Journal of Trauma and Acute Care Surgery, Publish Ahead of Print
DOI: 10.1097/TA.0000000000002689

Universal background checks for handgun purchases can reduce African American homicide rates

Elinore J. Kaufman, MD MSHP

University of Pennsylvania, Division of Traumatology, Surgical Critical Care, and Emergency Surgery

elinore.kaufman@pennmedicine.upenn.edu

Christopher N. Morrison, PhD

Columbia University Mailman School of Public Health

Monash University

cm3820@cumc.columbia.edu

Erik J. Olson, MD

Naval Medical Center San Diego

eolsoneo@gmail.com

David K. Humphreys, PhD

Oxford University

david.humphreys@spi.ox.ac.uk

Douglas J. Wiebe, PhD

University of Pennsylvania, Department of Biostatistics and Epidemiology

dwiebe@upenn.edu

Niels D. Martin, MD

University of Pennsylvania, Division of Traumatology, Surgical Critical Care, and Emergency Surgery

Niels.martin@pennmedicine.upenn.edu

Carrie A. Sims, MD PhD

University of Pennsylvania, Division of Traumatology, Surgical Critical Care, and Emergency Surgery

Carrie.sims@pennmedicine.upenn.edu

Mark H. Hoofnagle, MD, PhD

Washington University St. Louis

hoofnaglem@wustl.edu

C. William Schwab, MD

University of Pennsylvania, Division of Traumatology, Surgical Critical Care, and Emergency Surgery

Charles.Schwab@pennmedicine.upenn.edu

Patrick M. Reilly, MD

University of Pennsylvania, Division of Traumatology, Surgical Critical Care, and Emergency Surgery

reillyp@pennmedicine.upenn.edu

Mark J. Seamon, MD

University of Pennsylvania, Division of Traumatology, Surgical Critical Care, and Emergency Surgery

Mark.seamon@pennmedicine.upenn.edu

Corresponding author and address for reprints:

Elinore J. Kaufman, MD MSHP

Email: elinore.kaufman@pennmedicine.upenn.edu

Phone: (267) 847-2894

Address:

Division of Traumatology and Surgical Critical Care

University of Pennsylvania

Medical Office Building Suite 120

Penn Presbyterian Medical Center

51 North 39th Street

Philadelphia, PA, 19104

Conflict of interest statement: The authors have no conflicts of interest to report.

Meetings: This study was presented at the 78th Annual Meeting of the American Association for the Surgery of Trauma, September 18-20th, 2019 in Dallas, Texas

Funding: none

Abstract

Background: Federal law requires background checks for firearms purchased from licensed dealers, but states can extend requirements to private sales of handguns and purchases at gun shows (universal background checks for handguns: UBC-HG). Although firearm homicide disproportionately affects African Americans, little is known about how UBG-HG impacts African Americans. We hypothesized that implementation of UBC-HG would reduce rates of firearm homicide of African Americans.

Methods: We collected Centers for Disease Control firearm homicide counts for African American and white populations in the 50 states, 1999-2017. Laws were drawn from the State Firearm Laws Database. The exposure and outcome of interest were UBC-HG adoption and firearm homicide. We included non-Hispanic African American and non-Hispanic White populations. We used Poisson regression to perform a differences-in-differences analysis. A categorical variable for state accounted for time-stable state characteristics. We controlled for year to account for trends over time unrelated to policy. We controlled for state-specific, time-variable factors including median household income, population <25 or ≥65 years, alcohol consumption, and count of firearm laws (UBC-HG excluded). Standard errors were adjusted for clustering at the state level

Results: The firearm homicide rate among whites was 1.8 per 100,000 (Interquartile Range [IQR] 1.2-2.7) ranging from 1.4 in 2011 to 1.8 in 2016. The firearm homicide rate was 15.6 per 100,000 (IQR 11.6-21.0) among African Americans, ranging from 14.0 in 2009 to 19.6 in 2017.

While no significant difference in firearm homicides among whites (Incidence rate ratio [IRR] 0.93, 95% CI 0.73, 1.20) was appreciated, the passage of UBC-HG was associated with an 19% decrease in African Americans firearm homicides (IRR 0.81, 95% CI 0.70, 0.94; p=0.006).

Conclusions: Implementing UBC-HG was associated with decreased firearm homicides among African Americans—the population most at risk. Expanding UBC-HG may be an effective approach to reducing racial disparities in firearm homicides.

Level of Evidence: Level III, Epidemiological

Keywords: firearm homicide, injury prevention, health policy, background checks, guns

Background

There were 14,542 firearm homicides in 2017, and firearm injury is increasingly recognized as a public health crisis in the United States.[1] Leading professional organizations have spoken out in support of data-driven, consensus-based policies to reduce firearm violence.[2–5] Impact is not spread equally among the population, however, and African American populations experience high rates of firearm injury and homicide.[6] In 2017, African American boys and men ages 15-34 had the highest rate of firearm homicide of any demographic group in the U.S., with 81 deaths per 100,000 population, compared to 2.4 deaths per 100,000 in white boys and men of the same ages.[7] It is crucial to assess the impact of firearm policy on this key, vulnerable population. While stricter overall firearm policies have been associated with lower firearm homicide rates in several studies,[6,8] this benefit may not apply to African Americans.[9,10]

One appealing approach to reducing firearm violence involves preventing individuals with criminal convictions from accessing firearms. Since 1993, the Brady Act has required federally-licensed firearm dealers to conduct background checks of prospective firearm purchasers to prevent individuals with felony convictions or certain domestic violence misdemeanor convictions from purchasing firearms.[11] Background check results are usually instant, and there have been more than 3 million denials. [12,13] Several states have extended federal background check requirements to include sales of handguns conducted privately and at gun shows (universal background checks for handguns, UBC-HG). Between 1999 and 2017, nineteen states had laws requiring background checks for all handgun purchases, including

private sales.[14] Evidence on the impact of these expanded laws has been mixed and limited to studies focused on a single state. For example, Missouri's 2007 UBC-HG repeal was associated with a 25% increase in firearm homicides,[15] while earlier repeals in Tennessee and Indiana in 1998 were not associated with increased mortality.[16] More recently, Connecticut saw a 40% decrease in firearm homicides after instituting universal background checks.[17] In a national study of multiple firearm law types, Knopov et al. found that UBC laws were associated with lower overall firearm homicides.[18] Although not conclusive, these data suggest universal background laws reduce homicide rates at the state level. However, it is unknown whether these benefits are equally distributed among at-risk populations. In this study, we evaluate the impact of universal background checks for handgun purchasers, on firearm deaths among African American and white populations. We hypothesized that UBC-HG implementation would be associated with a reduction in homicides among African American populations.

Methods

Data sources and population

We computed firearm homicide counts for non-Hispanic African American and non-Hispanic white populations of each of the 50 states for 1999-2017. These data were derived from the Centers for Disease Control Wide-ranging Online Data for Epidemiologic Research (CDC WONDER). Other races and ethnicities were excluded from this analysis.[7] The CDC suppresses death counts of fewer than 10. Of 950 total state-years, 134 had suppressed counts for whites and 288 had suppressed counts for African Americans and these state-year-race combinations were excluded from the primary analysis. We performed several sensitivity

analyses. First, we estimated a state-race specific value. To do this, we calculated the total deaths in that state-race combination over the 19 years study period, subtracted the total non-suppressed deaths, and divided the remainder by the number of years with suppressed data. For state-race combinations where the count was suppressed for the total study period, we assumed that the total death count was 9 (the maximum suppressible count) and divided this by 19 years, yielding an average annual death count of 0.5. These estimates accounted for only 0.5% of total firearm homicide deaths overall. Second, we set all suppressed counts to 0, and third, we set these counts to 9. We did not analyze Asian, Hispanic, or other racial and ethnic populations because there were not enough firearm deaths to generate stable death counts for analysis in an adequate number of states. The Boston University State Firearms Laws database provided detailed, annual information on state firearm laws.[14]

Exposures and outcomes

The exposure of interest was implementation of a law requiring background checks to be performed for all handgun purchases (UBC-HG), including gun shows and private sales. States may implement this requirement in two ways. Eleven states require point-of-sale background checks for all purchases. Nine states issue permits for purchase and require the background checks to be performed during the permitting process (see Figure 1). We did not consider background check requirements for long gun purchases, as the vast majority of homicides involve handguns.[19–21] The primary outcome was counts of firearm homicide. Population denominators included in CDC WONDER are drawn from the U.S. Census, 1999-2017.

Analysis

We estimated the effect of UBC-HG on firearm homicide using a difference-in-differences (DID) analysis. DID analysis is a quasi-experimental design that combines the advantages of a pre-post analysis with the advantages of a between-state comparison. The aim of this analysis is to conduct two comparisons simultaneously. The first is a pre-post comparison for every state that enacted the policy. With this approach, we compared firearm homicide in each state that adopted UBC-HG before and after the policy change, allowing each state to serve as its own control. The second compares these states to the other states that did not change their policy. This helps prevent changes that were occurring in national homicide rates from being falsely attributed to the policy. States are very different from one another in ways that may impact both their likelihood of passing the law and their homicide rates. Many of these differences would be very hard to measure. Therefore, rather than attempting to control for every demographic or cultural variable that makes each state unique, we simply include each state separately in the analysis, which is termed state fixed effects. Likewise, homicide rates have fluctuated over time nationally. We therefore also control for each year of measurement. Because these national trends may not be linear, we include each year as a categorical rather than a continuous variable.

We used Poisson regression to analyze homicide counts using state population as the model offset. We included a categorical variable for each of the 50 states. These state fixed effects accounted for any characteristics of a given state that were stable over time. A categorical variable for year accounted for trends over time. By using states without policy change as an additional control, we simultaneously controlled for national trends in homicide rates over the

time period, subtracting the change that occurred in states without the policy from the change we observed in states that implemented UBC-HG.[22–24] This analysis yields estimates in the form of incidence rate ratios (IRR). IRR is analogous to an odds ratio derived from logistic regression. This study compares counts of deaths in states, and each death count must be controlled for population. The incidence rate is the number of deaths divided by the population. The incidence rate ratio is the ratio of the incidence rate in the presence of a given exposure to the incidence rate in the absence of that exposure.

We further controlled for factors commonly associated with firearm violence that might vary over the study period within a given state: median household income, population <25 or ≥65 years, per capita alcohol consumption,[25] and total count of firearm laws (UBC excluded) from the State Firearm Laws database[14]. Standard errors were adjusted for clustering at the state level.[26] We also stratified the analysis by victim sex. We used model-predicted events multiplied by the population exposed to calculate potential lives saved.

Specification Testing

To ensure the validity of our results, we performed several specification tests common to difference-in-difference analysis.[26] We tested the trend in firearm homicide prior to policy adoption to the trend over the same time period in states that did not adopt the policy. To assess whether the comparison between groups of states was valid, we tested whether trends in homicide rates were parallel in the pre-intervention period by testing the significance of an interaction term between time trend and group.[27] For this step, we compared UBC-HG states to never-adopting states from 1999 to 2005, before the first new UBC-HG law was implemented.

We conducted this analysis with and without including states that had the law throughout the study period.

A law may not take maximum effect immediately after passage. Therefore, to account for dissemination and enforcement time, we also analyzed the data using a 1- and 2-year time lag after policy adoption. We also performed a "placebo test" for the policy[28] by assessing the impact of UBC-HG on homicides not involving firearms, an outcome that we did not expect to be associated with this policy.

The primary analysis included all 50 states, but because Missouri was the only state that repealed a UBC-HG policy during the study period, we conducted a sensitivity analysis excluding this state. Further sensitivity analyses excluded states that had the UBC-HG policy in place throughout the entire study period (implemented before 1999).

We used Stata for all analyses (version 14.0, StataCorp, College Station, TX).

Results

The median firearm homicide rate among African Americans was 15.6 per 100,000 population per year (interquartile range [IQR] 11.6, 21.0 with a low of 14.0 in 2009 and a high of 19.6 in 2017). Among whites, the rate was 1.8 per 100,000 (IQR 1.2, 2.7) with a low of 1.4 in 2011 and a high of 1.8 in 2016 (Figure 2). A figure showing firearm homicide rates by UBC-HG status is included in the Supplemental Digital Content, Figure 1, http://links.lww.com/TA/B623.

In the difference-in-difference analysis, passage of UBC-HG was associated with a 19% decrease in firearm homicide of African Americans (IRR 0.81, 95% CI 0.70, 0.94; p=0.006). There was no association between UBC-HG and firearm homicide of whites (IRR 0.93, 95% CI 0.73, 1.20, p =0.599). The total count of firearm laws was associated with a small decrease in homicide of African Americans (IRR for a 10 law increase 0.91, 95% CI 0.85, 0.97, p=0.003), but increased firearm laws did not impact the homicide rate of whites. There was substantial variation among states with IRR ranging from 0.48 to 2.58 for African Americans and 0.16 to 1.32 for whites. Full results for the main analysis are shown in Table 1, and results of models in which we stratified by sex are shown in Table 2, demonstrating that the findings were consistent for both males and females. We calculated the National UBC-HG application could have saved 29,297 (95% CI 7,536, 45,057) lives in the states that lacked this provision during the study period.

Tests of Specification

There was no significant difference pre-2006 trends in firearm homicide for states that later did and did not adopt UBC-HG, confirming that these groups of states are appropriately comparable. Tests of a time lag yielded similar results for 0, 1 and 2 years after policy adoption. No lag is included in the main results for the sake of simplicity. The main analysis excluded state-race-year combinations with suppressed death counts. Sensitivity analyses for missing data yielded nearly identical results.

Firearms accounted for the majority of homicides among both whites and African Americans. Among whites, there were 1.3 (IQR 1.0, 1.6) non-firearm homicides per 100,000

population per year. Implementation of UBC-HG was associated with a decrease in non-firearm homicides among whites (OR 0.93, 95% CI 0.88, 0.97). There were 4.2 (IQR 3.5, 5.2) non-firearm homicides per 100,000 per year among African Americans. We found no association of UBC-HG with non-firearm homicides among African Americans. Findings were similar when Missouri was excluded and when states with pre-1999 UBC-HG laws were excluded.

Discussion

State implementation of a universal background check requirement for all handgun purchases, including private sales and gun shows, was associated with an 19% decrease in the incidence of firearm homicide of African Americans. To our knowledge, this is the first national evaluation of the impact of implementation of new background check requirements on homicide stratified by race. These findings are particularly important as firearm legislation has not always proven protective for African Americans.[9] and firearm homicides rates are nearly 8 times higher among African Americans than whites.[9] This disparity is multifactorial and is rooted in a legacy of structural racism, poverty, and disadvantage.[29,30] Many UBC-HG laws were passed during years in which homicide rates were increasing across the country, and rates continued to rise in some of these states. However, the difference-in-difference analysis reveals that this trend was tempered in states that passed UBC-HG laws.

Although federal law has required federally-licensed firearm dealers to conduct criminal background checks on all purchasers since the Brady Act of 1993, this Act has been criticized as a failure because it did not lead to a reduction in firearm homicide.[31] However, the Brady Act

is not a universal mandate and up to 40% of firearms are purchased at gun shows or through private sales and may bypass this requirement.[32] In fact, in a 2015 survey, 50% of firearm owners who had purchased a firearm within the previous year via private sale did so without undergoing a background check.[33] Importantly, as many as 10% of such private purchasers would have failed a background check if they had attempted to purchase through a licensed dealer.[34] Similarly, in a survey of people convicted of firearm offenses, 96% had previous convictions that would have preventing them from legally obtaining a firearm, yet they obtained their firearm without a background check. These dynamics may explain why Ludwig et al. determined that the implementation of the Brady Act was not associated with a reduction in firearm homicide.[31]

Nearly 90% of Americans support implementing universal background checks, regardless of political affiliation or gun ownership.[35,36] The impact of UBC-HG on firearm homicides has been mixed in single-state studies, perhaps due to small sample size or variable impacts across states. Only one out of 3 states included in a 2018 study saw increased background checks with the implementation of a universal background check requirement, perhaps because the requirement itself deters individuals who expect to be rejected from attempting to purchase a firearm.[13,37] Implementation of a universal background check requirement was associated with decreased firearm homicides in Connecticut,[17] while repeal of the same requirement in Missouri was associated with a 25% increase in firearm homicides.[15] These studies have not examined the impact of UBC-HG on African Americans specifically, and our findings suggest that expanding this policy across the United States could prevent deaths and reduce racial disparities in firearm homicide. Importantly, we found no corresponding increase in non-firearm

homicide, indicating that would-be assailants did not resort to alternative means when guns were unavailable. We did identify a significant decrease in non-firearm homicides of Whites. This may be related unmeasured confounding, misspecification of means of death, or to a general decrease in violence associated with UBC-HG laws. Reducing the use of firearms cannot eliminate violence. However, because firearms are a particularly lethal means of violence, reducing their use gives trauma clinicians the opportunity to save lives, providing our patients, our communities, and our policy makers a second chance.

Limitations

Our study has several limitations. Our ability to assess causality with this retrospective study is limited. We only included fatal injuries, which represent a minority of firearm injuries. There is no comprehensive data source for nonfatal firearm injuries in the United States, and the effect of UBC-HG on nonfatal injuries is unknown. We included only White and Black or African American populations because too few states have stable death counts in in any other racial/ethnic group for this analytic approach. We cannot assess the impact of this law on other groups. Future studies that focus on states with large populations in any particular racial and ethnic group would do well to attend to the impact of policy changes on these groups. Because homicide rates of Whites were so much lower than homicide rates of African Americans, we may have failed to detect a significant effect in Whites due to Type II error. Knopov et al used slightly different methods and identified a significant decrease in overall firearm homicides [18]. Although the state fixed effects model accounts for time-invariant state characteristics, there may be unmeasured, shared features of these states that confound our findings. State-level implementation, enforcement, and culture vary in ways that this study cannot capture, as does the

impact on homicides. The effect we identify here may not be replicated in other states that differ in measured and unmeasured ways. Comparison states may be more different from UBC-HG states than we can capture here. Regression to the mean may account for decreases in some areas, but we would expect this to affect states with and without the policy change approximately equally. Moreover, important variation exists within each state, and dynamics affecting homicide may well be local. This analysis assesses only state-level exposures and outcomes and may obscure larger, smaller, or opposite effects at the local level. Further research is needed to identify the optimal combination of firearm laws and enforcement strategies to reduce firearm violence and death. We focused on UBC-HG because handguns are involved in the vast majority of firearm homicides. UBC laws for long guns may have an additional effect on homicides and mass shootings that we did not assess here. Lastly, prior research has shown that laws in one state have a small, but significant, impact on outcomes in other states, as firearms can cross state lines.[8,10] We did not directly account for these dynamics here, which may have biased our results.

Conclusions

Implementing a universal background check requirement for all handgun purchases was associated with decreased firearm homicides among African Americans—the population most at risk. Our results suggest that expanding the federal background check policy to include all gun shows and private sales may be an effective approach to reducing firearm homicide of African Americans.

Author Contributions: EK and MS conceived and designed the study. EK collected and analyzed the data. EK and MS drafter the manuscript. All authors contributed critical review of the manuscript.

Conflicts of Interest and Funding Statement

The authors have no conflicts of interest to report. No specific funding was obtained for this study.

References

1. Steinbrook R, Stern RJ, Redberg RF. Firearm Injuries and Gun Violence: Call for Papers. *JAMA Intern Med*. 2016 May 1;176(5):596.
2. Butkus R, Doherty R, Bornstein SS, for the Health and Public Policy Committee of the American College of Physicians. Reducing Firearm Injuries and Deaths in the United States: A Position Paper From the American College of Physicians. *Ann Intern Med*. 2018 Nov 20;169(10):704.
3. The American Association for the Surgery of Trauma (AAST) Board of Managers. AAST statement on firearm injury. *Trauma Surg Acute Care Open*. 2018 Jul 1;3(1):e000204.
4. Talley CL, Campbell BT, Jenkins DH, Barnes SL, Sidwell RA, Timmerman G, Gross RI, Coburn M, Bailey JA, Eastman A et al. Recommendations from the American College of Surgeons Committee on Trauma's Firearm Strategy Team (FAST) Workgroup: Chicago Consensus I. *J Am Coll Surg*. 2019 Feb 1;228(2):198–206.
5. Giffords. Letter to Congressional Leaders on CDC Funding for Firearm Research [Internet]. [cited 2019 Jun 1]. Available from: https://giffords.org/wp-content/uploads/2018/12/CDC-campaign-sign-on-letter_Final.pdf
6. Kalesan B, Vasan S, Mobily ME, Villarreal MD, Hlavacek P, Teperman S, Fagan JA, Galea S. State-specific, racial and ethnic heterogeneity in trends of firearm-related fatality rates in the USA from 2000 to 2010. *BMJ Open*. 2014 Sep 18;4(9):e005628–e005628.
7. U.S. Centers for Disease Control and Prevention. Web-based Injury Statistics Query and Reporting System [Internet]. [cited 2016 May 15]. Available from: http://www.cdc.gov/injury/wisqars/index.html

8. Kaufman EJ, Morrison CN, Branas CC, Wiebe DJ. State Firearm Laws and Interstate Firearm Deaths From Homicide and Suicide in the United States: A Cross-sectional Analysis of Data by County. *JAMA Intern Med*. 2018 May 1;178(5):692–700.
9. Resnick S, Smith RN, Beard JH, Holena D, Reilly PM, Schwab CW, Seamon MJ. Firearm Deaths in America: Can We Learn From 462,000 Lives Lost? *Ann Surg*. 2017;266(3):432–40.
10. Olson EJ, Hoofnagle M, Kaufman EJ, Schwab CW, Reilly PM, Seamon MJ. American firearm homicides: The impact of your neighbors. *J Trauma Acute Care Surg*. 2019 May;86(5):797–802.
11. [USC03] 18 USC 922: Unlawful acts [Internet]. [cited 2019 Jun 27]. Available from: http://uscode.house.gov/view.xhtml?req=(title:18%20section:922%20edition:prelim)
12. Bureau of Justice Statistics (BJS) - Background Checks for Firearm Transfers, 2015 - Statistical Tables [Internet]. [cited 2019 Jun 27]. Available from: https://www.bjs.gov/index.cfm?ty=pbdetail&iid=6126
13. Vernick JS, Alcorn T, Horwitz J. Background Checks for all Gun Buyers and Gun Violence Restraining Orders: State Efforts to Keep Guns from High-Risk Persons. *J Law Med Ethics*. 2017 Mar;45(1_suppl):98–102.
14. Siegel M, Pahn M, Xuan Z, Ross CS, Galea S, Kalesan B, Fleegler E, Goss KA. Firearm-Related Laws in All 50 US States, 1991–2016. *Am J Public Health*. 2017 May 18;107(7):1122–9.
15. Webster D, Crifasi CK, Vernick JS. Effects of the Repeal of Missouri's Handgun Purchaser Licensing Law on Homicides. *J Urban Health*. 2014 Apr;91(2):293–302.

16. Kagawa RMC, Castillo-Carniglia A, Vernick JS, Webster D, Crifasi C, Rudolph KE, Cerdá M, Shev A, Wintemute GJ. Repeal of Comprehensive Background Check Policies and Firearm Homicide and Suicide. *Epidemiol*. 2018;29(4):494–502.
17. Rudolph KE, Stuart EA, Vernick JS, Webster DW. Association Between Connecticut's Permit-to-Purchase Handgun Law and Homicides. *Am J Public Health*. 2015 Aug;105(8):e49–54.
18. Knopov A, Siegel M, Xuan Z, Rothman EF, Cronin SW, Hemenway D. The Impact of State Firearm Laws on Homicide Rates among Black and White Populations in the United States, 1991-2016. *Health Soc Work*. 2019 Oct 17;44(4):232–40.
19. Bureau of Justice Statistics (BJS) - Homicide Trends in the United States, 1980-2008 [Internet]. [cited 2019 Jul 14]. Available from: https://www.bjs.gov/index.cfm?ty=pbdetail&iid=4944
20. Expanded Homicide Data Table 11 [Internet]. FBI. [cited 2019 Aug 7]. Available from: https://ucr.fbi.gov/crime-in-the-u.s/2017/crime-in-the-u.s.-2017/tables/expanded-homicide-data-table-11.xls
21. Planty M, Truman J. Firearm Violence, 1993-2011. Bureau of Justice Statistics Report NCJ 241730. U.S. Department of Justice, 2013;28.
22. Busch SH, Epstein AJ, Harhay MO, Fiellin DA, Un H, Leader D, Barry CL. The effects of federal parity on substance use disorder treatment. *Am J Manag Care*. 2014;20(1):76–82.
23. Kaufman EJ, Wiebe DJ. Impact of State Ignition Interlock Laws on Alcohol-Involved Crash Deaths in the United States. *Am J Public Health*. 2016 May;106(5):865–71.
24. Meyer BD. Natural and Quasi-Experiments in Economics. *J Bus*. 1995;12.

25. Publications | National Institute on Alcohol Abuse and Alcoholism | Surveillance Report #110 [Internet]. [cited 2019 Jul 2]. Available from: https://pubs.niaaa.nih.gov/publications/surveillance110/CONS16.htm
26. Bertrand M, Duflo E, Mullainathan S. How Much Should We Trust Differences-in-Differences Estimates? [Internet]. Cambridge, MA: National Bureau of Economic Research; 2002 Mar [cited 2016 May 16]. Report No.: w8841. Available from: http://www.nber.org/papers/w8841.pdf
27. Ryan AM, Burgess JF, Dimick JB. Why We Should Not Be Indifferent to Specification Choices for Difference-in-Differences. *Health Serv Res*. 2015 Aug;50(4):1211–35.
28. Epstein AJ. Effects of report cards on referral patterns to cardiac surgeons. *J Health Econ*. 2010 Sep;29(5):718–31.
29. Zakrison TL, Puyana JC, Britt LD. Gun violence is structural violence: Our role as trauma surgeons. *J Trauma Acute Care Surg*. 2017 Jan;82(1):224.
30. Beard JH, Sims CA. Structural Causes of Urban Firearm Violence: A Trauma Surgeon's View From Philadelphia. *JAMA Surg*. 2017 Jun 1;152(6):515–6.
31. Ludwig J, Cook PJ. Homicide and suicide rates associated with implementation of the Brady Handgun Violence Prevention Act. *JAMA*. 2000 Aug 2;284(5):585–91.
32. Wintemute GJ, Braga AA, Kennedy DM. Private-Party Gun Sales, Regulation, and Public Safety. *N Engl J Med*. 2010 Aug 5;363(6):508–11.
33. Miller M, Hepburn L, Azrael D. Firearm Acquisition Without Background Checks: Results of a National Survey. *Ann Intern Med*. 2017 Feb 21;166(4):233–9.
34. The Wild Wild Web [Internet]. EverytownResearch.org. [cited 2019 Jun 28]. Available from: https://everytownresearch.org/reports/the-wild-wild-web/

35. New Polling: 89 Percent of Minnesota Gun Owners Support Background Checks on All Gun Sales [Internet]. Everytown for Gun Safety. [cited 2019 Jul 4]. Available from: https://everytown.org/press/new-polling-89-percent-of-minnesota-gun-owners-support-background-checks-on-all-gun-sales/
36. Gun Policy Remains Divisive, But Several Proposals Still Draw Bipartisan Support | Pew Research Center [Internet]. 2018 [cited 2019 Jul 4]. Available from: https://www.people-press.org/2018/10/18/gun-policy-remains-divisive-but-several-proposals-still-draw-bipartisan-support/
37. Castillo-Carniglia A, Kagawa RMC, Webster DW, Vernick JS, Cerdá M, Wintemute GJ. Comprehensive background check policy and firearm background checks in three US states. *Inj Prev*. 2018;24(6):431–6.

Figure Legends

Figure 1: Map of states with universal background check laws

Figure 2: Annual median firearm homicide rates by race, 1999-2017

Figure 1

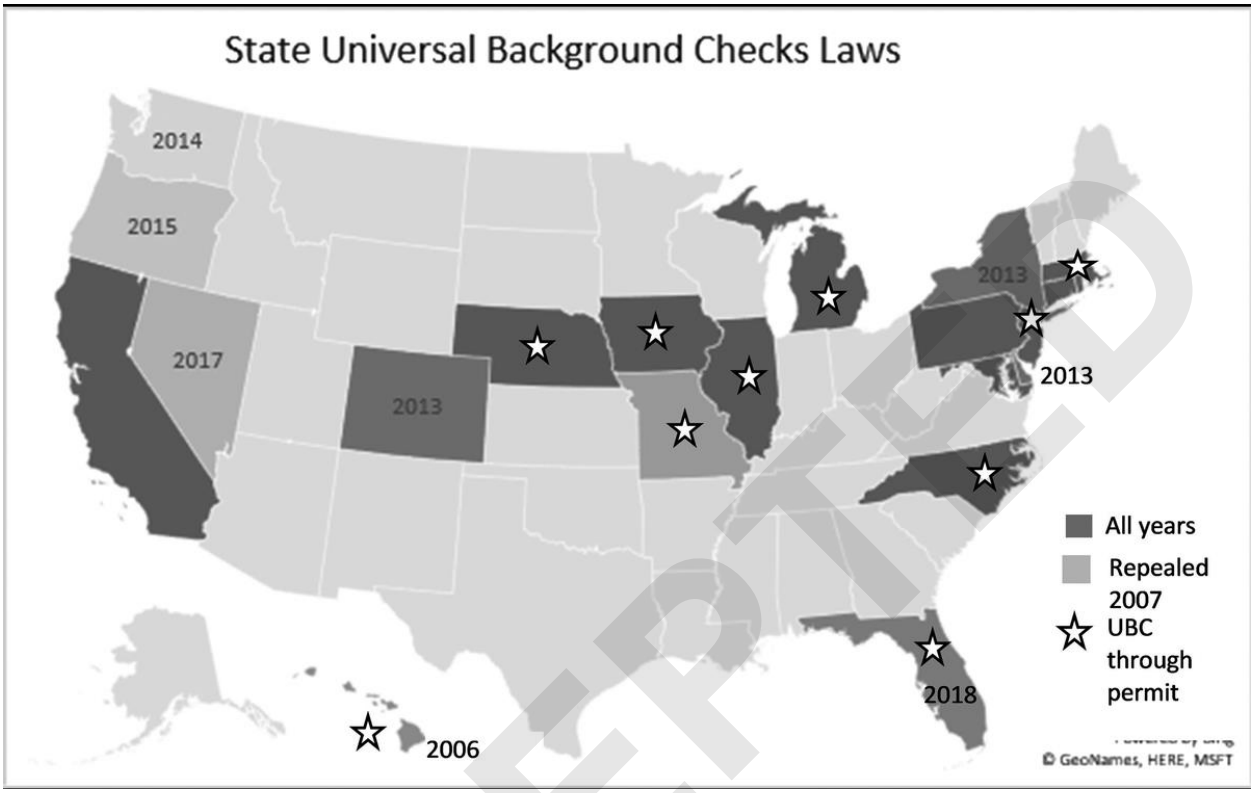


Figure 2

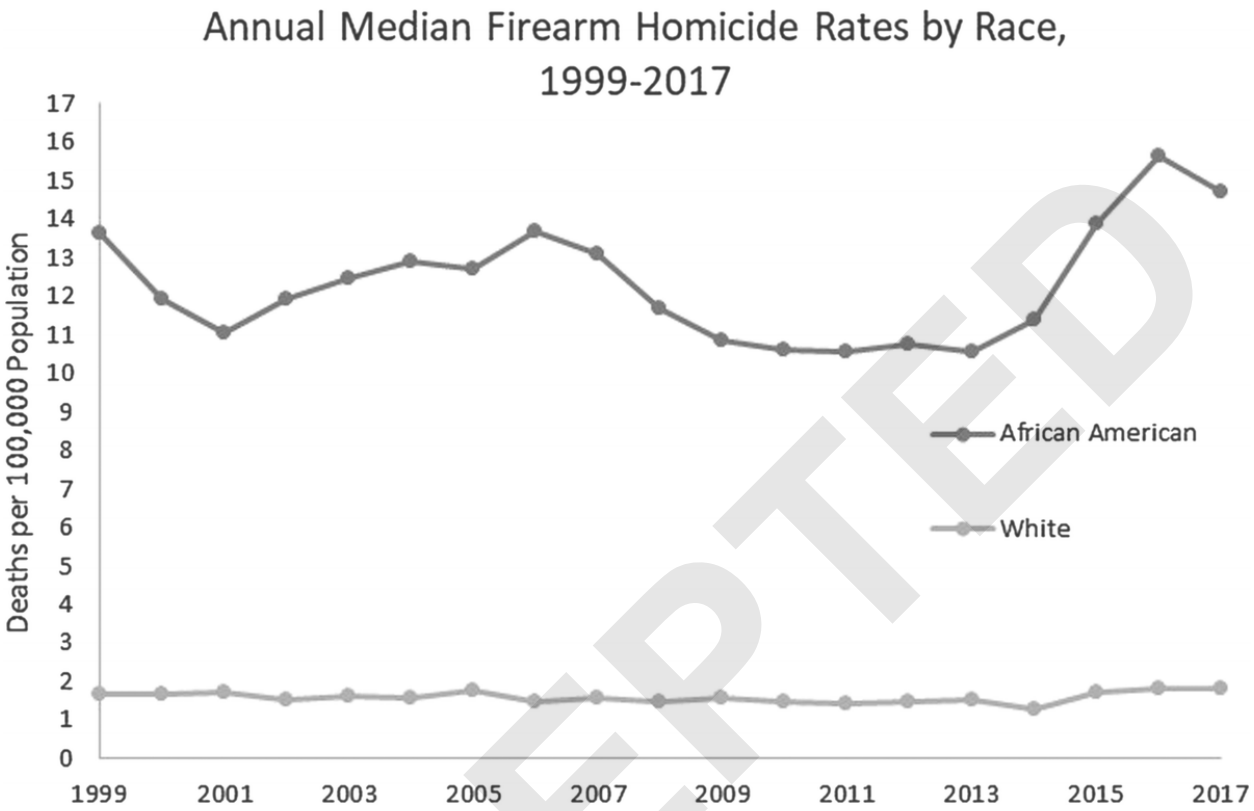


Table 1: Regression Model Results for Homicide of African Americans and White , 1999-2017

	Homicide of African Americans				Homicide of whites		
	IRR	95% CI	p		IRR	95% CI	p
Universal background checks for handguns	0.81	0.70, 0.94	0.006		0.93	0.73, 1.20	0.599
% of population age < 25	1.06	0.95, 1.18	0.317		1.07	0.97, 1.18	0.180
% of population age ≥ 65	0.97	0.86, 1.08	0.553		0.95	0.85, 1.07	0.403
Median household income (per $10,000)	1.00	0.91, 1.10	0.994		1.04	0.93, 1.18	0.485
Alcohol consumption per capita (gallons)	0.95	0.66, 1.35	0.762		1.31	0.87, 1.98	0.196
Other firearm laws (For each 10 laws)	0.91	0.85, 0.97	0.003		0.96	0.90, 1.02	0.191
Year							
1999	Reference				Reference		
2000	1.04	0.96, 1.13	0.307		0.98	0.93, 1.04	0.475
2001	1.06	0.97, 1.16	0.197		1.05	1.01, 1.10	0.029
2002	1.12	0.98, 1.28	0.085		1.05	0.96, 1.15	0.244
2003	1.14	1.00, 1.31	0.048		1.05	0.95, 1.16	0.313
2004	1.11	0.93, 1.31	0.242		1.04	0.93, 1.16	0.497
2005	1.20	1.01, 1.42	0.042		1.07	0.93, 1.23	0.329
2006	1.29	1.08, 1.53	0.004		1.07	0.93, 1.24	0.317
2007	1.25	1.05, 1.48	0.012		1.09	0.95, 1.25	0.219
2008	1.19	1.00, 1.41	0.056		1.09	0.97, 1.24	0.156
2009	1.13	0.93, 1.37	0.206		1.05	0.97, 1.24	0.448
2010	1.13	0.93, 1.38	0.241		1.01	0.87, 1.17	0.904
2011	1.15	0.91, 1.44	0.243		1.02	0.84, 1.24	0.843
2012	1.25	0.98, 1.60	0.075		1.06	0.86, 1.31	0.561
2013	1.27	0.97, 1.67	0.083		1.06	0.85, 1.33	0.616
2014	1.27	0.95, 1.68	0.102		1.07	0.85, 1.34	0.564
2015	1.55	1.14, 2.10	0.005		1.26	0.97, 1.64	0.089
2016	1.76	1.26, 2.45	0.001		1.43	1.06, 1.92	0.018
2017	1.82	1.28, 2.59	0.001		1.50	1.08, 2.08	0.016
State fixed effects: range for included states	0.48-2.58				0.16-1.32		

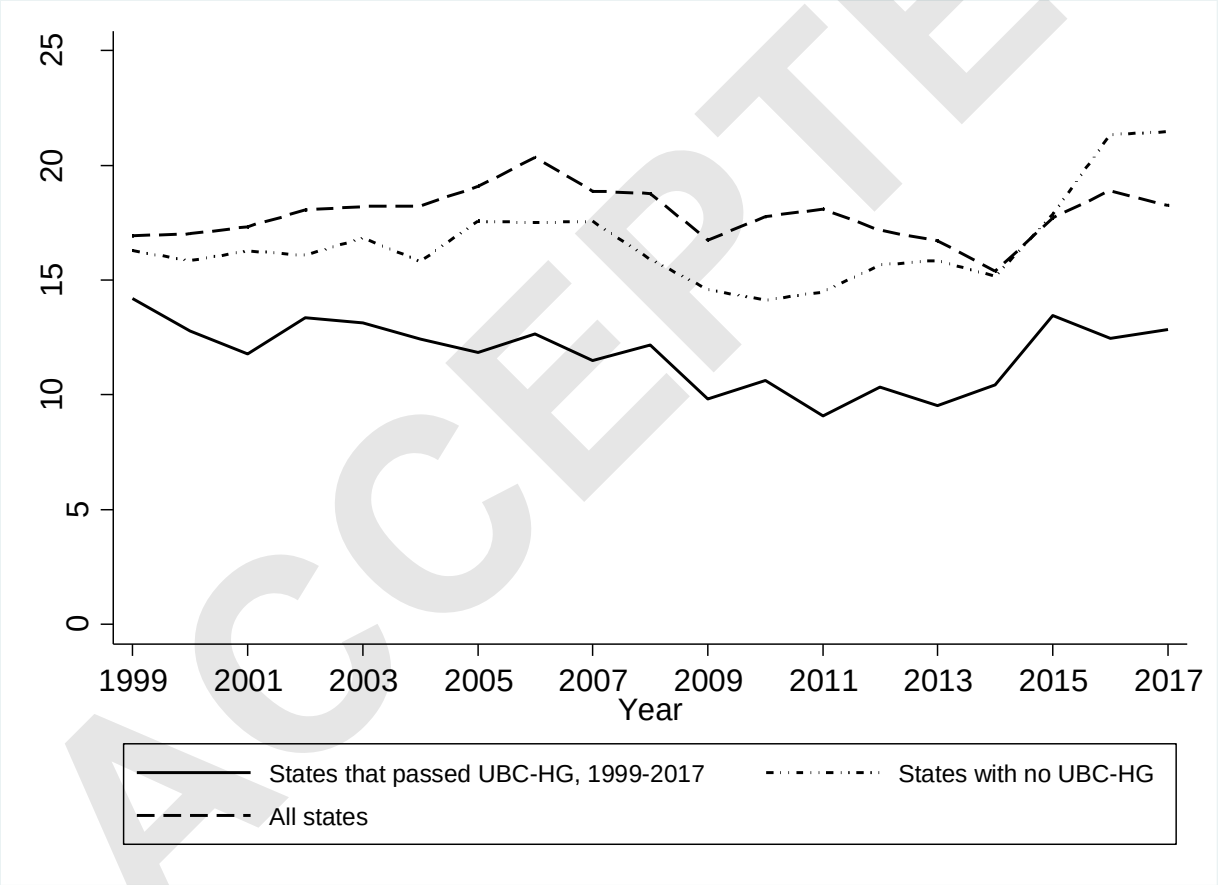
Table 2: Association of Implementation of Universal Background Checks for Handguns with Homicide by Race and Sex

	Firearm homicides per 100,000 (Median, IQR)	**IRR for UBC-HG (95% CI)**
African American male	28.5 (21.5, 39.1)	0.82 (0.70, 0.95)
African American female	3.3 (2.7, 4.6)	0.79 (0.71, 0.87)
African American, total	15.6 (11.6, 21.0)	0.81 (0.70, 0.94)
White male	2.7 (1.8, 4.2)	0.94 (0.71, 1.24)
White female	1.1 (0.8, 1.4)	0.92 (0.77, 1.09)
White, total	1.8 (1.2, 2.7)	0.93 (0.73, 1.20)

Supplemental Digital Content

Universal background checks for handgun purchases can reduce African American homicide rates

Firearm homicide rates of African Americans in states that did and did not pass UBC-HG laws, 1999-2017.



Note: this figure excludes Missouri, which repealed its UBC-HG law in 2007