bias results from conditioning on police encounter rates which are higher for Blacks (inflated denominator) and lower for Whites (deflated denominator) thereby making the groups appear more statistically similar.[41] Knox, Lowe & Mummolo (2019) developed a novel method to account for such statistical bias in estimating racial disparities under a variety of plausible assumptions (e.g., use-of-force reporting requirements); however, estimates remain conditioned on police–civilian encounters and civilian armed status was not considered.[45] Consequently, establishing an adequate reference or control group to estimate race and armed status interaction on police killings is fraught with challenges.

In epidemiology, the case-only study design is an efficient and innovative approach to evaluate potential statistical interaction between two risk factors. Commonly used to examine gene-environment interaction (G*E) among cancer patients,[47–49] case-only studies

consist only of people that have the outcome (i.e., cases), as implied. The design is used to identify multiplicative interaction between environmental exposures and inherited traits that are independent in the population.[50] Among cases, odds ratios that estimate the odds of G in those with E compared to the odds of G in those without E, and vice versa, reflect interaction on an outcome in the underlying population.[47,51,52] Case-only design has been a useful method to study social-environmental interaction, particularly by personal characteristics such as race.[53–56] Causality can be inferred when the case-only interaction is *mechanistic*—the estimate is greater than 1 (i.e., positive) and G and E are independent in the population and never preventative.[48]

Both risk factors (Black and armed) are not likely preventative against being shot by police,[4,37–40,57] but the absence of information on the racial distribution of armed status among those patrolled by police make G*E independence an untestable assumption. However, given what is known about US racial distributions of weapons carrying, race and armed status appear to be independent. Studies reporting on weapons and firearms carrying show no consistent pattern by race among nationally representative samples of adults,[58–61] high school students,[61,62] and adolescents and young adults.[63–65] Together, these findings provide some evidence that race and armed status are plausibly independent in the general population albeit more conclusive reporting is needed.

Assuming independence holds, newly reliable data on police killings can be analyzed using case-only series to investigate the modifying effect that armed status may have on the association between one's race and being killed by police, thereby eliminating the need for controls. However, in this example, prevailing opinion is that one would expect *negative*-multiplicative interaction between race and armed status in police encounters (i.e., odds ratio<1). That is, the gap between fatalities for armed versus unarmed civilians is *less* for Blacks than for Whites. Johnson et al. (2019) applied case-only series to identify civilian and officer predictors of the race of a person fatally shot by police using *WaPo* and *The Guardian* data and reported no evidence of an anti-black disparity in armed status. Notably, the analysis was restricted to civilian deaths in 2015.[56] A major contribution to the literature would be an examination across all police killings since 2015 using the most current *WaPo* data given that, unlike *The Guardian*, data collection has continued.

The main objective of this study is to examine statistical interaction between race and armed status on being shot and killed by police among Black and White males using case-only design. Race is conceptualized as a social construct representing the race-based experience of being perceived as Black or White in the US.[66–68] Being armed inherently increases the probability of being shot for anyone during a police encounter; however, Blacks maintain much higher risk whether armed or not.[4,12,15,16,36–40] We thereby hypothesize that the gap between being armed versus unarmed is smaller for Black compared to White males. Given that police use-of-force is higher for younger people,[34,37,56] those perceived as mentally ill,[69–71] and in cities with higher Black populations,[35,72,73] a secondary objective is to evaluate potential three-way interaction between race and armed status with age, mental illness status, and US region. Armed status disparities are theorized to reduce with age yet increase with signs of mental illness and in regions with larger Black population densities.

MATERIALS AND METHODS

Study Sample

Data are from *The Washington Post* (*WaPo*).[26] *WaPo* maintains an online public-use database of all on-duty police-involved shooting deaths since January 1, 2015 which has been utilized in several recent publications.[23,31,39,40,74] *WaPo* regularly collects, updates, and maintains information from every fatal shooting by police. The database includes civilian demographic information, armed status, perceived mental illness status, perceived threat-level, fleeing status, and incident location. *WaPo* validates the circumstances of the shootings using information from local reporting, police websites, social media, and open-source databases tracking police killings. Cases from January 1, 2015 through December 31, 2019 are analyzed (*N=4,938*). The study aim is to predict outcomes for unarmed Black males, hence the study sample is restricted to Black and White males with known armed status. The final sample size is comprised of 3,090 cases (Figure 1).

Outcome Assessment

Using a case-only design, G or E can be modeled as the outcome variable because either orientation will yield the same multiplicative interaction estimate (e.g. 2×3=3×2=6). Because race contributes so strongly to the risk of being killed by police, race is selected as the outcome. The two racial categories identified in *WaPo* (Non-Hispanic [NH] White, NH Black) are collapsed into a dichotomous *race* variable which excludes Hispanics (Black=0 [i.e., White], Black=1).

Exposure Assessment

Armed status.— *WaPo* recorded 86 armed categories ranging from “air conditioner” to “vehicle”. Given that officers have perceived civilian personal items as “life-threatening weapons” (e.g., cell phone),[75,76] *armed* status is assessed dichotomously by grouping all armed categories together, separate from those reportedly “unarmed” (unarmed=0, armed=1). The unarmed category presumably includes those whom officers misperceived as being armed during the event but there is no way to know with certainty.

Covariates

Theoretical and empirical variables considered to confound the association between race and armed status include civilian socioeconomic status, demographic characteristics, and perceived mental health status during the encounter[25,36,37,71,77,78] (Figure A.1). Civilian behaviors and situational factors during the encounter are identified as mediators[79,80] and therefore are excluded to avoid over-controlling.

Civilian age is coded as a 5-level ordinal variable (<25=1, 25–34=2, 35–44=3, 45–54=4, >54=5) to evaluate potential non-linear or dose-response associations. A civilian showing signs of mental illness (SMI) during the encounter is coded dichotomously (No=0, Yes=1). Apart from race and age, WaPo did not collect civilian socioeconomic and other demographic information. Because US Census municipal-level data is not available for an extensive number of fatalities, county-level data is used to proxy individual-level demographic characteristics using *QuickFacts*—2014–2018 population estimates. [81]

Proportions account for Black population, White population, population >64 years, persons foreign-born, owner-occupied housing units, households with a computer, households with broadband internet, persons with ≥Bachelor's degree, disabled persons age <65, persons without health insurance (2019 estimate), civilian labor force, persons in poverty, median gross rent, and median household income (2018 dollars). Uniform Crime Reporting Program Data account for county-level violent and property crime rates (per 100,000 people).[82] US region (hereafter region) is accounted for categorically (West=1, Midwest=2, South=3, Northeast=4).[83]

Statistical Analysis

STATA 16 IC is used for all statistical analyses.[84] There are no missing data apart from civilian age (*n=47*), which is negligible (1.5%). Civilian demographic characteristics do not differ between missing and non-missing age groups suggesting that the data are missing at random, though differences are found across regions (Table A.1). Hence missing values are imputed using sample mean replacement (age 37)[85] and sensitivity analyses are conducted to assess bias. Model specification includes theory and data-driven approaches.[86,87] Using case-only design, logistic regression of adjusted odds ratios yield an interaction estimate between the odds of being armed (vs. unarmed) for Black compared to White males. Put another way, estimates give the odds ratio of being killed for Black armed males compared to White armed males. Since being fatally shot by police is a rare event, odds ratios provide pseudo-risk interaction estimates ($\mathcal{S}_{OR}$; hereafter risk).[47,48] The specified reduced form equations that give rise to the interaction term are given below; where D represents the outcome.[50]

Equation A shows a standard population logistic regression model with the interaction term given by β_3:

$$\log(\Pr[D \mid G, E, \text{Covariates}]/1 - \Pr[D \mid G, E, \text{Covariates}]) = \beta_0 + \beta_1 G + \beta_2 E + \beta_3 G{*}E + \text{Covariates}$$

Equation B shows a case-only logistic regression with the interaction term given by α_1 which is equivalent to β_3 in Equation A, assuming G and E population independence:[50]

$$\log(\Pr[G \mid E, \text{Covariates}, D = 1]/1 - \Pr[G \mid E, \text{Covariates}, D = 1]) = \alpha_0 + \alpha_1 E + \text{Covariates}$$

RESULTS

Sample Characteristics

Sample distributions of civilian and regional characteristics are presented in Table 1. Notably, annual Black-White gaps among those fatally shot by police are decreasing for those armed (Figure 2) and increasing for those unarmed (Figure 3).

Regression model specification

Age and SMI status are forced-in covariates. Among those contributing to 100% of the principal components (eigenvalues>1), bivariate analysis identify collinearity between

several demographic variables (Table B.1). Hence, collinear covariates explaining the least of the variance—White population, ≥Bachelor's degree, labor force, and median income—are omitted. All remaining covariates confound the main exposure–outcome association using multivariable regression adjusted for one covariate at a time (P<0.05). Nested modeling and Akaike and Bayesian information criteria determined poverty and broadband internet do not improve model fit, and they are subsequently excluded. Variance inflation factors show no remaining multicollinearity. Therefore, the final model is adjusted for age, SMI, region, median gross rent, violent crime rate, and percent Black population and disabled persons age <65. Sensitivity analyses confirm that our imputation method did not add bias or reduce precision (Table B.2).

Multivariable logistic regression

Table 2 presents nested logistic regression models (crude to fully-adjusted). Model 1 shows a lower predicted crude risk of being armed (vs. unarmed) for Black compared to White males shot and killed by police (S_{OR}=0.60; 95% confidence interval [CI]=0.45–0.79). Model 2 shows this disparity is reduced after accounting for civilian age and SMI status (S_{OR}=0.72; 95% CI=0.54–0.97). Null interactions are estimated in Models 3–5 after further adjustment for (a) region and percent Black population (Model 3), (b) percent Black population, median gross rent, and percent disabled persons age <65 (Model 4), and (c) violent crime rate (Model 5). Since all civilian and regional confounders are significant at P<0.01, potential 3-way interactions are assessed by stratifying adjusted estimates by civilian age, SMI status, and region.

Figure 4 illustrates the fully-adjusted interaction estimate from Model 5 in Table 2 and interaction estimates adjusted for median gross rent, violent crime rate, and percent Black population and disabled persons age <65, and then stratified by (a) age, further adjusted for SMI and region, (b) SMI, further adjusted for age and region, and (c) region, further adjusted for age and SMI. Compared to White males, the risk of being armed is smaller for Black males over age 54 (S_{OR}=0.18; 95% CI=0.06–0.65), those showing mental illness signs (S_{OR}=0.50; 95% CI=0.26–0.98), and those killed in the South (S_{OR}=0.52; 95% CI=0.33–0.83), and that the risk is greater in the Midwest (S_{OR}=2.42; 95% CI=1.11–5.26) (Table B.3).

DISCUSSION

This is the first study to report statistical interaction between race and armed status among males fatally shot by police using a case-only study design. The fully-adjusted interaction estimate is null. All but one of the stratified-adjusted estimates predict negative-multiplicative interaction (S_{OR}<1), therefore most study estimates do not meet the full criteria for mechanistic interaction rendering them non-interpretable for causal effects (i.e., S_{OR}>1).[47,48] Nevertheless, strong multiplicative interaction does emerge across all stratified models. These results provide evidence of possible true *interaction*—the combined effect of two exposures differ from the sum of the individual effects—versus *effect modification*—main effects differs across covariate strata.[88–90] Our findings suggest that simply adjusting for civilian and regional main effects may mask more nuanced three-way interactions that

contribute to the Black-White disparities in police killings. Researchers should consider three-way interaction terms or stratifying police killing cases by specific civilian and regional characteristics when possible.

Interaction with age

Contrary to our hypothesis, we found no racial differences in the risk of being unarmed among younger males killed by police. The literature consistently points to higher fatality rates among males under age 35, along with considerable racial inequities among those unarmed.[3,4,9,13,25,36] Thus, unarmed Black (vs. White) males are thereby expected to have an even greater risk when they are young. Aligned with this hypothesis and prior work, increasing age was associated with lower risk of being killed when we simply controlled for (vs. stratified by) age (Table 2). The Black-White disparity in armed status we found among *older* males is likely because our study is the first to evaluate the intersection of race, armed status, *and* age. Importantly, unarmed males above age 54 are over 5 times more likely to be Black than White (11% vs. 2%), therefore officer perceptions regarding civilian armed status could vary by civilian age and/or race. Such differential officer engagement can exacerbate inequities in civilian arrests and/or police-related injury, potentially leading to over-representation of older Black men in the criminal and urgent care systems. Future investigations should confirm the strength of the association we find between being Black and unarmed among older males, and assess whether racial bias may play a role.

Interaction with signs of mental illness

Consistent with our hypothesis and prior literature,[70,71] the armed status gap is worse for Black males perceived as mentally ill. Officer use-of-force is generally greater against mentally impaired people with disparities for males, non-Whites, and those armed.[69–71,91] In the current study, White males are more likely to be perceived as mentally ill. This is unexpected given that Blacks are disproportionately diagnosed with psychotic disorders compared to Whites by 3 to 1.[92] Selective ascertainment and reporting of mental illness by police may be biased towards Whites and against Blacks. For instance, officers show a higher likelihood to commit a White suspect to an involuntary psychiatric hold compared to a Black suspect taking the same action, which investigators suggest likely leads to a higher prevalence of incarceration and less mental illness treatment for Blacks.[93] Further, Black (vs. White) males perceived as mentally ill in the current study are also less likely to be armed (88% vs. 95% respectively). Together, these findings suggest that anti-Black bias may be a stronger contributing factor in officer deadly use-of-force than the armed status of mentally impaired persons. However, potential underreporting of mental illness signs among Black males could bias our estimate away from the null. Further study among Black men with diagnosed mental illness would help disentangle the risk factors that may drive racial disparities in police killings within this highly vulnerable population.

Interaction with US Region

We are the first to report a Black-White armed status disparity by US region where Black males are at higher risk of being armed and fatally shot in the Midwest. Mechanistic interaction criteria is met thus causality can be inferred.[48] As expected, Black (vs. White) males are at lower risk of being armed in the Southern region, which has high Black

population density according to the US Census.[94] Conversely, the White population is highly dense in the Midwest.[94] This new evidence suggests that causal factors related to racial population density plays a role in the intersectional risk of being an unarmed Black male when killed by police.

Limitations and strengths

Study findings are generalizable: The sample includes nationally representative males fatally shot during 2015–19. Causal inference can only be inferred for one mechanistic interaction, though temporality is established for all estimates as race and armed status (exposures) precede a fatal shooting (outcome). Our use of case-only design to assess statistical interaction between race and armed status is novel but subject to an unverifiable assumption: the lack of verification on race and armed status independence amongst those patrolled by police is a key limitation in interpreting the reported interaction estimates. The hypothesized and highlighted negative interaction makes it impossible to weaken this assumption. However, if weapons carrying is generally higher among White (vs. Black) males patrolled by police, our results would underestimate racial gaps, and vice-versa if higher among Black males. The same is true for officer misperceptions of armed status: if misperceptions are more likely to be directed at White males (vs. Black males as expected), then our estimates will be biased towards the null, meaning our results are underestimated. Further, our use of county-level measures as proxies for individual-level confounding increase the likelihood of residual confounding. Study validity also largely depends on accurate data collection and proper validation of cases by *WaPo*. To assess data agreement, the number of 2015–16 *WaPo* cases (*N=1,958*) were cross-referenced with those in *The Guardian* database fatally shot by police during 2015–16 (*N=2,027*).[27] Results show 97% agreement, providing evidence of high repeatability of our study findings, although it is unlikely that all known cases have been accurately reported to any system. Last, the likelihood of a committing a Type II error is higher for interactions with smaller cell sizes.

Conclusion

This study uses case-only design to provide preliminary evidence that race and armed status interact leaving Black males at higher risk of being unarmed compared to White males when fatally shot by police, particularly for those over age 54, perceived as mentally ill, and killed in the South. Three-way causal interaction likely exists between race, armed status, and US region, reducing the risk for unarmed Blacks in the Midwest. We introduce a novel approach to investigating potential 3-way social-environmental statistical interactions that exacerbate racial disparities in deadly police shootings. US law enforcement agency policies and training focused on addressing anti-Black bias in officer deadly use-of-force may buffer racial gaps in police killings. A national registry of law enforcement data would help us to better understand how age, perceived mental illness, and geographic region impacts the use of lethal force against unarmed Black men in the US.

ACKNOWLEDGEMENTS

MD Thomas was partially supported by NIGMS grant UL1GM118985, USA and by a Ford Foundation Predoctoral Fellowship administered by the National Academies of Sciences, Engineering, and Medicine, USA. AM Allen was

also partially supported by NIMHD grant P60MD006902, USA. Study sponsors did not participate in study design, data collection, data analysis, interpretation of study results, or drafting of the manuscript. We wish to thank the HEARTs (Health Effects Associated with Racism Threat) Research Group at the [omitted] Center for Social Medicine for comments regarding the refinement of this manuscript, particularly Eli Michaels, Dr. Rachel Berkowitz, Elleni Hailu, Kevin Lee, Dr. Thu Thi Nguyen, and Saba Sohail.

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Abbreviations:

CI	confidence intervals
US	Unites States
WaPo	The Washington Post

APPENDICES

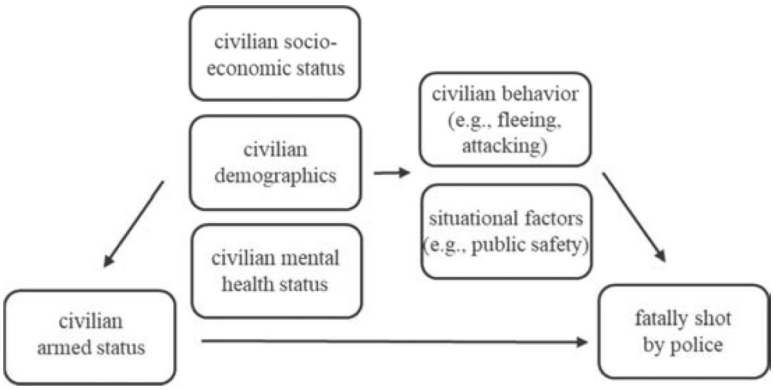

Figure A.1.
Conceptual framework representing working knowledge of factors linking a civilian's armed status and being shot and killed by police. Civilian behavior and situational factors were identified as mediators. Therefore, civilian socioeconomic status, demographics, and mental health status were assessed for confounding the association between being armed, shot and killed by police.

Table A.1.

Sensitivity analysis comparing confounder distributions between civilian's missing and not missing age among White and Black men shot and killed by police during 2015–19 in WaPo (*N=3,090*)

		Not Missing Age	Missing Age
		n (%)	
Cases		3043 (100)	47 (100)
Armed status			
	Armed	2834 (93)	44 (94)
	Unarmed	209 (7)	3 (6)

		Not Missing Age	Missing Age
Mental Illness Signs			
	No	2286 (75)	35 (75)
	Yes	757 (25)	12 (25)
US Region			
	West	777 (26)	11 (23)
	Midwest	609 (20)	4 (9)
	South	1405 (46)	32 (68)
	Northeast	252 (8)	0 (0)
		mean (sd)	
Black Population (%)		15 (15)	20 (17)
Median Gross Rent ($)		991 (279)	1029 (330)
Disabled & age <65 (%)		10 (3)	10 (3)
Violent Crime Rate (100K)		388 (249)	429 (283)

Abbreviations: WaPo=The Washington Post; sd=standard deviation

Table B.1.

Pearson correlation results comparing county-level covariates.

	2018 pop	**>age 65 years**	***White***	***Black***	**Foreign-born**	**Owner-occupied housing units**	***Median Gross Rent***	***Households with broadband***	***BA Degree***	***Age >65+ disability***	**Health insurance**	***Labor force***
2018 population	1.000											
>age 65 years	**−0.258**	1.000										
White	**−0.157**	**0.412**	1.000									
Black	0.003	**−0.293**	**−0.877**	1.000								
Foreign-born	**0.655**	**−0.373**	**−0.307**	**0.073**	1.000							
Owner-occupied housing units	**−0.434**	**0.535**	**0.603**	**−0.454**	**−0.586**	1.000						
Median gross rent	**0.412**	**−0.386**	**−0.379**	**0.126**	**0.735**	**−0.501**	1.000					
Households with broadband	**0.230**	**−0.339**	0.012	**−0.147**	**0.406**	**−0.207**	**0.670**	1.000				
BA Degree	**0.191**	**−0.410**	**−0.375**	**0.232**	**0.419**	**−0.506**	**0.720**	**0.659**	1.000			
Disabled & age <65	**0.405**	**0.501**	**0.199**	**−0.045**	**−0.608**	**0.338**	**−0.680**	**−0.663**	**−0.651**	1.000		
Health insurance	**0.064**	0.031	−0.015	**0.047**	**0.093**	**0.053**	**−0.249**	**−0.305**	**−0.351**	**0.114**	1.000	
Labor force	**0.226**	**−0.669**	**−0.218**	**0.123**	**0.382**	**−0.391**	**0.531**	**0.657**	**0.698**	**−0.734**	**−0.222**	1.000
M edian household income	**0.188**	**−0.376**	**−0.160**	**−0.052**	**0.458**	**−0.170**	**0.832**	**0.745**	**0.753**	**−0.706**	**−0.389**	**0.664**
Poverty	**−0.053**	**0.061**	**−0.310**	**0.390**	**−0.169**	**−0.256**	**−0.441**	**−0.716**	**−0.397**	**0.567**	**0.241**	**0.537**

	2018 pop	**>age 65 years**	***White***	***Black***	**Foreign-born**	**Owner-occupied housing units**	***Median Gross Rent***	***Households with broadband***	***BA Degree***	***Age >65+ disability***	**Health insurance**	***Labor force***
Violent crime rate	**0.160**	**−0.243**	**−0.485**	**0.478**	**0.189**	**−0.463**	**0.051**	**−0.075**	**0.076**	**−0.042**	**0.112**	**0.111**
Property crime rate	0.024	**−0.222**	**−0.352**	**0.352**	**0.053**	**−0.352**	**−0.037**	−0.006	**0.039**	0.025	**0.174**	**0.116**

Bolded=P<0.05

Italicized column name=Variable contributed to 100% of the principal components.

Italicized row name=Selected for adjustment in final models post-nested model and best model fit analyses.

Table B.2.

Sensitivity analysis comparing logistic regression using imputed data versus complete case analysis of White and Black men shot and killed by police during 2015–19

	Complete Case *(N=3,043)*						**Imputed *(N=3,090)***					
	S_{OR}	**LB 95% CI**	**UB 95% CI**	***S_{OR}***	**LB 95% CI**	**UB 95% CI**	***S_{OR}***	**LB 95% CI**	**UB 95% CI**	***S_{OR}***	**LB 95% CI**	**UB 95% CI**
Black *Armed	***0.613**	0.462	0.813	0.772	0.558	1.069	***0.597**	0.451	0.790	0.754	0.546	1.040
Age				**0.953**	0.946	0.961				**0.953**	0.946	0.961
Mental Illness Signs				**0.391**	0.312	0.490				**0.399**	0.319	0.499
US Region				**1.193**	1.071	1.328				**1.190**	1.069	1.324
Black Population				**147.7**	69.3	315.1				**164.2**	77.5	347.9
Median Gross Rent				**1.001**	1.000	1.001				**1.001**	1.000	1.001
Disabled & age <65				**4.E-05**	4.E-07	0.005				**4.E-05**	4.E-07	0.004
Violent Crime Rate				**1.156**	1.109	1.205				**1.152**	1.105	1.200
Intercept	*0.833*[a]			*0.784*[b]			*0.860*[c]			*0.847*[d]		
BIC	3918.0			3029.6			3995.2			3081.0		

Abbreviations: WaPo=The Washington Post; S_{OR}=odds ratio interaction estimate; LB=lower bound; UB=upper bound; BIC=Bayesian information criterion

Interaction reference group=White and Armed

[a]95% CI=0.635–1.094

[b]95% CI=0.304–2.020

[c]95% CI=0.656–1.126

[d]95% CI=0.332–2.166

Bolded=P<0.01;

*P<0.001

Note: All covariates in the adjusted models had p-values less than 0.01 but no asterisk is shown on estimates as they were not the main associations of interest.

Table B.3.

Logistic regression of the interaction between being Black and armed among males shot by police during 2015–19 in WaPo, stratified by civilian characteristics (*N=3,090*)

		Black*Armed		
		S_{OR}	LB 95% CI	UB 95% CI
Age[a]				
	>25	0.893	0.464	1.719
	25–34	0.884	0.498	1.569
	35–44	0.715	0.392	1.305
	44–54	0.554	0.161	1.909
	>54	***0.186**	**0.051**	**0.672**
SMI[b]				
	No	0.812	0.562	1.173
US Region[c]	Yes	**0.485**	**0.250**	**0.938**
	West	0.541	0.274	1.070
	Midwest	**2.418**	**1.111**	**5.263**
	South	***0.525**	**0.332**	**0.831**
	Northeast	0.805	0.202	3.219

Abbreviations: WaPo=The Washington Post; SMI=signs of mental illness; S_{OR}=odds ratio interaction estimate; LB=lower bound; UB=upper bound

Interaction reference group= White and Armed.

[a]Adjusted for SMI, US region, median gross rent, violent crime rate, and percent Black population and persons disabled & age <65.

[b]Adjusted for age, US region, median gross rent, violent crime rate, and percent Black population and persons disabled & age <65.

[c]Adjusted for age, SMI, median gross rent, violent crime rate, and percent Black population and persons disabled & age <65.

Bolded=P<0.05;

*P<0.01

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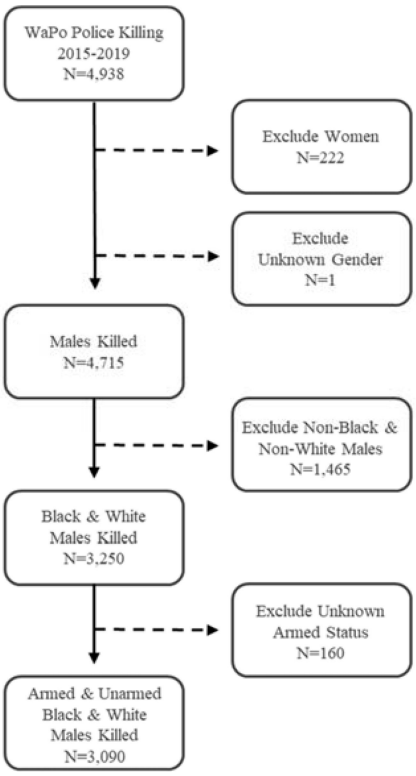

Figure 1.
The Washington Post (*Wapo*) study sample selection process.

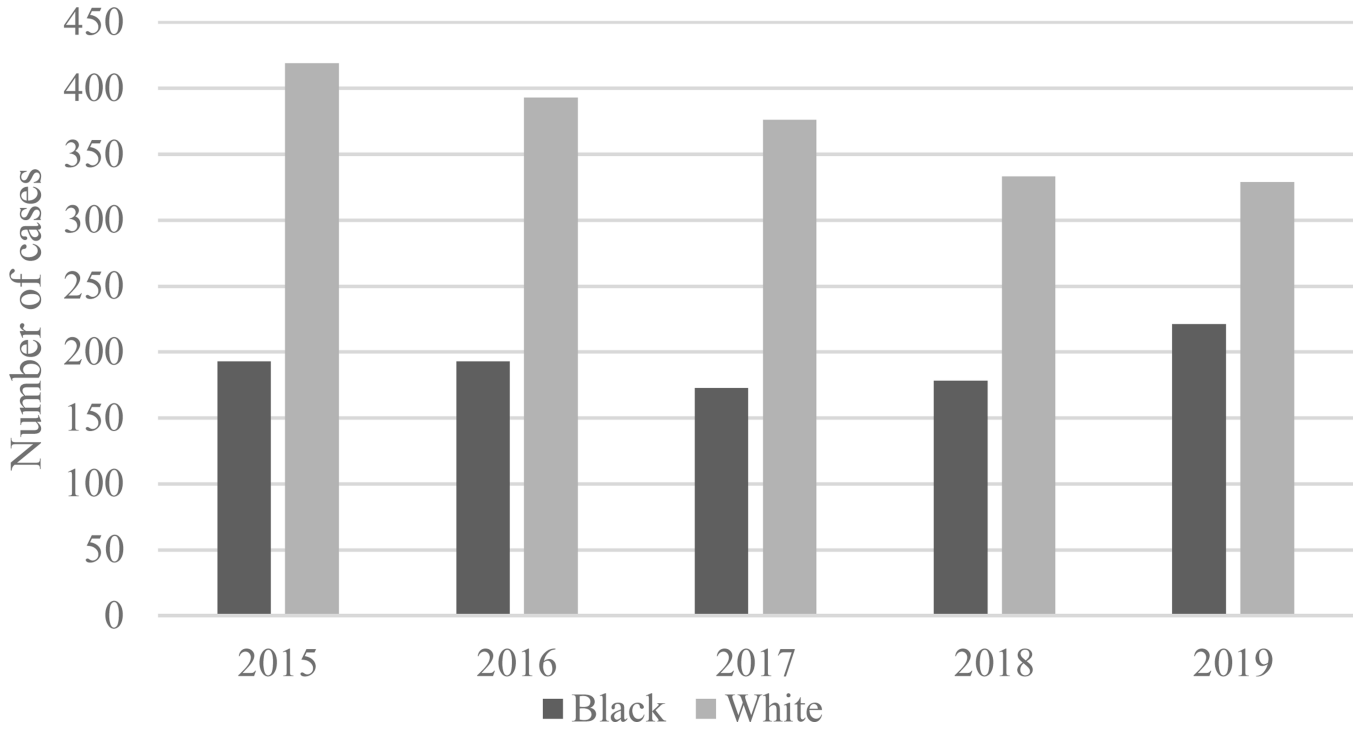

Figure 2.
WaPo racial distribution of armed males killed annually by police.

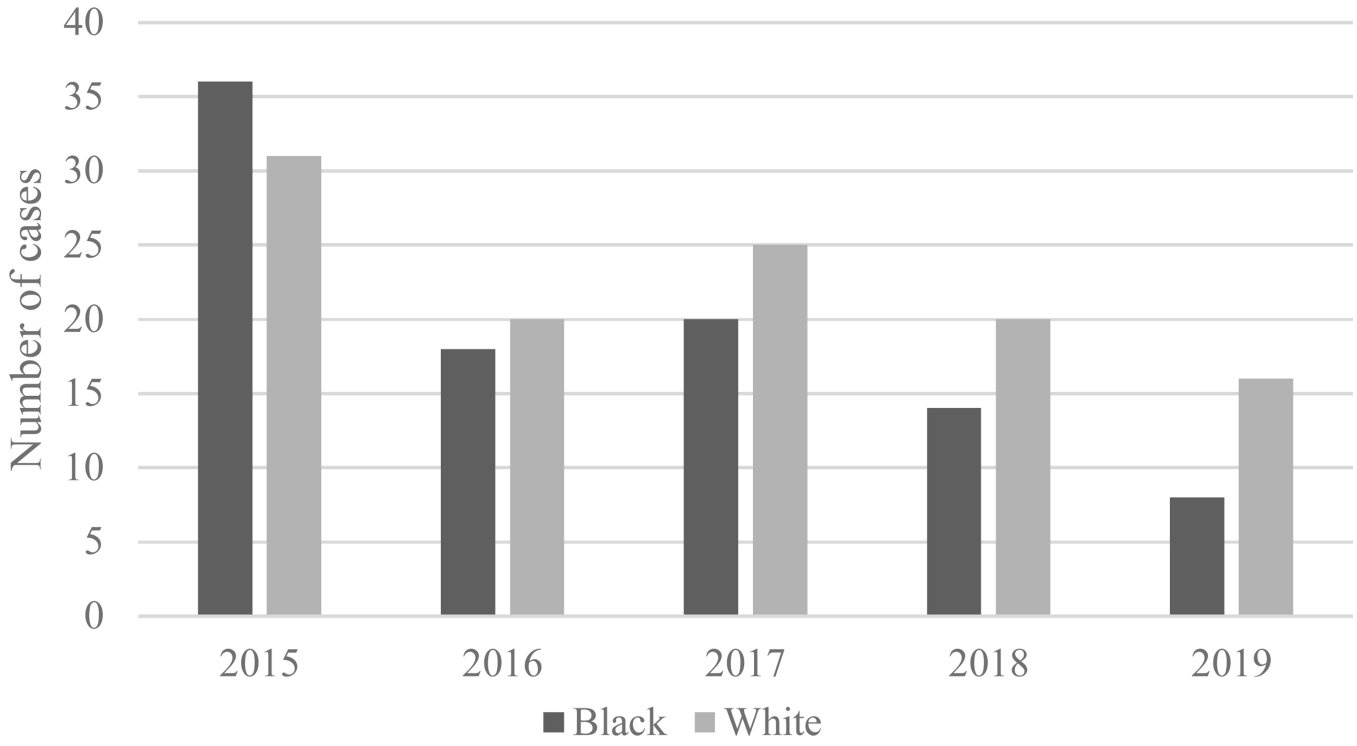

Figure 3.
WaPo racial distribution of unarmed males killed annually by police.

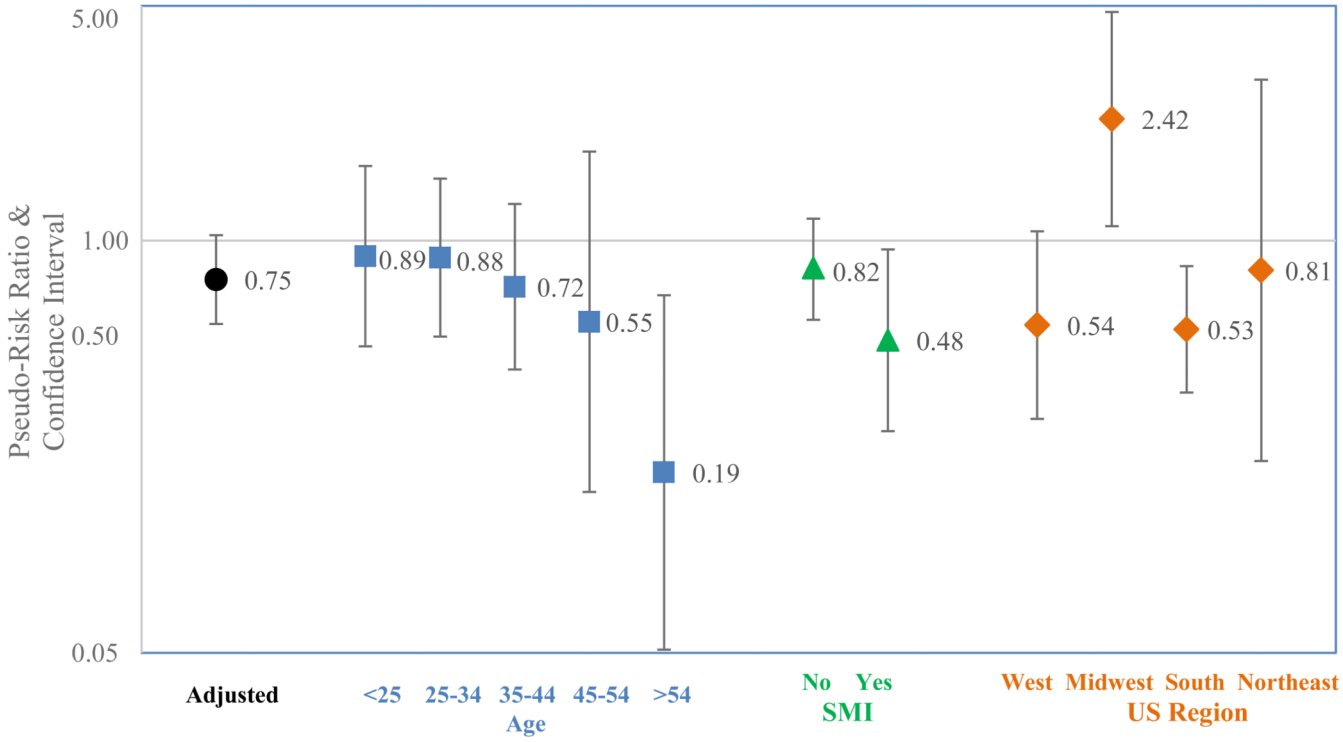

Figure 4.

Fully-adjusted interaction estimate from Model 5 in Table 2 of the risk of being armed versus unarmed for Black compared to White males fatally shot by police 2015–19 in *WaPo*, and adjusted interaction estimates stratified by age, SMI status, and US region, where entries [CI] are main effects from case-only statistical Equation B which estimate the interaction term in statistical Equation A, assuming independence (*N=3,090*).

Table 1.

WaPo sample characteristics of White and Black men shot and killed by police during 2015–19.

	Total	White	Black
		n (%)	
Cases	3090 (100)	2016 (65)	1074 (35)
Armed status			
Armed	2878 (93)	1924 (94)	992 (91)
Unarmed	212 (7)	114 (6)	99 (9)
Age			
mean (sd)	37 (13)	40(13)	32 (11)
>25	512 (17)	221 (11)	291 (27)
25–34	976 (31)	581 (29)	395 (37)
35–44	677(22)	464 (23)	213 (20)
44–54	499(16)	403 (20)	96 (9)
>54	426 (14)	347 (17)	79 (7)
Mental Illness Signs			
No	2321 (75)	1409 (70)	912 (85)
Yes	769 (25)	607 (30)	162 (15)
US Region			
West	788 (25)	610 (30)	178(17)
Midwest	613 (20)	384 (19)	229 (21)
South	1437 (47)	878 (44)	559 (52)
Northeast	252 (8)	144 (7)	108(10)
		mean (sd)	
Black Population (%)	15.3 (14.9)	10.7 (12.0)	24.0 (15.9)
Median Gross Rent ($)	992 (280)	954 (273)	1064 (278)
Disabled & age <65 (%)	10.0 (3.0)	10.0 (3.2)	8.9 (2.6)
Violent Crime Rate (100K)	388 (250)	334 (220)	491 (268)

Abbreviations: WaPo=The Washington Post; sd=standard deviation

Note: Those classified as armed include those whom were actually armed, therefore those whom police potentially misperceived as armed are included in the unarmed category.

Table 2.

Nested logistic regression of the interaction between being Black and armed among males shot by police during 2015–19 in WaPo (*N=3,090*)

	Model 1			Model 2			Model 3			Model 4			Model 5		
	S_{OR}	LB 95% CI	UB 95% CI	S_{OR}	LB 95% CI	UB 95% CI	S_{OR}	LB 95% CI	UB 95% CI	S_{OR}	LB 95% CI	UB 95% CI	S_{OR}	LB 95% CI	UB 95% CI
Black *Armed	0.60**	0.45	0.79	0.72*	0.54	0.97	0.74	0.54	1.02	0.76	0.55	1.05	0.75	0.55	1.04
Age				0.95	0.95	0.96	0.95	0.94	0.96	0.95	0.95	0.96	0.95	0.95	0.96
Mental Illness Signs				0.44	0.36	0.54	0.43	0.34	0.53	0.40	0.32	0.50	0.40	0.32	0.50
US Region							0.98	0.89	1.09	1.12	0.01	1.24	1.19	1.07	1.32
Black Population							688	349	1357	533	267	1065	164	78	348
Median Gross Rent										1.00	1.00	1.00	1.00	1.00	1.00
Disabled & age <65										4e-5	4e-7	4e-3	4e-5	4e-7	4e-3
Violent Crime Rate													1.15	1.11	1.20
Intercept	0.86[a]			*5.03*[b]			*1.80*[c]			*1.62*[d]			*0.85*[e]		
BIC	3995			3694			3196			3120			3081		

Abbreviations: WaPo=The Washington Post; S_{OR}=odds ratio interaction estimate; LB=lower bound; UB=upper bound; BIC=Bayesian information criterion Interaction reference group=White and Armed

[a] 95% CI=0.66–1.13

[b] 95% CI=3.51–7.21

[c] 95% CI=1.16–2.78

[d] 95% CI=0.66–4.00

[e] 95% CI=0.33–2.17

** P<0.001;

* P<0.05

Model 1 is unadjusted; Model 2 adjusts for covariates in Model 1 and civilian age and showing mental illness signs; Model 3 adjusts for covariates in Model 2 and US region and percent Black population; Model 4 adjusts for covariates in Model 3 and median gross rent, percent disabled under age 65; and Model 5 adjusts for covariates in Model 4 and violent crime rate.