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State-specific and racial/ethnic heterogeneity in trends of firearm-related fatality rates in the United States from 2000-2010

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Galea and Kalesan conceived and supervised the study. Kalesan and Vasan completed the analyses. Kalesan, Galea and Villarreal led the writing. Fagan, Teperman, Mobily and Hlavacek assisted with the study and analyses. Hlavacek assisted with obtaining state gun laws.

Abstract:

Objectives: To document overall, racial/ethnic and intent-specific spatio-temporal trends of firearm related fatality rates (FRF-rate) in the United States.

Design: Cross-sectional study per year from 2000 to 2010.

Setting: United States.

Participants: All people in the US from 2000 to 2010.

Outcome measures: Data from the Web-based Injury Statistics Query and Reporting System from 2000-2010 was used to determine annual FRF-rates per 100,000 and by states, race/ethnicity and intent.

Results: National 11-year FRF-rate was 10.21 per 100,000, from 3.02 to in Hawaii to 18.62 in Louisiana: 60% of states had higher than national rates and 41 states showed no temporal change. National FRF-rates among blacks and whites were 18.51 and 9.05 per 100,000 and among Hispanics and non-Hispanics were 7.13 and 10.13 per 100,000; Hispanics had a decreasing change of -0.18, p-trend<0.0001. In states with increasing trends (Florida and Massachusetts), whites and non-Hispanics drove the rise; while in states with decreasing trends (California, North Carolina, Arizona, Nevada, New York, Illinois), Hispanics and blacks drove the fall. National FRF-rates due to homicides (4.1 per 100,000) and suicides (5.8 per 100,000) remained constant, but varied between states.

Conclusion: Endemic national FRF-rates mask a wide variation in time trends between states. FRF-rates were twice as high in blacks than whites but decreased among Hispanics. Efforts to identify state-specific best practices can contribute to changes in national FRF-rates that remain.

Strengths of this study

- This study uses the best available data reporting system for surveillance of firearm mortality in US.
- Brings into light the overall state-specific variability of temporal trends of firearm mortality, which was obscured by the endemic national firearm fatality rates during 2000-2010 and according to race, ethnicity and intent from a seemingly stable national burden of firearm deaths.
- This is the first report that documents firearm fatality trends by ethnicity
- Our results call for identification of drivers of state-specific temporal trends to introduce tailored programs targeted to reduce deaths and injury due to firearms.

Limitations of this study

- Possible under reporting of firearm fatal events, which cannot be verified.
- Despite the considerable state-specific heterogeneity, the actual variation in firearm mortality may be a feature of cities and counties with varying crime rates, and we do not address the variation existing at such level.
- Finally, comparisons made between other races may not be usefully interpreted due to the heterogeneity and the small frequency of events in this sub-population.

Firearm violence increased during the 1980s and peaked in 1993, with 39,595 firearm deaths in the US and a firearm-related fatality rate (FRF-rate) of 15.0 per 100,000.[1] Since the turn of the 21st century, FRF-rates in the US have become endemic around 10.3 per 100,000 accounting for 17.5% of all injury deaths,[2] while the intent of firearm deaths was mainly suicide and homicide.[3]

The FRF-rate in 1993 among blacks was three-times greater than whites, but similar among Hispanics and non-Hispanics.[1 4] The overall fall in FRF after 2000 corresponded to a related narrowing of the racial gap between blacks and whites, where, by 2010, the FRF-rates among blacks was twice greater than whites.[1] Several factors have been posited that might explain these persistent racial differences, including socioeconomic determinants and increased firearm availability.[5 6]

Although the national temporal trends in FRF have been previously well documented,[3 7 8] there is ample reason to suspect substantial heterogeneity in FRF across states, such as dramatic differences in gun laws controlling access to firearms, variability in enforcement of national standards across states,[8 9] changing demographics and violence.[10] It is likely that some of the state-to-state heterogeneity in the potential determinants of FRF may also contribute to variability in racial/ethnic differences in FRF within states.

With this in mind, this study had two distinct aims. First, we aimed to document national and state-specific trends in FRF-rates along with the annual change in FRF-rates from 2000-2010 and second, to determine the racial, ethnic and intent-specific differences in FRF-rates within each state during the same time period.

METHODS

Data source

We accessed the restricted fatal injury data reports from the Web-based Injury Statistics Query and Reporting System (WISQARS™), an interactive database system provided by Centers for Disease Control and Prevention's (CDC) Injury Prevention and Control Unit (http://www.cdc.gov/injury/wisqars/).[1] The data in the WISQARS system is derived from CDC annual mortality data from National Vital Statistics System (NVSS), National Center for Health Statistics (NCHS) (http://www.cdc.gov/nchs/) and CDC. The NCHS and the National Association of Public Health Statistics and Information Systems restricts reporting NVSS data for cumulative frequencies <10 for sub-national geographic areas to prevent unintentional disclosure of cases. International Classification of Disease-10th Revision (ICD-10) was used for coding mortality data including intent of injury.[11]

Study population and variables

Our study population consisted of national and state-specific fatal firearm injuries from 2000-2010 obtained from querying the WISQARS data system. Aggregate information such as number of firearm deaths, total population and age-adjusted rates by race (black, white, other), ethnicity (Hispanic and non-Hispanic) and intent (homicide/legal intervention, suicide, undetermined and unintentional) was obtained.

Statistical analysis

The standard errors (SE) for national and state-specific age-adjusted FRF-rates per 100,000 persons were derived for the 11-year period and annually and by race, ethnicity and intent. Since only aggregate data could be obtained from WISQARS without individual patient data, we used random effects meta-analysis and meta-regression.[12] The rates in each category and the SEs were meta-analyzed using random-effects meta-analysis. Heterogeneity between states was assessed using I^2 statistic; which ranges from 0 to 100% and denotes the proportion of variation across states other than by chance.[13 14] In order to assess the temporal trends from 2000-2010, we assumed linear trends across 11 years and used meta-regression to calculate the change in rates and the standard deviation (SD). The p-value from meta-regression was used to assess evidence for trend. Standardized mean difference (SMD) was calculated by dividing the annual change in age-adjusted rate by SD.[15 16] We do not present estimates for those states with number of deaths below 10. Lives-lost or saved are estimated by applying annual change to the total 11-year population (2000-2010). The difference between 11-year national and state-specific FRF-rates (overall and category-specific) were used to spatially represent the variation between states. STATA 13.1 (StataCorp LP, College Station, Texas; 2009) was used to analyze the data.

RESULTS

Between 2000 and 2010, a total of 335,609 firearm-related deaths were recorded and the overall mortality rate was 10.21 per 100,000. The annual change in FRF-rate across 11-years was -0.017 with a 95% confidence interval (95% CI) of -0.044-0.010, p-trend=0.18, indicating no significant change in national FRF-rates. **Table 1** presents national FRF-rates, for 11-years and annually according to race, ethnicity and intent. Cumulative 11-year FRF-rates were disproportionally high among blacks (18.51) as compared to whites and other race groups, and lowest among other races (3.38). Among whites the FRF-rates were lower than the overall national 11-year rate while increasing from 8.97 to 9.20 from 2000-2010. This annual increase was small (0.006, SMD=0.11) but not significant, p-trend=0.71. Even though the FRF-rates among blacks were consistently higher than national FRF-rates, the annual rates reduced from 18.30 to 16.90; and this decline, -0.114 was not significant, SMD=-0.40, p-trend=0.22. The decline in FRF-rates from 4.76 to 3.25 among other races was significant (change=-0.12, SMD=-1.83, p-trend<0.0001). Annual reduction observed among Hispanics showed a significant reduction, -0.179, p-trend<0.0001 alongside an already low 11-year FRF-rate of 7.13. FRF-rates among non-Hispanics remained slightly above the national rates without increase. FRF-rate by intent was highest for suicides (5.80) while the annual change was minimal in all four categories with a small significant reduction for unintentional deaths (change=-0.010, SMD=-1.70, p-trend<0.0001).

State-specific 11-year FRF-rates are represented in **Figure 1** and **Supplementary Table 1**. Hawaii (HI) (3.02) and Massachusetts (MA) (3.24) had the lowest 11-year FRF-rates, while Louisiana (LA) had the highest at 18.62. District of Columbia (DC) had the largest significant annual reduction at -1.067 (6.2 lives-saved per year, p-trend = 0.002) though it had the highest rate of 21.71. Although MA had a low FRF-rate, a significant increase was observed, change=0.074, p-trend=0.008. Florida (FL) also showed an increase, change=0.160, 28.2 lives-lost per year, p-trend=0.016. FRF-rates for Delaware (DL) and Ohio (OH) were 8.89 and 9.10, with a near significant increasing trend, changes of 0.20 and 0.12. FRF-rate in New York (NY) was 5.15 with a change=-0.064, 12.3 lives-saved per year, p-trend=0.006. Illinois (IL) had a significant reduction, change=-0.155, 19.6 lives-saved per year, p-trend=0.025). FRF-rates in CA was -0.166 (59.3 lives-saved per year, p-trend=0.001), Arizona (AZ) at -0.230 (13.4 lives-saved per year, p-trend=0.025) and Nevada (NV) at -0.264 (6.4 lives-saved per year, p-trend = 0.008). Maryland (MA) and North Carolina (NC) had a significant decline: change=-0.169, 9.4 lives-saved per year, p-trend=0.048 and -0.174, 15.3 lives-saved per year, p-trend=0.001).

The 11-year FRF-rates for each state by race are presented in **Figures 2A to 2C** and **Supplementary Figures 1A-C**. Among whites, the lowest rate was in MA with a significant increase from 2000-2010 (change=0.05, p-trend=0.037). FL also recorded a significant increase (change=0.12, p-trend=0.045) but had high 11-year FRF-rate, 10.02. NV recorded the highest and unchanging FRF-rate at 16.30. The four states that showed a significant declining trend from 2000-2010 were NY

(change=-0.05, p-trend=0.015), IL (change=-0.12, p-trend=0.028), NC (change=-0.10, p-trend=0.032), and CA (change=-0.12, p-trend=0.001). Among blacks, HI had the lowest 11-year FRF-rates at 2.93 while Missouri (MO) had the highest at 30.12 and DC was at 40.95. Oklahoma (OK), OH and DL had high 11-year rates at 20.04, 20.19 and 13.61 respectively with a significant increasing changes of 0.93, 0.51 and 0.79, p-trends of 0.008, 0.027 and 0.028 respectively. A declining trend was observed among blacks in CA (change=-0.58, p-trend=0.042), AZ (change=-0.83, p-trend=0.019), NV (change=-1.53, p-trend=0.005), NC (change=-0.38, p-trend=0.024), Indiana (IN) (change=-0.66, p-trend=0.012), Kansas (KA) (change=-1.07, p-trend=0.021), Minnesota (MN) (change=-0.61, p-trend=0.038), and DC (change=-1.58, p-trend=0.017), even though their 11-year FRF-rates were high. Among other races, Texas (TX) (change=-0.19, p-trend=0.033) and CA (change=-0.10, p-trend=0.009) showed a significant decline.

Figures 3A-B and **Supplementary Figures 3A-B** presents the 11-year FRF-rates for each state by ethnicity. Georgia (GA) (change=-0.54, p-trend=0.012), CA (change=-0.18, p-trend=0.009), Utah (UT) (change=-0.79, p-trend=0.030), AZ (change=-0.56, p-trend=0.016), and NV (change=-0.48, p-trend=0.007) were five high-FRF-rate states (>7.13) while NY (change=-0.17, p-trend=0.001), IL (change=-0.40, p-trend=0.001), TX (change=-0.21, p-trend=0.004), and Oregon (OR) (change=-0.33, p-trend=0.037) were the four low-FRF-rate states with a significant declining trend among Hispanics. No states demonstrated an increase among Hispanics, while non-Hispanics showed a significant increasing trend in MA

(change=0.07, p-trend=0.033), Pennsylvania (PA) (change=0.08, p-trend=0.039), OH (change=0.13, p-trend=0.048), DL (change=0.25, p-trend=0.036), TX (change=0.14, p-trend=0.022), FL (change=0.23, p-trend=0.002) and OK (change=0.15, p-trend=0.045). A declining trend in non-Hispanics was observed in MD (change=-0.16, p-trend=0.068), NC (change=-0.14, p-trend=0.004) and CA (change=-0.15, p-trend=0.001). In TX, the FRF-rates among Hispanics (change=-0.21, p-trend=0.004) demonstrated a significant decline and a significant increase among non-Hispanics (change=0.14, p-trend=0.022) (**Supplementary Table 2**).

FRF-rates from 2000-2010 and by intent is provided in **Figures 4A-D** and **Supplementary Figures 4A-D**. Most of the northern states had low (<3.73) homicide-FRF while southern states had high FRF. NY (change=-0.05, p-trend=0.004), IL (change=-0.10, p-trend=0.027), NC (change=-0.10, p-trend=0.023), NV (change=-0.15, p-trend=0.031) and DC (change=-1.0, p-trend=0.002) had significant declining trends while MA (change=0.08, p-trend=0.001), Connecticut (CT) (change=0.08, p-trend=0.023), OH (change=0.12, p-trend=0.006), DL (change=0.37, p-trend<0.0001) and FL (change=0.15, p-trend=0.007) had increasing homicide-FRF. A majority of the states had suicide-FRF-rates >5.80; CA (change=-0.07, p-trend=0.009) and NC (change=-0.07, p-trend=0.037) had declining trends. Unintentional-FRF-rates showed a significant decreasing trend in three states, OH (change=-0.01, p-trend=0.022), Kentucky (KY) (change=-0.06, p-trend=0.009), and Tennessee (TN) (change=-0.05, p-trend=0.002).

DISCUSSION

National 11-year FRF-rate from 2000-2010 was 10.21, was almost three times higher than Switzerland and Finland.[17] There were four main observations that emerge from this analysis. First, while overall, blacks had higher national rates than whites and Hispanics had lower national rates than non-Hispanics, the 11-year FRF-rates declined among Hispanics and non-white non-black races with no significant change observed among whites, blacks or non-Hispanics. Second, a substantial inter-state heterogeneity was evidenced by 11-year state-specific FRF-rates being as low as 3.02 in HI to as high as 21.71 in DC. FL and MA recorded an upward FRF trend while AZ, CA, IL, MD, NV, NY, NC and DC had declining FRF-rates during the study period. Third, racial-ethnic variation was shown to drive many of the state-specific variations. Fourth, changes in different FRF-intent also drove many of the state-specific differences.

Firearm deaths increased from 28,663 in 2000 to 31,672 in 2010, about 30,509 deaths per year and no change in rate. These findings are similar to a report by the Bureau of Justice of a rapid decline in firearm homicides from 1993 to 1999 followed by a leveling of rates from 2000-2011.[18] Taken at face value, this endemic FRF-rate may seem reassuring, evidencing no increase in burden over time, concealing a substantial existing public health burden due to long-term cumulative burden to the country, as a whole surpasses the toll suffered during the 1980s epidemic stage.[19] During 2000-2011 there were 306,946 firearm related deaths. With the endemic annual FRF-rate of 10.3, US-population at 338 million by 2020[20]

and 10% decadal population increase, we estimate 336,778 firearm related deaths to occur between 2011 and 2020.

The 11-year FRF-rates we report among blacks was twice greater than that of whites and six-times greater than that of other races is in line with reports showing disproportionately larger firearm fatality and injury rates than whites and other race.[3 21 22] Although there was a plateau of the national FRF-rates, rates among Hispanics and non-white non-black races declined and may be explained by the lack of access to firearms or low firearm ownership among Hispanics and other races.[23] Our results explain the report where Hispanics were least likely to use firearms for suicides albeit being more likely to self-injury than any other race groups.[24] Data from 1981-2010 found that among youths a decline in homicide rates for blacks between was significantly slower than the declines for Hispanics and other racial/ethnic groups[25], suggestive of lower crime.

We found 41 states with no FRF-rate change, while 7 states and DC demonstrated either a significant decline or increase. MA and FL recorded a significant increase, MA with smallest and FL with largest annual increase while MA had the lowest 11-year FRF-rate. The Brady Center to Prevent Gun Violence [9] firearm legislative strength score for 2013, has MA to be third with score of 65 among all states in restrictive firearm legislation, while FL has a score of 3. After MA passed the toughest firearm-control legislation in 1998, firearm ownership rates plummeted but violent crimes (476.1 to 468.9) and homicides (2.2 to 3.3) rose.[26]

The significant FRF-rate increase in MA may be due to the influx of firearms from the two neighboring states (Maine and New Hampshire) with weak firearm control legislation.[27] FL is a "shall issue", weak legislature state with just 2 laws to prevent illegal gun-trafficking.[27] In contrast to the increasing FRF-rates, the aggregate violent crimes in FL declined from 801.1 to 542.9,[28] emphasizing a particularly concerning public health problem of increasing gun violence even in a climate of reducing violence.

CA, NY, IL, AZ, NV, MD, NC, and DC had declining trends but the most marked reduction was observed in CA and may be directly linked to strength of firearm legislature, a score of 81.[9] CA has eight state laws to prevent illegal gun trafficking[27] and a reduction in homicide crime rate in CA by 25.4% from 2001-2010.[29] An emergency department study from 2004-2008 reporting reduction of firearm death rate in CA echoing the results of our study.[30] NY and IL had similar trend profiles and an overall decline in FRF-rates, but the Brady scores were 62 and 35[9] with 10 and 8 policies preventing illegal firearm trafficking respectively.[27] FRF-rate reduction in AZ and NV is in contrast to CA and NY, having no laws preventing illegal gun trafficking,[27] with Brady scores 0 and 5 respectively.[9] In AZ violent crime rate dropped from 544.5 offenses in 2002 to 372.2 in 2010,[31 32] and NV had reductions in index crimes.[33] This reduction and our results may be attributed to policing strategies.[34] Our reported reduction in firearm death rates in DC may be attributed to 9 laws preventing illegal gun trafficking.[27] Firearm policies are not stringent in NC, strength of firearm legislature being 16[9] with only 5 illegal gun trafficking

laws.[27] However, the violent crime rate in NC dropped from 493 to 363 from 2000-2010,[35] suggesting that the factors that led to reduction in crime rates may have also driven FRF-rate reduction.

We found that the state-specific increasing trend in FL was driven by an increase among whites, blacks and non-Hispanics and can be explained by violent crime rates in FL which ranks 4th in violent crime.[36] The racial gap in arrests for major crimes widened in FL from 2000-2010: 6,175 blacks and 6,071 whites were arrested in 2000 to 2,398 and 3,192 in 2010.[37] The increase in FRF-rates in MA driven by whites and non-Hispanics is in contrast to the racial differences observed in violent deaths with non-Hispanic blacks having the highest rate of 21.6 as compared to 4.9 among whites.[38] MA has relatively low violent crime rate (ranks 20th in US),[36] and stringent firearm control.[9] Even though nationally no significant reduction in FRF-rates among blacks was observed in our study, FRF-rates among blacks drove the state-specific declines in AZ, NV, CA, NC and DC. Declining trends among Hispanics in AZ, NV, CA, NY and IL contributing to state-specific declines may be due to a combination of low firearm ownership[23] and racially targeted crime-control activities.[39] In IN, KS, MN and OK, with no statewide reduction, the FRF-rates fell solely among blacks, with no change among whites. These states have very few laws to prevent firearm violence and trafficking[27] and rank among the highest twenty states in crime rates except MN.[36]

The increasing trend in FL and MA in our study was due to increase in firearm homicides. According to data from CDC, rates of suicides in FL remained constant from 2000-2010 while in MA these rates doubled from 1.92 to 3.15.[1] In 2010, 71% of homicides in FL were by firearms,[28] and in MA, 22% of the homicides were by firearm.[38] In CA, where all racial-ethnic groups revealing declining trends, was driven by reduction in suicide-FRF and is associated with the states' increased effort in implementing "The Mental Health Services Act" to reduce suicide rates.[40] In our study, reduction in homicides was caused by declines in AZ, IL, NV, NY, NC and DC. These declining patterns are similar to the reduction in all-cause homicide rates from 2000-2010 that occurred in a smaller magnitude among AZ, IL, NV, NY, NC and in a much larger magnitude in DC.[1]

There are several limitations in our study. Under reporting of firearm fatal events is a known phenomenon and a limitation of this study, which cannot be verified. There is, however, no reason to suspect that blacks and Hispanics are more likely than whites and non-Hispanic individuals to have a fatal firearm injury misclassified on the death certificate, so this under-reporting should not have biased our findings. Another limitation is that, despite the considerable state-specific heterogeneity, the actual variation in firearm mortality may be a feature of cities and counties with varying crime rates, and we do not address the variation existing at such level. Finally, comparisons made between other races may not be usefully interpreted due to the heterogeneity and the small frequency of events in this sub-

population. However, as other race makes up about 10% of the US population, the results are discussed in relation to blacks and Hispanics.

In summary, we showed no change in national firearm mortality rates during 2000-2010, but showed distinct state-specific patterns with racial/ethnic variation and by intent. The patterns observed do not map neatly onto known firearm control efforts by individual states. While some of the states with most stringent gun laws showed an expected decrease in firearm death rates, some states with strong gun control laws reported an increase in death rates. This may have a direct implication for a public health approach to gun violence prevention that more broadly needs to grapple with firearm available and porous cross-state borders that permit firearm carriage across states. The distinctive state-specific firearm fatality profiles vary by race, ethnicity and intent adding another layer of complexity to the FRF trends. This calls for specific studies to identify the drivers of the state-specific temporal trends followed by introducing tailored programs that target specific racial-ethnic groups in specific states.

Table 1: Trends in firearm deaths in the United States, WISQARS 2000-2010.

	Age-adjusted firearm deaths per 100,000 population												Change			
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total	Annual	95% CI	SMD	P-trend
All	10.14	10.31	10.43	10.29	9.99	10.27	10.22	10.24	10.23	10.05	10.07	10.21	-0.017	-0.044, 0.010	-0.44	0.181
Race																
White	8.97	9.21	9.19	9.05	8.84	8.98	8.80	8.98	9.18	9.13	9.20	9.05	0.006	-0.027, 0.039	0.11	0.705
Black	18.30	18.32	19.22	19.01	18.31	19.34	19.98	19.31	18.19	17.15	16.90	18.51	-0.114	-0.311, 0.082	-0.40	0.220
Other	4.76	3.89	4.19	4.03	3.70	3.88	3.83	3.38	3.25	3.37	3.25	3.38	-0.121	-0.166, -0.076	-1.83	<0.0001
Ethnicity																
Hispanic	7.81	7.73	7.63	7.68	7.42	7.51	7.19	7.21	6.60	6.38	5.86	7.13	-0.179	-0.236, -0.122	-2.13	<0.0001
Non-Hispanic	10.31	10.50	10.67	10.50	10.23	10.53	10.54	10.61	10.74	10.55	10.71	10.54	0.027	-0.002, 0.056	0.63	0.068
Intent																
Homicide/Legal Intervention	3.88	4.05	4.17	4.19	4.05	4.28	4.40	4.32	4.14	3.89	3.73	4.10	-0.008	-0.054, 0.038	-0.12	0.705
Suicide	5.90	5.90	5.92	5.77	5.65	5.66	5.54	5.63	5.82	5.91	6.06	5.80	0.001	-0.035, 0.038	0.03	0.932
Undetermined	0.08	0.08	0.08	0.08	0.08	0.07	0.07	0.09	0.09	0.07	0.08	0.08	-0.0001	-0.002, 0.002	-0.02	0.944
Unintentional	0.27	0.28	0.26	0.25	0.22	0.27	0.21	0.20	0.19	0.18	0.20	0.23	-0.010	-0.014, -0.006	-1.70	<0.0001

All values are age-adjusted rates per 100,000 persons. Change denotes annual change in rate per 100,000. Negative value indicates decline in firearm death rates per 100,000 from 2000-2010 and positive value indicates increase in firearm death rate per 100,000 from 2000-2010. CI denotes confidence intervals of the annual change in firearm death rate per 100,000. SMD indicates standardized mean difference; is equal to annual change/standard deviation. P-trend calculated using meta-regression indicates the significance of the decline or the increase in firearm related death rates from 2000-2010.Data are from Center for Disease Control and Prevention (CDC)'s National center for Injury Prevention and Control Web-based Injury Statistics Query and Reporting System (WISQARS).

CONTRIBUTORSHIP STATEMENT

Galea and Kalesan conceived and supervised the study. Kalesan and Vasan completed the analyses. Kalesan, Galea and Villarreal led the writing. Fagan, Teperman, Mobily and Hlavacek assisted with the study and analyses. Hlavacek assisted with obtaining state gun laws.'

COMPETING INTERESTS

None

DATA SHARING STATEMENT

No additional data are available

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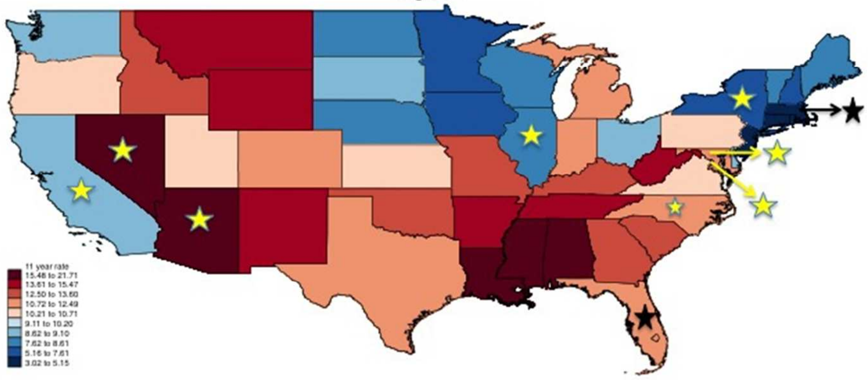
Figure 1



		AZ	CA	DC	IL	MD	NV	NY	NC		FL	MA
Overall	FRF rate	15.47	9.01	21.71	8.61	11.39	16.07	5.15	12.49		11.12	3.24
	Change, P-trend	-0.23, 0.025	-0.17, 0.001	-1.07, 0.002	-0.16, 0.025	-0.17, 0.048	-0.26, 0.008	-0.06, 0.006	-0.17, 0.001		0.16, 0.016	0.07, 0.008
Whites	FRF rate	15.73	8.73	3.03	5.80	6.81	16.30	4.05	11.61		10.02	2.57
	Change, P-trend	-0.19, 0.081	-0.12, 0.001	-0.03, 0.89	-0.12, 0.028	-0.05, 0.29	-0.08, 0.38	-0.05, 0.015	-0.10, 0.032		0.12, 0.045	0.05, 0.037
Blacks	FRF rate	18.97	23.43	40.95	24.48	21.18	22.36	10.73	14.77		15.16	10.65
	Change, P-trend	-0.83, 0.019	-0.58, 0.042	-1.58, 0.017	-0.32, 0.14	-0.42, 0.067	-1.53, 0.005	-0.06, 0.27	-0.38, 0.024		0.29, 0.056	0.25, 0.097
Other	FRF rate	7.83	2.88	2.78	0.90	2.17	4.93	0.82	7.73		3.07	0.97
	Change, P-trend	-0.43, 0.053	-0.10, 0.009	ne, ne	ne, ne	-0.12, 0.60	-0.48, 0.19	-0.05, 0.20	-0.30, 0.11		-0.08, 0.49	-1.08, 0.26
Hispanic	FRF rate	14.73	7.42	4.71	6.65	3.96	10.05	3.63	8.12		6.24	4.00
	Change, P-trend	-0.56, 0.016	-0.18, 0.009	ne, ne	-0.40, 0.001	-0.25, 0.33	-0.48, 0.007	-0.17, 0.001	-0.24, 0.20		0.09, 0.34	0.09, 0.34
Non-Hispanic	FRF rate	14.58	9.19	23.45	8.60	11.95	16.93	5.36	12.62		12.31	3.08
	Change, P-trend	-0.05, 0.57	-0.15, 0.001	-1.20, 0.003	-0.06, 0.28	-0.16, 0.068	-0.11, 0.27	-0.04, 0.094	-0.14, 0.004		0.23, 0.002	0.07, 0.033
Intent	Homicide	↓	↔	↓	↓	↔	↓	↓	↓		↑	↑
	Suicides	↔	↓	↔	↔	↔	↔	↔	↓		↔	↔
	Undetermined	↔	↔	ne	↔	ne	ne	ne	ne		↔	↔
	Unintentional	ne	↔	ne	↔	ne	ne	ne	↔		↔	↔

Figure 1: Firearm related fatality rates from 2000-2010.

Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia ranging from 3.02 (HI) to 21.71 (DC) per 100,000. The colors represent increasing rates from blue to red. Significant decline in 7 states (AZ, CA, IL, MD, NV, NY and NC and DC) are represented as gold stars and significant increase in FL and MA as black stars within the map and in the table.

The table summarizes the rates per 100,000, annual change in rate and p-trend for those states that show significant increase or decrease. “FRF” denotes firearm related fatality. “Change” indicates the annual change in rates from 2000 to 2010. “P-trend” indicates the significance of the decline or the increase in firearm related fatality rates from 2000 to 2010 and was calculated using meta-regression. Negative values for change indicate a decrease while positive values indicate increase in rates across the years. The intent-specific rates of firearm related fatality is denoted with arrows in the table below: downward arrow denotes reduction in rates, upward arrows indicate an increase and two-way arrows indicate no change. “ne” represents data which cannot be estimated due to frequency <10. HI (11-year=3.02, change=-0.057, p-trend=0.36) and AK (11-year=18.09, change=0.10, p-trend=0.64) are not represented in the map.

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Figure 2

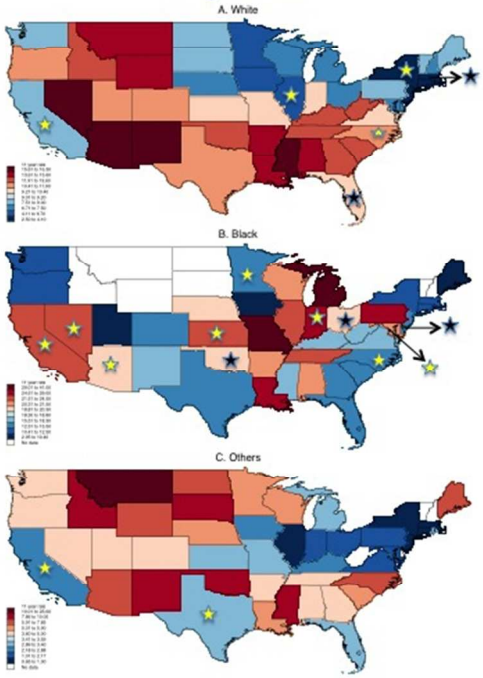

Figure 2: Firearm related fatality rates from 2000-2010 according to race.

Whites:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 2.57 (MA) to 16.30 (NV) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10 among whites. Significant decline in 4 states (CA, NY, IL and NC) are represented as gold stars and significant increase in MA and FL as black stars. HI (11-year=4.29, change=0.03, p-trend=0.84) and AK (11-year=15.77, change=0.15, p-trend=0.56) are not represented in the map.

Blacks:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 2.93 (HI) to 40.95 (DC) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10 among blacks. Significant decline in 8 states (CA, NV, AZ, KA, MN, IN, NC and DC) are represented as gold stars and significant increase in OK, OH and DL as black stars. HI (11-year=2.93) and AK (11-year=12.36) are not represented in the map.

Other race:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 0.82 (NY) to 22.54 (AK) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10 among other race. Significant decline in 2 states (CA and TX) are represented as gold stars and there were no states with significant increase. HI (11-year=2.18, change=-0.04, p-trend=0.50) and AK (11-year=22.54, change=-0.15, p-trend=0.75) are not represented in the map.

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Figure 3

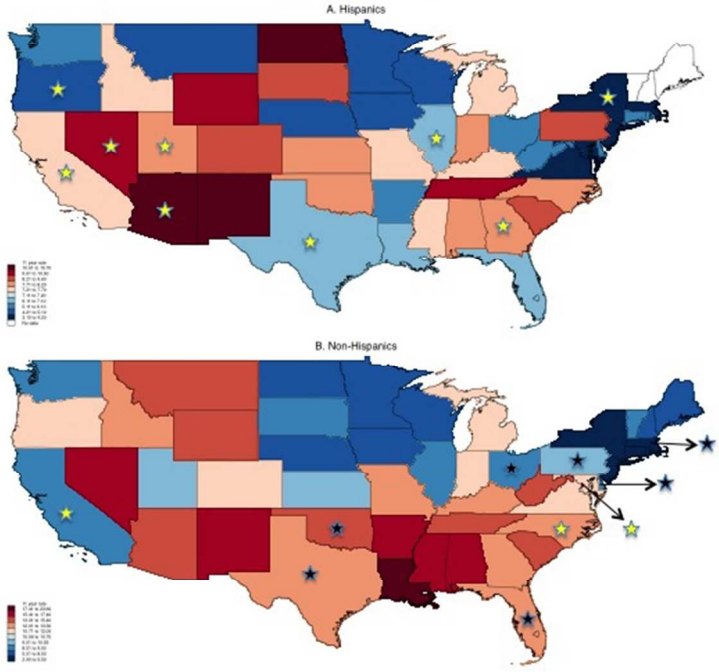


Figure 3: Firearm related fatality rates from 2000-2010 according to ethnicity.

Hispanic:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 3.13 (NJ) to 15.63 (ND) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10 among Hispanics. Significant decline in 9 states (CA, AZ, NV, OR, UT, TX, IL, GA and NY) are represented as gold stars and there were no states with significant increase. HI (11-year=3.84) and AK (11-year=8.95) are not represented in the map.

Non-Hispanic:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 2.95 (HI) to 23.45 (DC) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10 among non-Hispanics. Significant decline in 3 states (CA, NC and DC) are represented as gold stars and significant increase in 7 states (TX, OK, FL, OH, PA, DL, and MA) as black stars. HI (11-year=2.95, change=-0.05, p-trend=0.50) and AK (11-year=18.44, change=0.13, p-trend=0.57) are not represented in the map.

254x190mm (72 x 72 DPI)

Figure 4

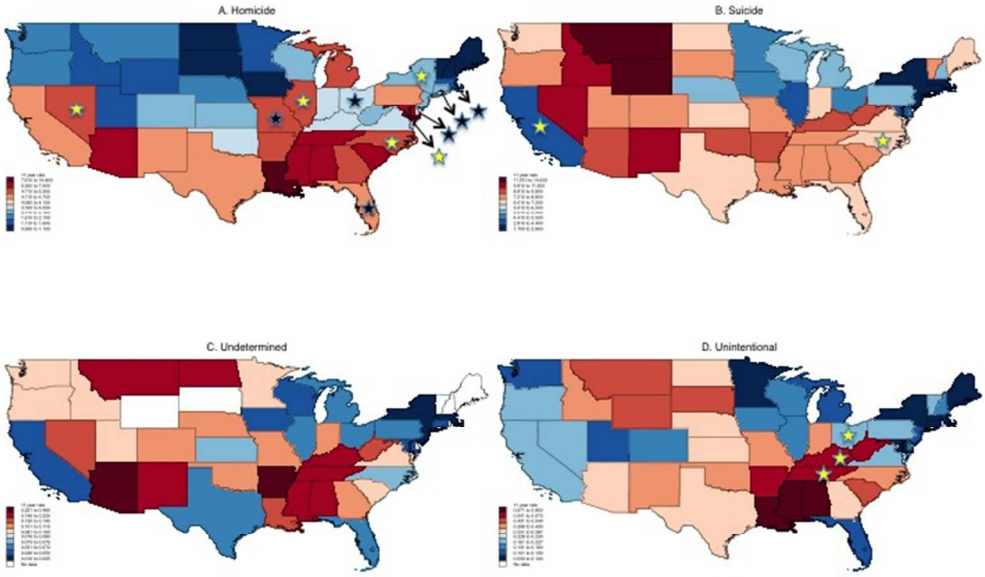


Figure 4: Firearm related fatality rates from 2000-2010 according to intent.

Homicide:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 0.65 (NH) to 19.75 (DC) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10. Significant decline in 5 states (NV, IL, NC, NY and DC) are represented as gold stars and significant increase in MO, FL, OH, MA, CT, and DL as black stars. HI (11-year=0.79, change=-0.01, p-trend=0.68) and AK (11-year=3.54, change=0.001, p-trend=0.95) are not represented in the map.

Suicide:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 1.61 (MA) to 13.79 (AK) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10. Significant decline in 2 states (CA and NC) are represented as gold stars and there were no states with significant increase. HI (11-year=2.10, change=-0.001, p-trend=0.95) and AK (11-year=13.79, change=0.11, p-trend=0.61) are not represented in the map.

Undetermined:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 0.01 (NJ) to 0.47 (AK) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10. There was no significant decline or increasing state-specific trends. HI (11-year=ne) and AK (11-year=0.47) are not represented in the map.

Unintentional:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 0.04 (MA) to 0.83 (LO) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10. Significant decline in 3 states (OH, KN and TN) are represented as gold stars and there

were no states with significant increase. HI (11-year=0.08) and AK (11-year=0.29) are not represented in the map.

254x190mm (72 x 72 DPI)

Supplementary Table 1: Firearm related trends in death, annual rate of change in death, lives lost and saved in the United States by states, WISQARS 2000 to 2010.

	Age-adjusted firearm deaths per 100,000 population												Change in rate			Lives lost/ saved (-)	
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total	Annual	95% CI	P-trend	11 years	Per year
All	10.14	10.31	10.43	10.29	9.99	10.27	10.22	10.24	10.23	10.05	10.07	10.21	-0.17	-0.044, 0.010	0.181	-5527.8	-502.5
Northeast																	
Massachusetts	2.73	3.00	3.13	3.09	3.16	3.42	3.22	3.55	3.34	3.1	4.03	3.24	0.074	0.025, 0.122	0.008	52.4	4.8
Rhode Island	5.10	4.30	5.14	3.12	3.61	3.60	4.21	3.40	3.94	5.02	4.60	4.18	-0.013	-0.180, 0.155	0.869	-1.5	-0.1
New Jersey	4.11	4.44	4.88	5.42	5.37	5.15	5.82	5.25	4.94	4.70	5.20	5.03	0.063	-0.035, 0.161	0.182	59.8	5.4
Connecticut	5.32	5.63	4.32	4.37	5.00	5.34	4.99	4.15	5.60	4.90	5.85	5.04	0.028	-0.103, 0.159	0.637	10.8	1.0
New York	5.70	5.54	5.13	5.32	4.88	5.21	5.14	5.04	4.90	4.79	5.07	5.15	-0.064	-0.104, -0.023	0.006	-134.9	-12.3
New Hampshire	6.27	7.23	5.91	6.8	5.02	6.62	6.22	5.56	6.86	6.34	8.22	6.49	0.065	-0.126, 0.255	0.461	9.2	0.8
Maine	8.55	7.29	6.63	6.02	7.9	7.71	7.28	7.61	8.42	8.58	7.86	7.61	0.100	-0.077, 0.277	0.232	14.4	1.3
Vermont	8.74	8.20	9.74	7.58	9.41	6.79	8.14	8.08	8.19	8.72	10.21	8.53	0.037	-0.222, 0.296	0.753	2.5	0.2
Pennsylvania	10.15	9.53	9.96	9.87	10.2	10.76	10.9	10.52	10.53	10.41	10.11	10.27	0.064	-0.014, 0.142	0.095	87.8	8.0
Midwest																.	.
Iowa	6.46	6.37	6.73	6.94	6.45	6.71	6.34	4.99	7.25	6.23	6.8	6.5	-0.017	-0.157, 0.124	0.796	-5.6	-0.5
Minnesota	6.34	6.49	6.06	6.5	7.04	6.94	6.3	6.48	6.97	6.17	6.76	6.57	0.024	-0.053, 0.101	0.495	13.5	1.2
Nebraska	9.77	8.12	8.05	7.64	6.71	7.67	7.69	7.95	8.27	7.26	8.16	7.94	-0.071	-0.231, 0.090	0.346	-13.8	-1.3
Wisconsin	7.99	8.70	8.08	8.44	7.37	8.48	7.56	8.54	7.72	7.91	8.57	8.14	-0.008	-0.113, 0.096	0.859	-4.9	-0.4
North Dakota	6.6	7.6	9.12	8.83	7.5	8.9	6.62	8.27	8.51	8.92	9.56	8.23	0.155	-0.086, 0.395	0.180	11.1	1.0
Illinois	9.00	10.21	9.69	9.01	7.8	8.01	8.08	8.03	8.55	8.17	8.19	8.61	-0.155	-0.286, -0.025	0.025	-215.3	-19.6
South Dakota	7.47	7.1	7.91	9.86	9.97	10.2	9.74	6.14	10.5	9.31	9.23	8.89	0.157	-0.168, 0.481	0.304	13.5	1.2
Ohio	7.81	9.00	9.31	8.12	8.97	9.63	9.66	9.55	9.67	8.5	9.95	9.1	0.122	-0.010, 0.253	0.066	153.8	14.0
Kansas	11.15	9.93	9.7	11.13	10.73	9.25	10.84	10.35	9.7	10.76	10.44	10.37	-0.012	-0.158, 0.135	0.860	-3.6	-0.3
Michigan	10.83	10.83	10.99	10.33	10.52	10.78	11.53	11.03	10.96	11.07	10.98	10.9	0.037	-0.034, 0.109	0.271	40.6	3.7
Indiana	10.88	11.82	11.68	11.19	10.22	11.11	11.63	10.5	11.24	11.33	10.82	11.13	-0.031	-0.143, 0.081	0.546	-21.4	-1.9
Missouri	13.24	13.14	12.21	11.42	11.44	12.9	13	12.79	13.74	13.71	13.93	12.88	0.135	-0.036, 0.306	0.108	86.1	7.8

South																.	.
Delaware	6.66	9.47	9.07	7.86	8.78	8.78	9.19	8.91	10.65	8.76	9.88	8.89	0.201	-0.018, 0.419	0.067	18.7	1.7
Virginia	11.13	10.61	11.01	10.86	10.81	11.48	10.36	10.4	10.18	10.28	10.69	10.71	-0.068	-0.149, 0.014	0.092	-56.6	-5.1
Texas	10.57	11.22	10.83	11.21	10.66	11.09	10.47	10.89	10.83	10.98	10.93	10.89	0.001	-0.054, 0.056	0.976	2.5	0.2
Florida	10.19	10.68	10.97	11.05	10.46	9.95	11.05	12.02	12.18	11.98	11.44	11.12	0.160	0.038, 0.282	0.016	310.1	28.2
Maryland	11.91	11.46	11.54	11.96	11.93	11.86	12.1	12.04	11.61	10.19	9.26	11.39	-0.169	-0.335, -0.002	0.048	-103.5	-9.4
North Carolina	13.56	13.06	13.43	12.35	12.21	12.74	12.55	12.17	12.31	11.59	11.57	12.49	-0.174	-0.255, -0.092	0.001	-168.1	-15.3
Georgia	13.4	13.44	13.39	13.72	12.16	12.05	12.54	13.4	12.43	13.06	12.62	12.92	-0.076	-0.197, 0.045	0.189	-75.0	-6.8
Kentucky	13.25	12.69	13.04	13.38	13.04	12.94	12.47	14.11	13.28	12.78	12.48	13.05	-0.020	-0.140, 0.010	0.713	-9.2	-0.8
Oklahoma	13.21	14.01	12.81	12.77	12.86	13.15	13.26	13.18	13.91	14.33	14.31	13.45	0.105	-0.028, 0.238	0.108	41.3	3.8
South Carolina	12.42	13.72	13.69	14.17	13.5	13.75	13.88	13.09	13.17	13.52	13.92	13.55	0.032	-0.088, 0.152	0.561	15.2	1.4
West Virginia	12.99	13.15	14.67	14.01	13.6	13.72	13.32	14.06	12.66	13.21	14.23	13.6	0.002	-0.183, 0.188	0.978	0.4	0.0
Tennessee	15.63	14.47	15.4	14.11	14.54	16.03	15.3	14.74	15.46	15.06	14.42	15.03	-0.013	-0.148, 0.123	0.837	-8.6	-0.8
Arkansas	15.42	15.27	16.29	14.96	14.65	15.62	15.12	15.09	15.6	16.03	14.39	15.31	-0.033	-0.193, 0.126	0.648	-10.1	-0.9
Alabama	17.14	16.41	16.08	16.8	14.79	15.99	16.7	17.24	17.31	17.18	16.18	16.53	0.045	-0.128, 0.217	0.574	22.8	2.1
Mississippi	16.56	17.64	17.34	16.81	16.41	15.98	16.54	18.28	19.25	16.65	16.05	17.06	0.015	-0.209, 0.239	0.883	4.8	0.4
Louisiana	17.58	17.46	19.31	18.61	19.52	18.35	19.02	19.77	18.34	18.03	19.11	18.62	0.082	-0.081, 0.244	0.286	40.4	3.7
District of Columbia	22.24	25.46	29.79	25.71	22.64	23.47	19.99	21.66	20.01	15.96	14.62	21.71	-1.067	-1.621, -0.512	0.002	-67.7	-6.2
West																.	.
Hawaii	4.2	3.74	2.82	2.88	3.1	2.14	2.38	2.44	3.04	3.34	3.21	3.02	-0.057	-0.190, 0.076	0.359	-8.1	-0.7
Washington	8.94	8.53	9.34	9.17	9.17	8.8	8.37	8.32	8.69	9.14	8.92	8.85	-0.018	-0.099, 0.063	0.623	-12.5	-1.1
California	9.27	9.31	9.75	9.78	9.24	9.52	9.15	8.84	8.5	8.17	7.7	9.01	-0.166	-0.249, -0.083	0.001	-652.3	-59.3
Utah	9.93	10.99	9.6	10.51	10.13	9.91	9.75	10.63	9.68	10.46	12.16	10.39	0.081	-0.077, 0.240	0.276	22.1	2.0
Oregon	10.81	10.16	10.49	10.72	10.36	10.68	10.16	9.91	9.73	10.31	11.33	10.44	-0.011	-0.127, 0.106	0.839	-4.4	-0.4
Colorado	10.36	11.68	11.47	11.13	11.96	11.53	10.33	10.38	10.39	11.58	10.72	11.05	-0.045	-0.183, 0.092	0.474	-23.1	-2.1
Idaho	10.19	13.5	12.42	12.33	13.04	13.94	12.69	12.75	11.4	12.85	12.73	12.56	0.077	-0.148, 0.302	0.459	12.1	1.1
Wyoming	11.72	13.91	18.87	17.46	11.15	13.39	14.85	14.66	16.91	17.59	15.54	15.09	0.267	-0.257, 0.791	0.279	15.3	1.4
Montana	14.85	17.77	14.61	15.68	13.05	16.85	12.25	13.54	15.73	16.04	15.56	15.11	-0.040	-0.420, 0.341	0.819	-4.2	-0.4

New Mexico	16.08	15.26	16.61	17.55	15.15	13.89	14.45	14.85	14.68	14.48	14.84	15.23	-0.184	-0.376, 0.008	0.058	-39.2	-3.6
Arizona	15.58	15.92	17.89	15.29	15.84	16	16.22	15.38	14.36	13.49	14.53	15.47	-0.230	-0.423, -0.036	0.025	-147.2	-13.4
Nevada	17.26	16.54	17.06	17.04	16.74	16.09	16.3	15.87	15.15	15.11	14.49	16.07	-0.264	-0.441, -0.086	0.008	-69.9	-6.4
Alaska	17.96	14.83	19.89	19.24	17.51	17.47	16.94	18.22	20.92	14.68	20.51	18.09	0.102	-0.375, 0.580	0.639	7.5	0.7

All values are age-adjusted rates per 100,000 population.
Change denotes annual change in rate per 100,000. Negative value indicates decline in firearm death rates per 100,000 from 2000 to 2010 and positive value indicates increase in firearm death rate per 100,000 from 2000 to 2010.
CI denotes confidence intervals of the annual change in firearm death rate per 100,000.
P-trend calculated using meta-regression indicates the significance of the decline or the increase in firearm related death rates from 2000 to 2010.
Lives lost or saved are calculated by applying annual change to the total 11-year population from 2000 to 2010. The annual lives lost or saved are the total/ 11 years. Negative denotes lives saved and positive values are lives lost.
Data are from Center for Disease Control and Prevention (CDC)'s National center for Injury Prevention and Control Web-based Injury Statistics Query and Reporting System (WISQARS).

Supplementary Table 2: US states with significant racial and ethnic trends within firearm fatality rates

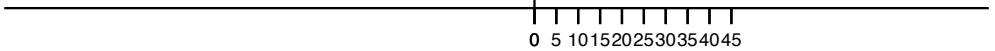
		GA	IN	KA	MN	OK	OR	PA	TX	UT
Overall	FRF rate	12.92	11.13	10.37	6.57	13.45	10.44	10.27	10.89	10.39
	Change	-0.08	-0.03	-0.01	0.02	0.11	-0.01	0.06	0.001	0.08
	P-trend	0.19	0.55	0.86	0.49	0.11	0.84	0.095	0.98	0.28
Whites	FRF rate	12.16	9.25	9.46	6.04	12.94	10.64	7.84	10.81	10.66
	Change	-0.07	0.01	0.07	0.06	-0.02	0.01	0.06	0.03	0.08
	P-trend	0.36	0.77	0.38	0.12	0.74	0.89	0.076	0.45	0.34
	Pop % change	-3.8	-2.0	-1.7	-3.3	-2.2	-2.0	-2.6	-2.3	-1.4
Blacks	FRF rate	14.05	28.92	24.14	13.52	20.04	11.47	27.48	13.37	7.73
	Change	-0.06	**-0.66**	**-1.07**	**-0.61**	**0.93**	-0.67	-0.14	-0.09	ne
	P-trend	0.57	**0.012**	**0.021**	**0.038**	**0.008**	0.23	0.59	0.60	ne
	Pop % change	2.3	1.2	0.6	1.9	0.4	0.4	1.3	0.6	0.5
Other	FRF rate	4.89	2.01	3.36	5.23	9.11	4.49	2.12	3.21	4.59
	Change	-0.32	ne	ne	-0.35	**0.37**	-0.07	-0.20	**-0.19**	ne
	P-trend	0.089	ne	ne	0.18	**0.062**	0.70	0.35	**0.033**	ne
	Pop % change	1.5	0.8	1.0	1.4	1.8	1.5	1.2	1.7	0.9
Hispanic	FRF rate	8.02	8.19	8.05	4.65	7.92	4.83	9.11	7.04	7.88
	Change	**-0.54**	-0.18	-0.15	-0.48	-0.26	**-0.33**	**-0.39**	**-0.21**	**-0.79**
	P-trend	**0.012**	0.33	0.49	0.31	0.21	**0.037**	**0.065**	**0.004**	**0.030**
	Pop % change	3.5	2.5	3.5	1.8	3.7	3.7	2.5	5.6	3.9
Non-Hispanic	FRF rate	13.15	11.18	10.38	6.60	13.73	10.76	10.25	12.28	10.53
	Change	-0.02	-0.04	0.01	0.05	**0.15**	0.03	**0.08**	**0.14**	**-0.15**
	P-trend	0.73	0.45	0.91	0.21	**0.045**	0.56	**0.039**	**0.022**	**0.001**
	Pop % change	-3.5	-2.5	-3.5	-1.8	-3.7	-3.7	-2.5	-5.6	-3.9
Intent	Homicide	↔	↔	↔	↔	↔	↔	↔	↔	↔
	Suicides	↔	↔	↔	↔	↔	↔	↔	↔	↔
	Undetermined	↔	ne	ne	ne	ne	ne	↔	↔	ne
	Unintentional	↔	↔	↔	ne	↔	ne	↔	↔	ne

FRF: firearm related fatality, Pop % change: change in population percentage from 2000 to 2010. All values are age-adjusted rates per 100,000 population. Change denotes annual change in rate per 100,000. Negative value indicates decline in firearm death rates per 100,000 from 2000 to 2010 and positive value indicates increase in firearm death rate per 100,000 from 2000 to 2010. CI denotes confidence intervals of the annual change in firearm death rate per 100,000. SMD indicates standardized mean difference; is equal to annual change/standard deviation. P-trend calculated using meta-regression indicates the significance of the decline or the increase in firearm related death rates from 2000 to 2010.Data are from Center for Disease Control and Prevention (CDC)'s National center for Injury Prevention and Control Web-based Injury Statistics Query and Reporting System (WISQARS)

Supplementary Figure 1A:

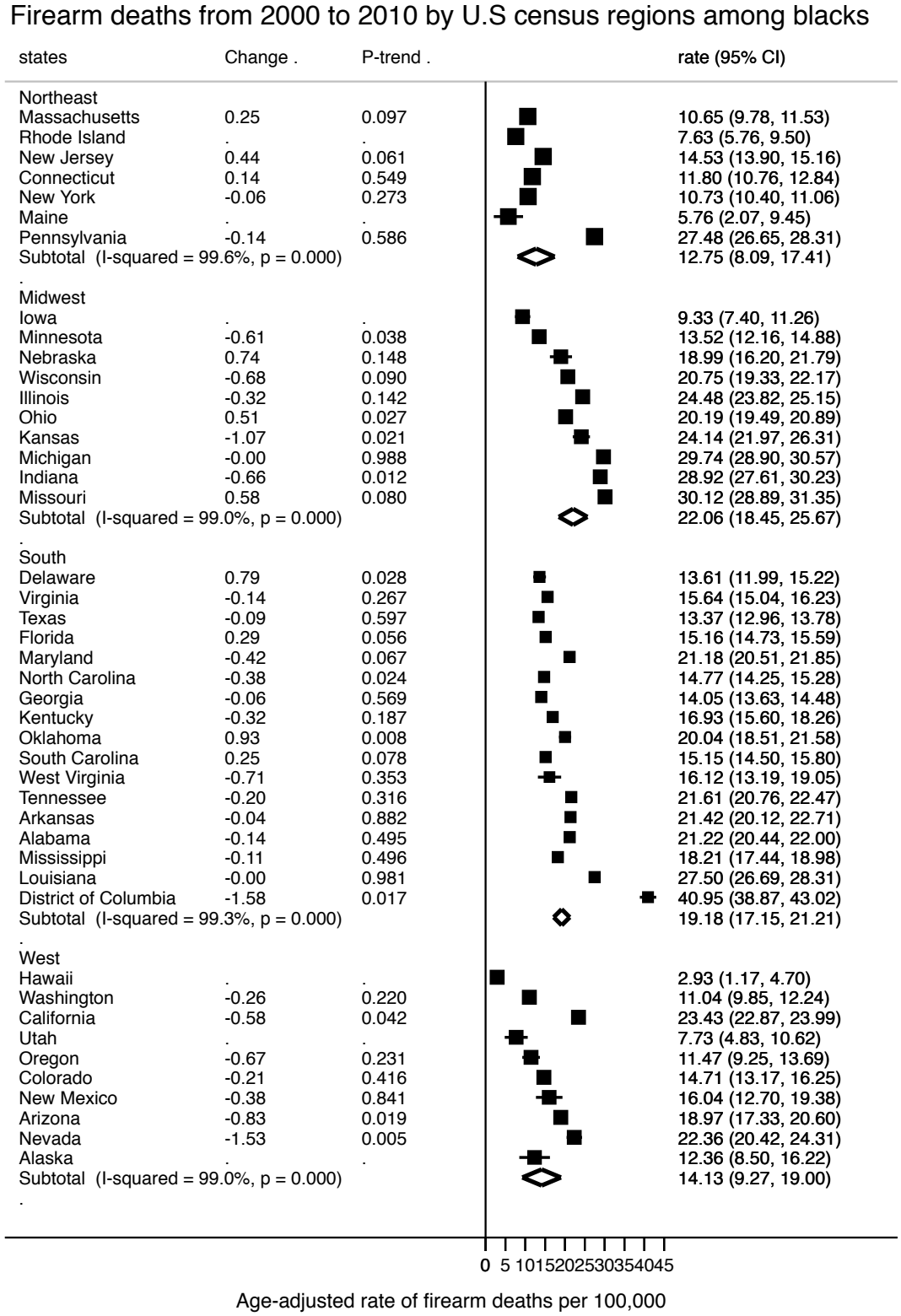
Firearm deaths from 2000 to 2010 by U.S census regions among whites

states	Change .	P-trend .	rate (95% CI)
Northeast			
Massachusetts	0.05	0.037	2.57 (2.45, 2.70)
Rhode Island	0.06	0.422	3.80 (3.42, 4.17)
New Jersey	-0.01	0.771	3.23 (3.10, 3.36)
Connecticut	-0.00	0.926	4.06 (3.85, 4.28)
New York	-0.05	0.015	4.05 (3.95, 4.15)
New Hampshire	0.08	0.380	6.61 (6.18, 7.04)
Maine	0.09	0.245	7.61 (7.15, 8.07)
Vermont	0.05	0.681	8.60 (7.90, 9.31)
Pennsylvania	0.06	0.076	7.84 (7.68, 8.00)
Subtotal (I-squared = 99.8%, p = 0.000)			5.36 (4.10, 6.62)
.			
Midwest			
Iowa	-0.02	0.765	6.44 (6.16, 6.72)
Minnesota	0.06	0.115	6.04 (5.83, 6.26)
Nebraska	-0.13	0.083	7.27 (6.87, 7.66)
Wisconsin	0.02	0.597	7.08 (6.86, 7.30)
North Dakota	0.16	0.189	8.25 (7.56, 8.94)
Illinois	-0.12	0.028	5.80 (5.66, 5.94)
South Dakota	0.16	0.274	8.74 (8.07, 9.40)
Ohio	0.04	0.410	7.43 (7.26, 7.59)
Kansas	0.07	0.382	9.46 (9.09, 9.82)
Michigan	0.03	0.383	7.44 (7.26, 7.62)
Indiana	0.01	0.772	9.25 (9.01, 9.49)
Missouri	0.04	0.423	10.30 (10.03, 10.57)
Subtotal (I-squared = 99.3%, p = 0.000)			7.78 (6.98, 8.59)
.			
South			
Delaware	-0.06	0.599	7.39 (6.75, 8.02)
Virginia	-0.01	0.896	9.63 (9.38, 9.87)
Texas	0.03	0.448	10.81 (10.67, 10.95)
Florida	0.12	0.045	10.02 (9.86, 10.18)
Maryland	-0.05	0.290	6.81 (6.55, 7.07)
North Carolina	-0.10	0.032	11.61 (11.36, 11.86)
Georgia	-0.07	0.359	12.16 (11.89, 12.43)
Kentucky	-0.01	0.900	12.70 (12.36, 13.04)
Oklahoma	-0.02	0.736	12.94 (12.55, 13.34)
South Carolina	-0.06	0.394	12.60 (12.21, 12.98)
West Virginia	0.00	0.959	13.54 (13.02, 14.06)
Tennessee	0.03	0.560	13.38 (13.07, 13.69)
Arkansas	-0.02	0.820	14.00 (13.54, 14.47)
Alabama	0.09	0.299	14.49 (14.10, 14.88)
Mississippi	0.07	0.601	15.74 (15.18, 16.29)
Louisiana	0.12	0.109	13.76 (13.35, 14.17)
District of Columbia	-0.03	0.896	3.03 (2.34, 3.73)
Subtotal (I-squared = 99.5%, p = 0.000)			11.45 (10.40, 12.51)
.			
West			
Hawaii	0.03	0.840	4.29 (3.67, 4.91)
Washington	0.01	0.754	8.96 (8.72, 9.20)
California	-0.12	0.001	8.73 (8.62, 8.83)
Utah	0.08	0.342	10.66 (10.26, 11.06)
Oregon	0.01	0.896	10.64 (10.31, 10.98)
Colorado	-0.02	0.802	11.09 (10.78, 11.39)
Idaho	0.10	0.378	12.61 (12.04, 13.18)
Wyoming	0.27	0.285	15.34 (14.31, 16.38)
Montana	-0.02	0.920	14.98 (14.20, 15.76)
New Mexico	-0.16	0.116	15.91 (15.33, 16.49)
Arizona	-0.19	0.081	15.73 (15.40, 16.06)
Nevada	-0.08	0.384	16.30 (15.76, 16.83)
Alaska	0.15	0.560	15.77 (14.70, 16.83)
Subtotal (I-squared = 99.7%, p = 0.000)			12.37 (10.73, 14.01)
.			



Age-adjusted rate of firearm deaths per 100,000

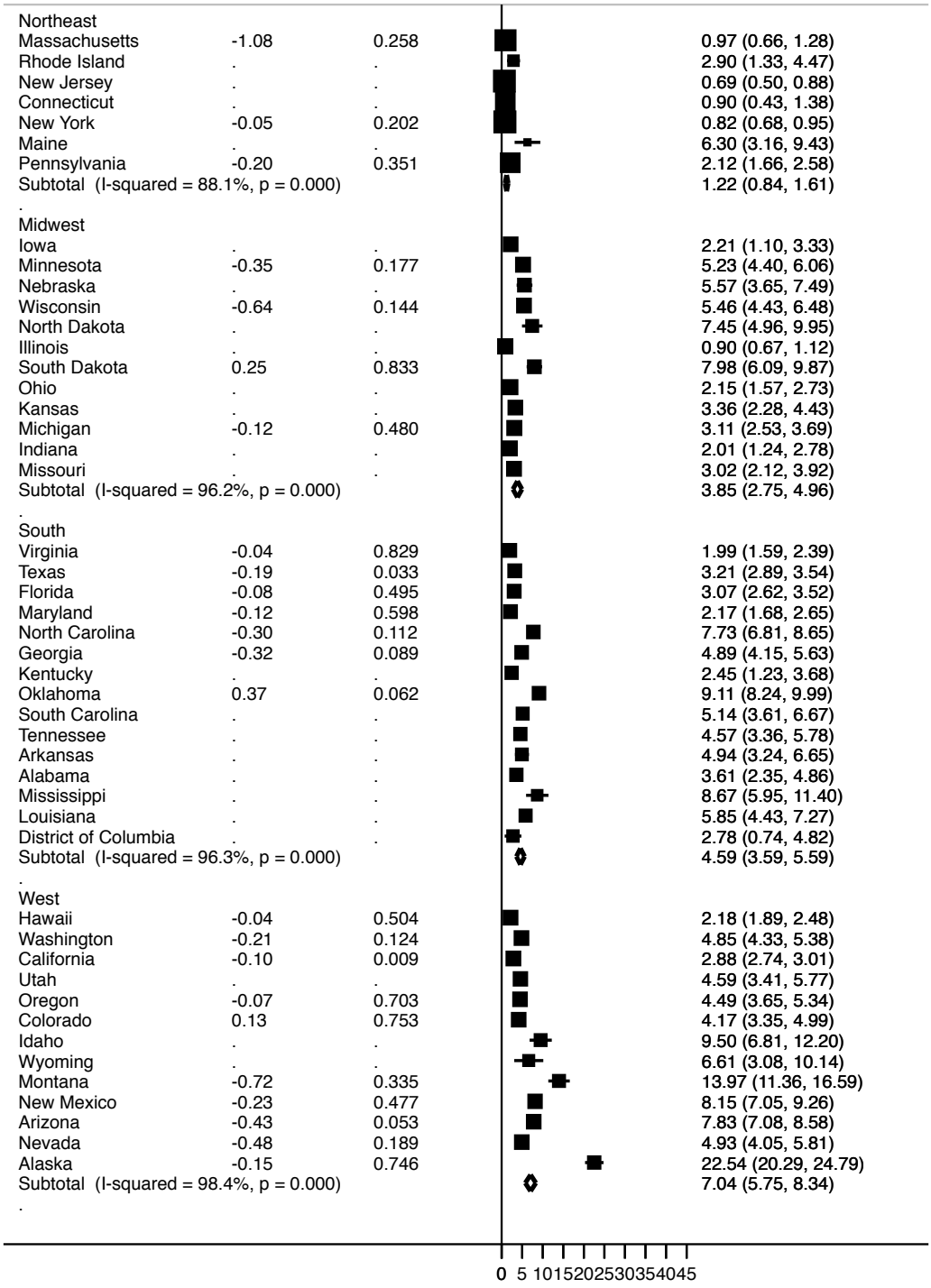
Supplementary Figure 1B:



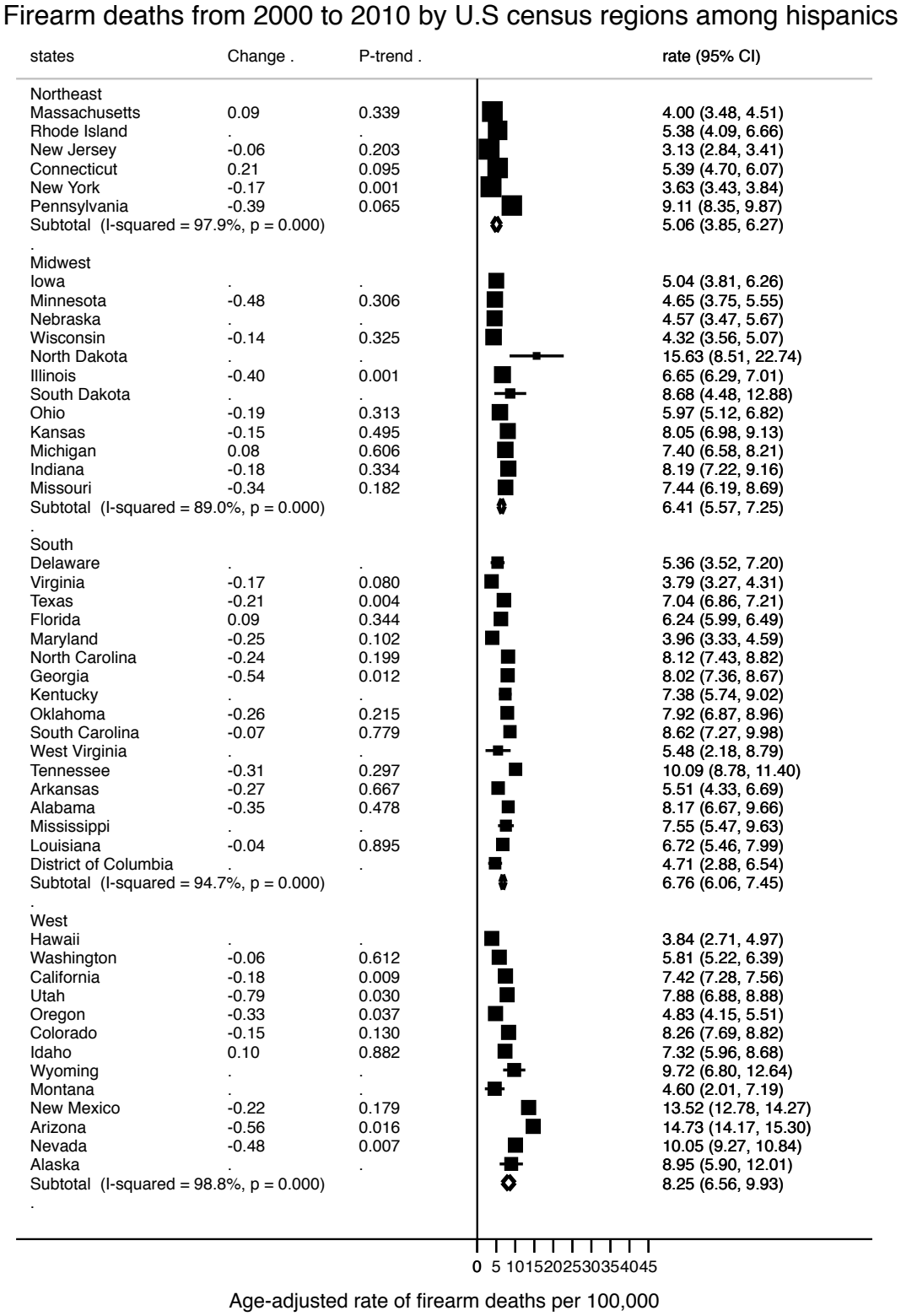
Supplementary Figure 1C

Firearm deaths from 2000 to 2010 by U.S census regions among other race

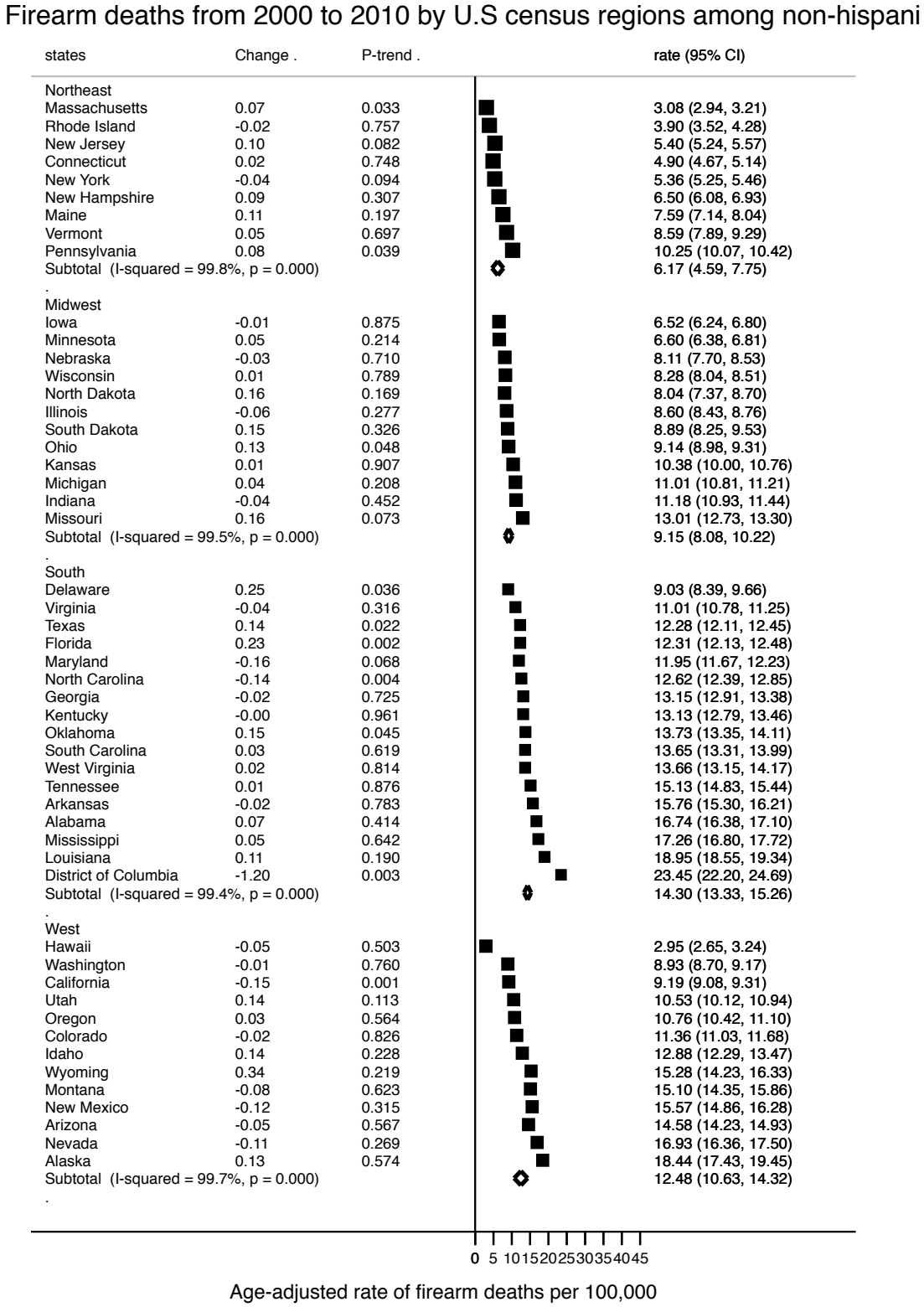
states	Change .	P-trend .	rate (95% CI)
Northeast			
Massachusetts	-1.08	0.258	0.97 (0.66, 1.28)
Rhode Island	.	.	2.90 (1.33, 4.47)
New Jersey	.	.	0.69 (0.50, 0.88)
Connecticut	.	.	0.90 (0.43, 1.38)
New York	-0.05	0.202	0.82 (0.68, 0.95)
Maine	.	.	6.30 (3.16, 9.43)
Pennsylvania	-0.20	0.351	2.12 (1.66, 2.58)
Subtotal (I-squared = 88.1%, p = 0.000)			1.22 (0.84, 1.61)
.			
Midwest			
Iowa	.	.	2.21 (1.10, 3.33)
Minnesota	-0.35	0.177	5.23 (4.40, 6.06)
Nebraska	.	.	5.57 (3.65, 7.49)
Wisconsin	-0.64	0.144	5.46 (4.43, 6.48)
North Dakota	.	.	7.45 (4.96, 9.95)
Illinois	.	.	0.90 (0.67, 1.12)
South Dakota	0.25	0.833	7.98 (6.09, 9.87)
Ohio	.	.	2.15 (1.57, 2.73)
Kansas	.	.	3.36 (2.28, 4.43)
Michigan	-0.12	0.480	3.11 (2.53, 3.69)
Indiana	.	.	2.01 (1.24, 2.78)
Missouri	.	.	3.02 (2.12, 3.92)
Subtotal (I-squared = 96.2%, p = 0.000)			3.85 (2.75, 4.96)
.			
South			
Virginia	-0.04	0.829	1.99 (1.59, 2.39)
Texas	-0.19	0.033	3.21 (2.89, 3.54)
Florida	-0.08	0.495	3.07 (2.62, 3.52)
Maryland	-0.12	0.598	2.17 (1.68, 2.65)
North Carolina	-0.30	0.112	7.73 (6.81, 8.65)
Georgia	-0.32	0.089	4.89 (4.15, 5.63)
Kentucky	.	.	2.45 (1.23, 3.68)
Oklahoma	0.37	0.062	9.11 (8.24, 9.99)
South Carolina	.	.	5.14 (3.61, 6.67)
Tennessee	.	.	4.57 (3.36, 5.78)
Arkansas	.	.	4.94 (3.24, 6.65)
Alabama	.	.	3.61 (2.35, 4.86)
Mississippi	.	.	8.67 (5.95, 11.40)
Louisiana	.	.	5.85 (4.43, 7.27)
District of Columbia	.	.	2.78 (0.74, 4.82)
Subtotal (I-squared = 96.3%, p = 0.000)			4.59 (3.59, 5.59)
.			
West			
Hawaii	-0.04	0.504	2.18 (1.89, 2.48)
Washington	-0.21	0.124	4.85 (4.33, 5.38)
California	-0.10	0.009	2.88 (2.74, 3.01)
Utah	.	.	4.59 (3.41, 5.77)
Oregon	-0.07	0.703	4.49 (3.65, 5.34)
Colorado	0.13	0.753	4.17 (3.35, 4.99)
Idaho	.	.	9.50 (6.81, 12.20)
Wyoming	.	.	6.61 (3.08, 10.14)
Montana	-0.72	0.335	13.97 (11.36, 16.59)
New Mexico	-0.23	0.477	8.15 (7.05, 9.26)
Arizona	-0.43	0.053	7.83 (7.08, 8.58)
Nevada	-0.48	0.189	4.93 (4.05, 5.81)
Alaska	-0.15	0.746	22.54 (20.29, 24.79)
Subtotal (I-squared = 98.4%, p = 0.000)			7.04 (5.75, 8.34)
.			



Supplementary Figure 2A:

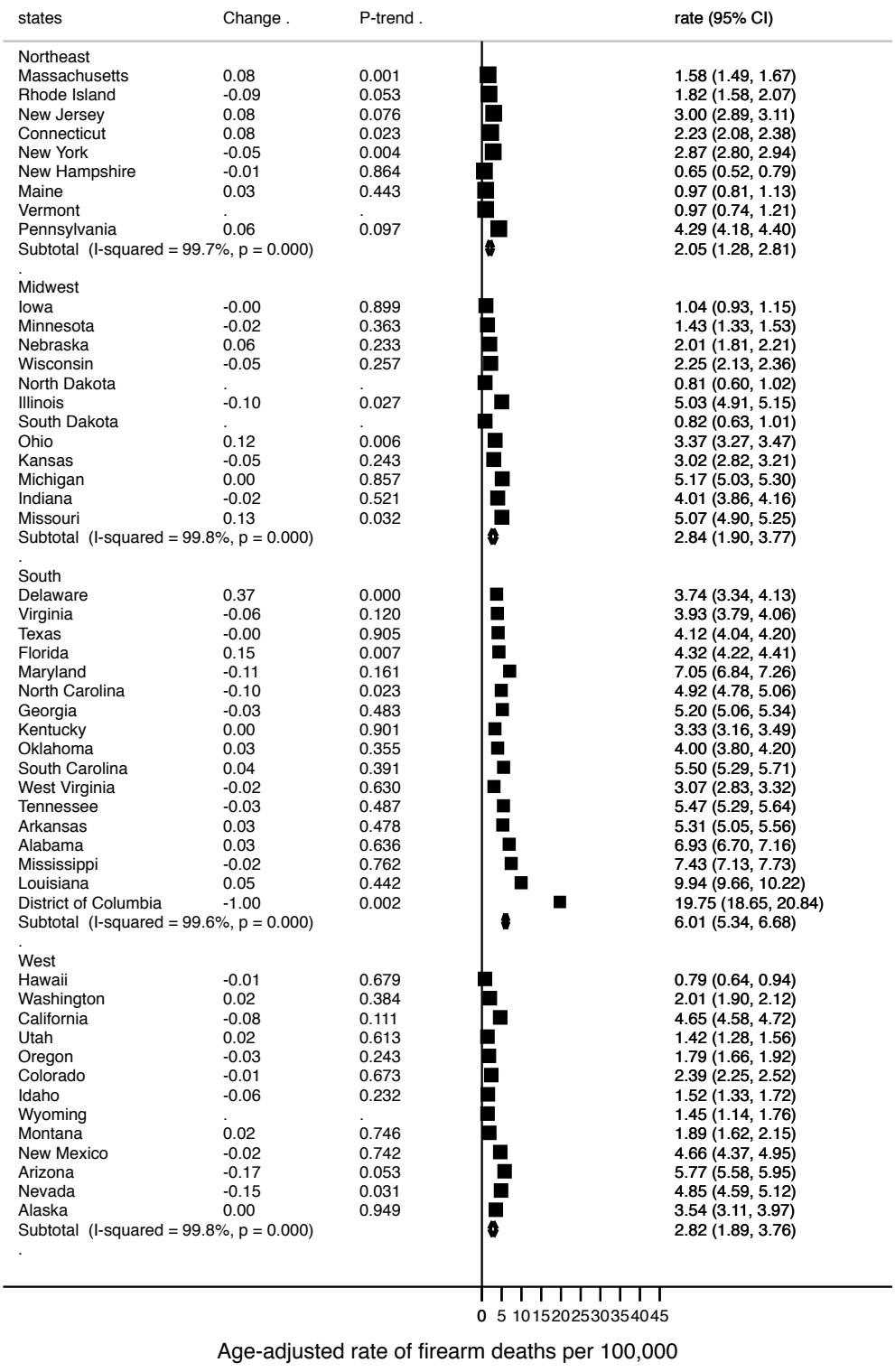


Supplementary Figure 2B:



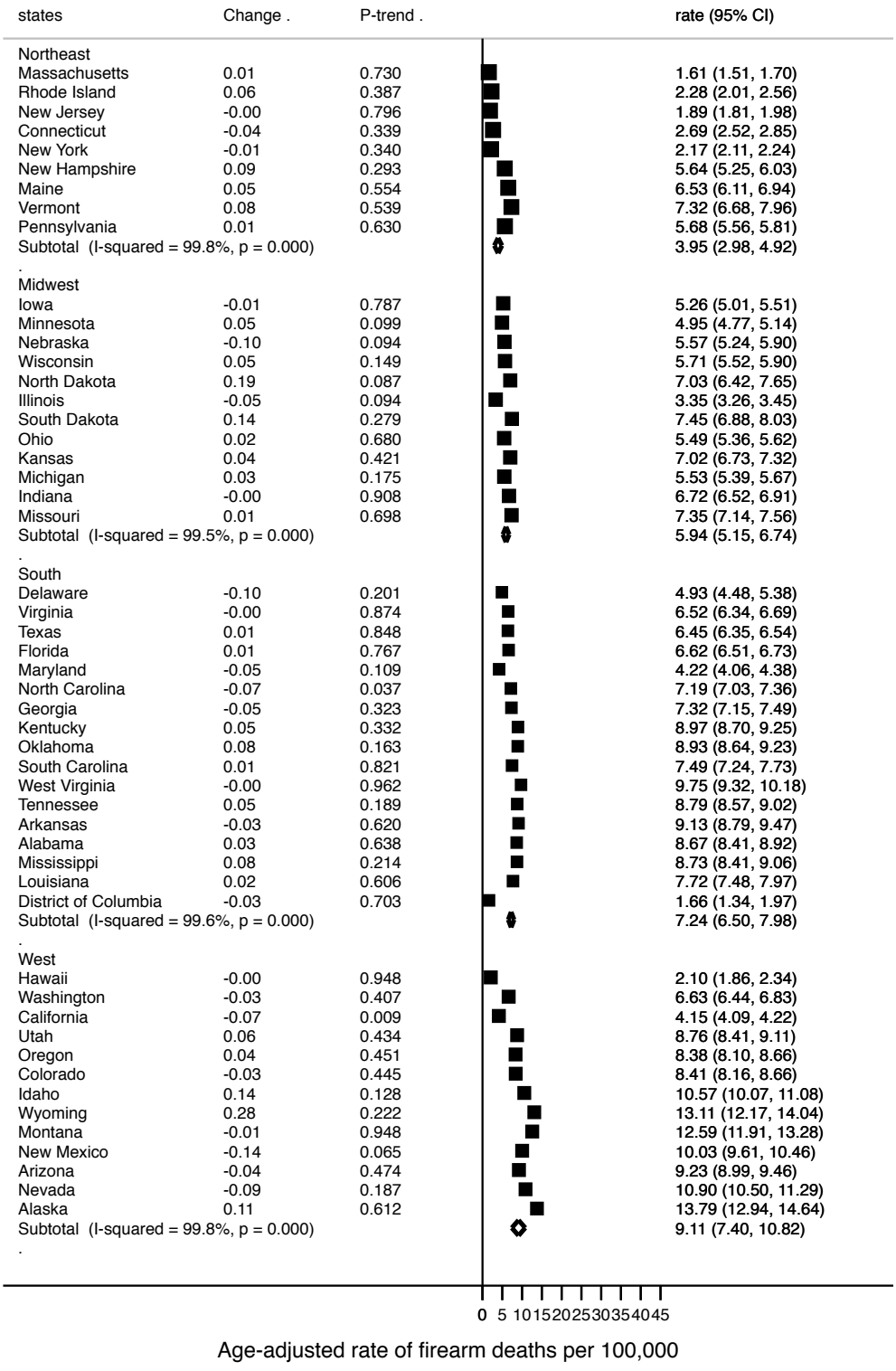
Supplementary Figure 3A:

Firearm deaths due to homicide from 2000 to 2010 by U.S census regions

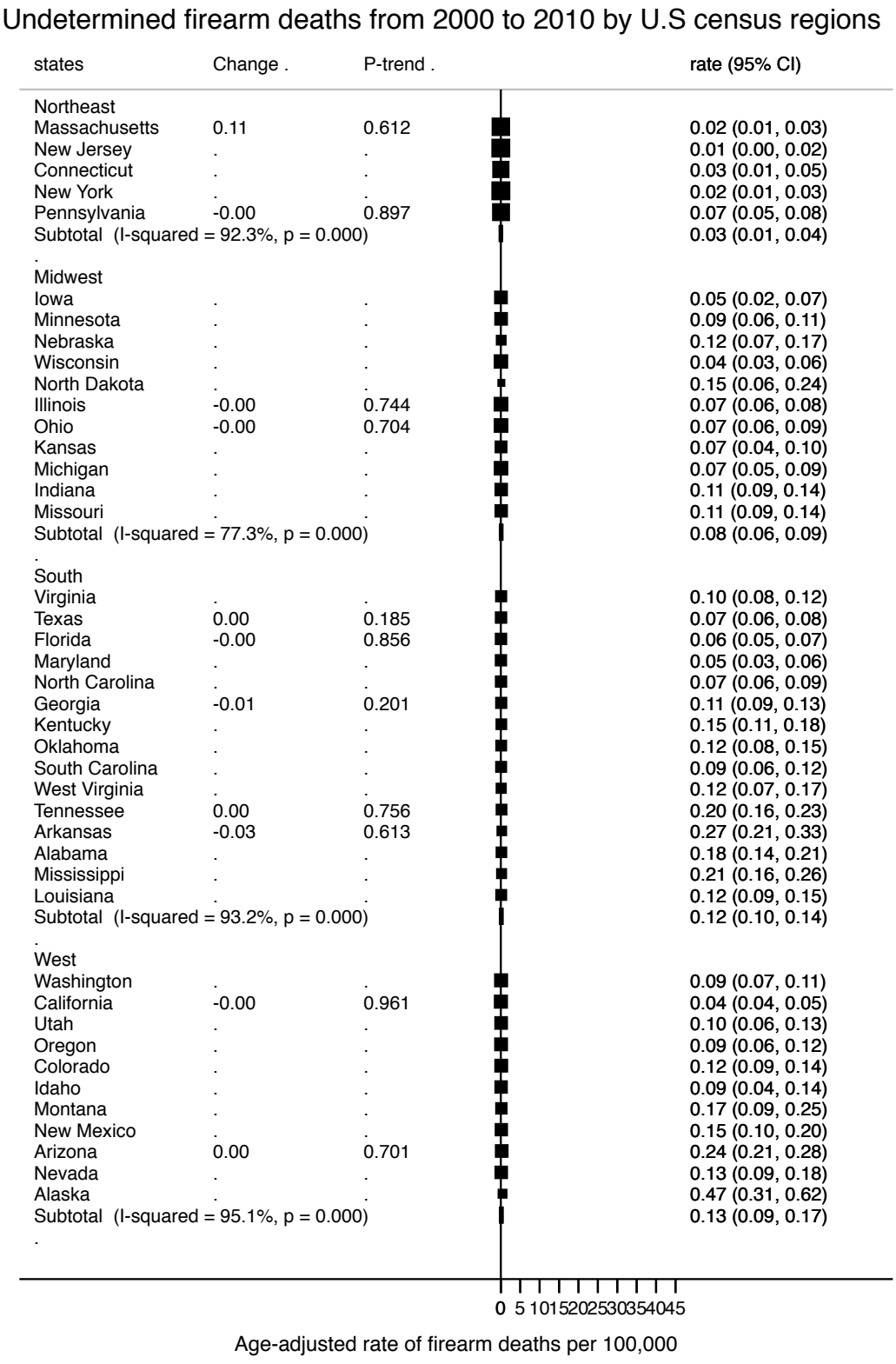


Supplementary Figure 3B:

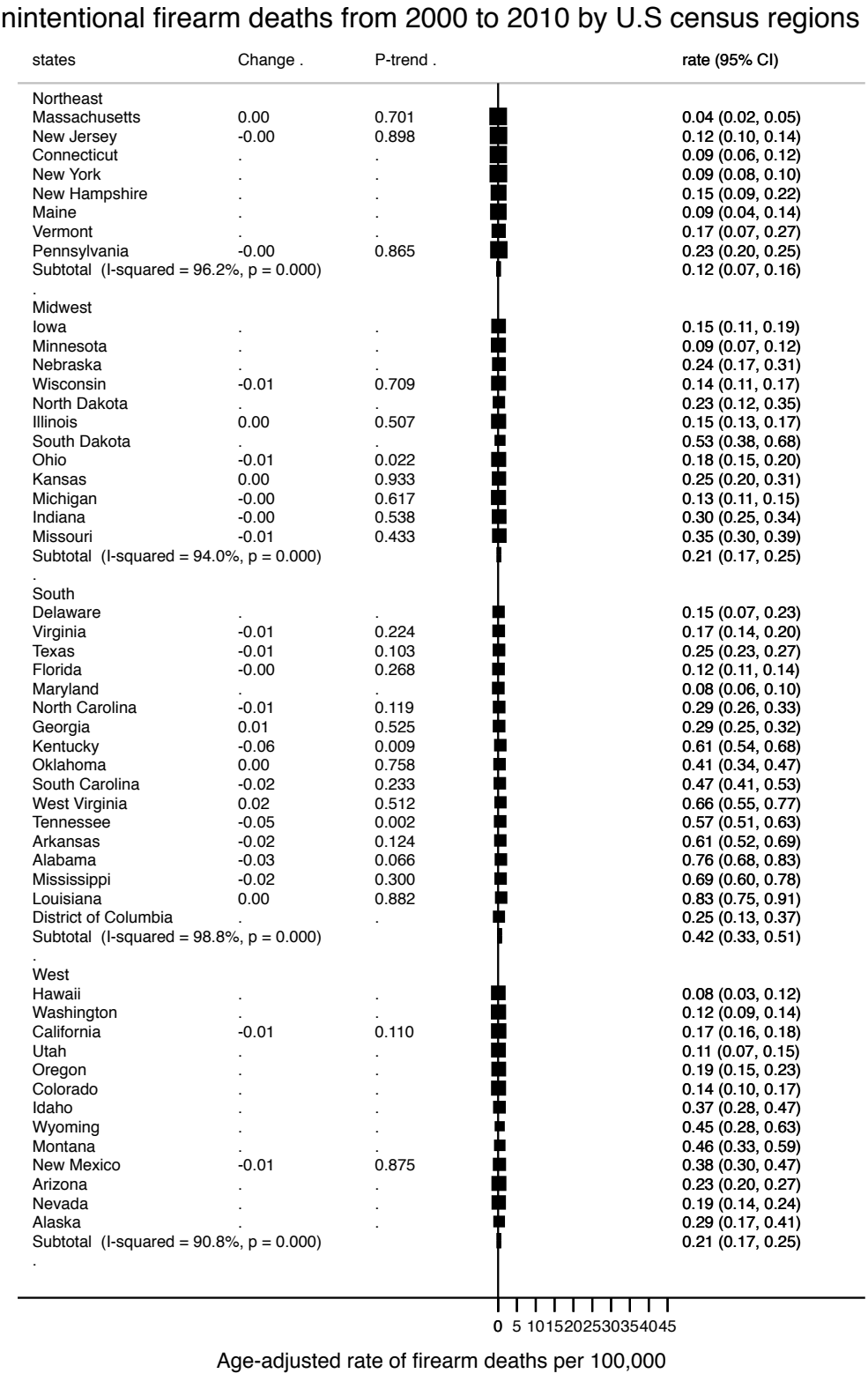
Firearm deaths due to suicides from 2000 to 2010 by U.S census regions



Supplementary Figure 3C:



Supplementary Figure 3D:



STROBE 2007 (v4) checklist of items to be included in reports of observational studies in epidemiology*

Checklist for cohort, case-control, and cross-sectional studies (combined)

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	3
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5
Objectives	3	State specific objectives, including any pre-specified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	6
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*6*
Bias	9	Describe any efforts to address potential sources of bias	16-17
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7
		(*b*) Describe any methods used to examine subgroups and interactions	7
		(*c*) Explain how missing data were addressed	na
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed	7

		Cross-sectional study—If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	na
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	na
		(c) Consider use of a flow diagram	na
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	na
		(b) Indicate number of participants with missing data for each variable of interest	na
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	na
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	na
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	na
		Cross-sectional study—Report numbers of outcome events or summary measures	8-11
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-11
		(*b*) Report category boundaries when continuous variables were categorized	na
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	na
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	8-11
Discussion			
Key results	18	Summarise key results with reference to study objectives	12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	16-17
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12-16
Generalisability	21	Discuss the generalisability (external validity) of the study results	na
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	na

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.
Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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State-specific, racial and ethnic heterogeneity in trends of firearm-related fatality rates in the United States from 2000-2010

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Title: State-specific, racial and ethnic heterogeneity in trends of firearm-related fatality rates in the United States from 2000-2010

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Abstract:

Objectives: To document overall, racial, ethnic and intent-specific spatio-temporal trends of firearm related fatality rates (FRF-rate) in the United States.

Design: Cross-sectional study per year from 2000 to 2010.

Setting: United States.

Participants: Aggregate count of all people in the US from 2000 to 2010.

Outcome measures: Data from the Web-based Injury Statistics Query and Reporting System from 2000-2010 was used to determine annual FRF-rates per 100,000 and by states, race, ethnicity and intent.

Results: The average national 11-year FRF-rate was 10.21 per 100,000, from 3.02 to in Hawaii to 18.62 in Louisiana: 60% of states had higher than national rates and 41 states showed no temporal change. The average national FRF-rates among blacks and whites were 18.51 and 9.05 per 100,000 and among Hispanics and non-Hispanics were 7.13 and 10.13 per 100,000; Hispanics had a decreasing change of -0.18, p-trend<0.0001. In states with increasing trends (Florida and Massachusetts), whites and non-Hispanics drove the rise; while in states with decreasing trends (California, North Carolina, Arizona, Nevada, New York, Illinois, Maryland), Hispanics and blacks drove the fall. The average national FRF-rates due to homicides (4.1 per 100,000) and suicides (5.8 per 100,000) remained constant, but varied between states.

Conclusion: Endemic national FRF-rates mask a wide variation in time trends between states. FRF-rates were twice as high in blacks than whites but decreased

among Hispanics. Efforts to identify state-specific best practices can contribute to changes in national FRF-rates that remain high.

Strengths of this study

- This study uses the best available data reporting system for surveillance of firearm mortality in US.
- Brings into light the overall state-specific variability of temporal trends of firearm mortality, which was obscured by the endemic national firearm fatality rates during 2000-2010 and according to race, ethnicity and intent from a seemingly stable national burden of firearm deaths.
- This is the first report that documents firearm fatality trends by ethnicity
- Our results call for identification of drivers of state-specific temporal trends to introduce tailored programs targeted to reduce deaths and injury due to firearms.

Limitations of this study

- Possible under reporting of firearm fatal events, which cannot be verified.
- Despite the considerable state-specific heterogeneity, the actual variation in firearm mortality may be a feature of cities and counties with varying crime rates, and we do not address the variation existing at such level.
- Finally, comparisons made between other races may not be usefully interpreted due to the heterogeneity and the small frequency of events in this sub-population.

Firearm violence increased during the 1980s and peaked in 1993, with 39,595 firearm deaths in the US and a firearm-related fatality rate (FRF-rate) of 15.0 per 100,000.[1] Since the turn of the 21st century, FRF-rates in the US have become endemic around 10.3 per 100,000 accounting for 17.5% of all injury deaths,[2] while the intent of firearm deaths was mainly suicide and homicide.[3]

The FRF-rate in 1993 among blacks was three-times greater than whites, but similar among Hispanics and non-Hispanics.[1 4] The overall fall in FRF after 2000 corresponded to a related narrowing of the racial gap between blacks and whites, where, by 2010, the FRF-rates among blacks was twice greater than whites.[1] Several factors have been posited that might explain these persistent racial differences, including socioeconomic determinants and increased firearm availability.[5 6]

Although the national temporal trends in FRF have been previously well documented,[3 7 8] there is ample reason to suspect substantial heterogeneity in FRF across states, such as dramatic differences in gun laws controlling access to firearms, variability in enforcement of national standards across states,[8 9] changing demographics and violence.[10] It is likely that some of the state-to-state heterogeneity in the potential determinants of FRF may also contribute to variability in racial and ethnic differences in FRF within states.

With this in mind, this study had two distinct aims. First, we aimed to document national and state-specific trends in FRF-rates along with the annual change in FRF-rates from 2000-2010 and second, to determine the racial, ethnic and

intent-specific differences in FRF-rates within each state during the same time period.

METHODS

Data source

We accessed the restricted fatal injury data reports from the Web-based Injury Statistics Query and Reporting System (WISQARS™), an interactive database system provided by Centers for Disease Control and Prevention's (CDC) Injury Prevention and Control Unit (http://www.cdc.gov/injury/wisqars/).[1] The data in the WISQARS system is derived from CDC annual mortality data from National Vital Statistics System (NVSS), National Center for Health Statistics (NCHS) (http://www.cdc.gov/nchs/) and CDC. The NCHS and the National Association of Public Health Statistics and Information Systems restricts reporting NVSS data for cumulative frequencies <10 for sub-national geographic areas to prevent unintentional disclosure of cases. International Classification of Disease-10th Revision (ICD-10) was used for coding mortality data including intent of injury.[11]

Study population and variables

Our study population consisted of national and state-specific fatal firearm injuries from 2000-2010 obtained from querying the WISQARS data system. Aggregate information such as number of firearm deaths, total population and age-adjusted rates according to race (black, white, other), ethnicity (Hispanic and non-Hispanic) and intent (homicide/legal intervention, suicide, undetermined and unintentional) was obtained.

Statistical analysis

The standard errors (SE) for national and state-specific age-adjusted FRF-rates per 100,000 persons were derived for the overall 11-year period and annually and by race, ethnicity and intent. Age-adjusted rates are obtained by direct standardization using the 2000 population. The overall 11-year rates were assessed as total firearm deaths over the total population during the 11-years. Since only aggregate data could be obtained from WISQARS without individual patient data, we used random effects meta-analysis and meta-regression.[12] The rates in each category and the SEs were meta-analyzed using random-effects meta-analysis. Heterogeneity between states was assessed using I^2 statistic; which ranges from 0 to 100% and denotes the proportion of variation across states other than by chance.[13] [14] In order to assess the temporal trends from 2000-2010, we assumed linear trends across 11 years and used meta-regression to calculate the change in rates (slope) and the standard deviation (SD). The p-value from meta-regression was used to assess evidence for trend. Standardized mean difference (SMD) was calculated by dividing the annual change in age-adjusted rate by SD.[15] [16] We do not present estimates for those states with number of deaths below 10. Lives-lost or saved are estimated by applying annual change to the total 11-year population (2000-2010). The difference between 11-year national and state-specific FRF-rates (overall and category-specific) were used to spatially represent the variation between states. STATA 13.1 (StataCorp LP, College Station, Texas; 2009) was used to analyze the data.

RESULTS

Between 2000 and 2010, a total of 335,609 firearm-related deaths were recorded and the overall mortality rate was 10.21 per 100,000. The annual change in FRF-rate across 11-years was -0.017 with a 95% confidence interval (95% CI) of -0.044-0.010, p-trend=0.18, indicating no significant change in national FRF-rates. **Table 1** presents national FRF-rates, for 11-years and annually according to race, ethnicity and intent. Cumulative 11-year FRF-rates were disproportionally high among blacks (18.51) as compared to whites and other race groups, and lowest among other races (3.38). Among whites the FRF-rates were lower than the overall national 11-year rate while increasing from 8.97 to 9.20 from 2000-2010. This annual increase was small (0.006, SMD=0.11) but not significant, p-trend=0.71. Even though the FRF-rates among blacks were consistently higher than national FRF-rates, the annual rates reduced from 18.30 to 16.90; and this decline, -0.114 was not significant, SMD=-0.40, p-trend=0.22. The decline in FRF-rates from 4.76 to 3.25 among other races was significant (change=-0.12, SMD=-1.83, p-trend<0.0001). Annual reduction observed among Hispanics showed a significant reduction, -0.179, p-trend<0.0001 alongside an already low 11-year FRF-rate of 7.13. FRF-rates among non-Hispanics remained slightly above the national rates without increase. FRF-rate by intent was highest for suicides (5.80) while the annual change was minimal in all four categories with a small significant reduction for unintentional deaths (change=-0.010, SMD=-1.70, p-trend<0.0001).

State-specific 11-year FRF-rates are represented in **Figure 1** and **Supplementary Table 1**. Hawaii (HI) (3.02) and Massachusetts (MA) (3.24) had the lowest 11-year FRF-rates, while Louisiana (LA) had the highest at 18.62. DC and 7 states showed a significant declining trend in FRF-rate, while MA and FL documented a significant increase. District of Columbia (DC) had the largest significant annual reduction at -1.067 (6.2 lives-saved per year, p-trend = 0.002) though it had the highest rate of 21.71. Although MA had a low FRF-rate, a significant increase was observed, change=0.074, p-trend=0.008. Florida (FL) also showed an increase, change=0.160, 28.2 lives-lost per year, p-trend=0.016. FRF-rates for Delaware (DL) and Ohio (OH) were 8.89 and 9.10, with a near significant increasing trend, changes of 0.20 and 0.12. FRF-rate in New York (NY) was 5.15 with a change=-0.064, 12.3 lives-saved per year, p-trend=0.006. Illinois (IL) had a significant reduction, change=-0.155, 19.6 lives-saved per year, p-trend=0.025). FRF-rates in CA was -0.166 (59.3 lives-saved per year, p-trend=0.001), Arizona (AZ) at -0.230 (13.4 lives-saved per year, p-trend=0.025) and Nevada (NV) at -0.264 (6.4 lives-saved per year, p-trend = 0.008). Maryland (MA) and North Carolina (NC) had a significant decline: change=-0.169, 9.4 lives-saved per year, p-trend=0.048 and -0.174, 15.3 lives-saved per year, p-trend=0.001).

The 11-year FRF-rates for each state by race are presented in **Figures 2A to 2C** and **Supplementary Figures 1A-C**. Among whites, the lowest rate was in MA with a significant increase from 2000-2010 (change=0.05, p-trend=0.037). FL also recorded a significant increase (change=0.12, p-trend=0.045) but had high 11-year

FRF-rate, 10.02. NV recorded the highest and unchanging FRF-rate at 16.30. The four states that showed a significant declining trend from 2000-2010 were NY (change=-0.05, p-trend=0.015), IL (change=-0.12, p-trend=0.028), NC (change=-0.10, p-trend=0.032), and CA (change=-0.12, p-trend=0.001). Among blacks, HI had the lowest 11-year FRF-rates at 2.93 while Missouri (MO) had the highest at 30.12 and DC was at 40.95. Oklahoma (OK), OH and DL had high 11-year rates at 20.04, 20.19 and 13.61 respectively with a significant increasing changes of 0.93, 0.51 and 0.79, p-trends of 0.008, 0.027 and 0.028 respectively. A declining trend was observed among blacks in CA (change=-0.58, p-trend=0.042), AZ (change=-0.83, p-trend=0.019), NV (change=-1.53, p-trend=0.005), NC (change=-0.38, p-trend=0.024), Indiana (IN) (change=-0.66, p-trend=0.012), Kansas (KA) (change=-1.07, p-trend=0.021), Minnesota (MN) (change=-0.61, p-trend=0.038), and DC (change=-1.58, p-trend=0.017), even though their 11-year FRF-rates were high. Among other races, Texas (TX) (change=-0.19, p-trend=0.033) and CA (change=-0.10, p-trend=0.009) showed a significant decline.

Figures 3A-B and **Supplementary Figures 3A-B** presents the 11-year FRF-rates for each state by ethnicity. Georgia (GA) (change=-0.54, p-trend=0.012), CA (change=-0.18, p-trend=0.009), Utah (UT) (change=-0.79, p-trend=0.030), AZ (change=-0.56, p-trend=0.016), and NV (change=-0.48, p-trend=0.007) were five high-FRF-rate states (>7.13) while NY (change=-0.17, p-trend=0.001), IL (change=-0.40, p-trend=0.001), TX (change=-0.21, p-trend=0.004), and Oregon (OR) (change=-0.33, p-trend=0.037) were the four low-FRF-rate states with a significant

declining trend among Hispanics. No states demonstrated an increase among Hispanics, while non-Hispanics showed a significant increasing trend in MA (change=0.07, p-trend=0.033), Pennsylvania (PA) (change=0.08, p-trend=0.039), OH (change=0.13, p-trend=0.048), DL (change=0.25, p-trend=0.036), TX (change=0.14, p-trend=0.022), FL (change=0.23, p-trend=0.002) and OK (change=0.15, p-trend=0.045). A declining trend in non-Hispanics was observed in MD (change=-0.16, p-trend=0.068), NC (change=-0.14, p-trend=0.004) and CA (change=-0.15, p-trend=0.001). In TX, the FRF-rates among Hispanics (change=-0.21, p-trend=0.004) demonstrated a significant decline and a significant increase among non-Hispanics (change=0.14, p-trend=0.022) (**Supplementary Table 2**).

FRF-rates from 2000-2010 and by intent is provided in **Figures 4A-D** and **Supplementary Figures 4A-D**. Most of the northern states had low (<3.73) homicide-FRF while southern states had high FRF. NY (change=-0.05, p-trend=0.004), IL (change=-0.10, p-trend=0.027), NC (change=-0.10, p-trend=0.023), NV (change=-0.15, p-trend=0.031) and DC (change=-1.0, p-trend=0.002) had significant declining trends while MA (change=0.08, p-trend=0.001), Connecticut (CT) (change=0.08, p-trend=0.023), OH (change=0.12, p-trend=0.006), DL (change=0.37, p-trend<0.0001) and FL (change=0.15, p-trend=0.007) had increasing homicide-FRF. A majority of the states had suicide-FRF-rates >5.80; CA (change=-0.07, p-trend=0.009) and NC (change=-0.07, p-trend=0.037) had declining trends. Unintentional-FRF-rates showed a significant decreasing trend in three

states, OH (change=-0.01, p-trend=0.022), Kentucky (KY) (change=-0.06, p-trend=0.009), and Tennessee (TN) (change=-0.05, p-trend=0.002).

DISCUSSION

National 11-year FRF-rate from 2000-2010 was 10.21, was almost three times higher than Switzerland and Finland.[17] There were four main observations that emerge from this analysis. First, while overall, blacks had higher national rates than whites and Hispanics had lower national rates than non-Hispanics, the 11-year FRF-rates declined among Hispanics and non-white non-black races with no significant change observed among whites, blacks or non-Hispanics. Second, a substantial inter-state heterogeneity was evidenced by 11-year state-specific FRF-rates being as low as 3.02 in HI to as high as 21.71 in DC. FL and MA recorded an upward FRF trend while AZ, CA, IL, MD, NV, NY, NC and DC had declining FRF-rates during the study period. Third, racial and ethnic variation was shown to drive many of the state-specific variations. Fourth, changes in different FRF-intent also drove many of the state-specific differences.

Firearm deaths increased from 28,663 in 2000 to 31,672 in 2010, about 30,509 deaths per year and no change in rate. These findings are similar to a report by the Bureau of Justice of a rapid decline in firearm homicides from 1993 to 1999 followed by a leveling of rates from 2000-2011.[18] It is important to bear in mind that these endemic conditions are associated with substantial, long-term cumulative health burden associated with firearm death throughout the US..[19] During 2000-2011 there were 306,946 firearm related deaths. With the endemic annual FRF-rate of 10.3, US-population at 338 million by 2020[20] and 10% decadal population

increase, we estimate 336,778 firearm related deaths to occur between 2011 and 2020.

The 11-year FRF-rates we report among blacks was twice greater than that of whites and six-times greater than that of other races is in line with reports showing disproportionately larger firearm fatality and injury rates than whites and other race.[3 21 22] Although there was a plateau of the national FRF-rates, rates among Hispanics and non-white non-black races declined and may be explained by the lack of access to firearms or low firearm ownership among Hispanics and other races.[23] Our results explain the report where Hispanics were least likely to use firearms for suicides albeit being more likely to self-injury than any other race groups.[24] Data from 1981-2010 found that among youths a decline in homicide rates for blacks between was significantly slower than the declines for Hispanics and other racial and ethnic groups[25], suggestive of lower crime.

We found 41 states with no FRF-rate change, while 7 states and DC demonstrated either a significant decline or increase. MA and FL recorded a significant increase, MA with smallest and FL with largest annual increase while MA had the lowest 11-year FRF-rate. The Brady Center to Prevent Gun Violence [9] firearm legislative strength score for 2013, has MA to be third with score of 65 among all states in restrictive firearm legislation, while FL has a score of 3. After MA passed the toughest firearm-control legislation in 1998, firearm ownership rates plummeted but violent crimes (476.1 to 468.9) and homicides (2.2 to 3.3) rose.[26]

The significant FRF-rate increase in MA may be explained by the influx of firearms from the two neighboring states (Maine and New Hampshire) with weak firearm control legislation.[27] FL is a "shall issue", weak legislature state with just 2 laws to prevent illegal gun-trafficking.[27] In contrast to the increasing FRF-rates, the aggregate violent crimes in FL declined from 801.1 to 542.9,[28] emphasizing a particularly concerning public health problem of increasing gun violence even in a climate of reducing violence.

CA, NY, IL, AZ, NV, MD, NC, and DC had declining trends but the most marked reduction was observed in CA and may be directly linked to strength of firearm legislature, a score of 81.[9] CA has eight state laws to prevent illegal gun trafficking[27] and a reduction in homicide crime rate in CA by 25.4% from 2001-2010.[29] An emergency department study from 2004-2008 reporting reduction of firearm death rate in CA echoing the results of our study.[30] NY and IL had similar trend profiles and an overall decline in FRF-rates, but the Brady scores were 62 and 35[9] with 10 and 8 policies preventing illegal firearm trafficking respectively.[27] FRF-rate reduction in AZ and NV is in contrast to CA and NY, having no laws preventing illegal gun trafficking,[27] with Brady scores 0 and 5 respectively.[9] In AZ violent crime rate dropped from 544.5 offenses in 2002 to 372.2 in 2010,[31 32] and NV had reductions in index crimes.[33] This reduction and our results may be attributed to policing strategies.[34] Our reported reduction in firearm death rates in DC may be attributed to 9 laws preventing illegal gun trafficking.[27] Firearm policies are not stringent in NC, strength of firearm legislature being 16[9] with only 5 illegal gun trafficking

laws.[27] However, the violent crime rate in NC dropped from 493 to 363 from 2000-2010,[35] suggesting that the factors that led to reduction in crime rates may have also driven FRF-rate reduction.

We found that the state-specific increasing trend in FL was driven by an increase among whites, blacks and non-Hispanics and can be explained by violent crime rates in FL which ranks 4th in violent crime.[36] The racial gap in arrests for major crimes widened in FL from 2000-2010: 6,175 blacks and 6,071 whites were arrested in 2000 to 2,398 and 3,192 in 2010.[37] The increase in FRF-rates in MA driven by whites and non-Hispanics is in contrast to the racial differences observed in violent deaths with non-Hispanic blacks having the highest rate of 21.6 as compared to 4.9 among whites.[38] MA has relatively low violent crime rate (ranks 20th in US),[36] and stringent firearm control.[9] Even though nationally no significant reduction in FRF-rates among blacks was observed in our study, FRF-rates among blacks drove the state-specific declines in AZ, NV, CA, NC and DC. Declining trends among Hispanics in AZ, NV, CA, NY and IL contributing to state-specific declines may be due to a combination of low firearm ownership[23] and racially targeted crime-control activities.[39] In IN, KS, MN and OK, with no statewide reduction, the FRF-rates fell solely among blacks, with no change among whites. These states have very few laws to prevent firearm violence and trafficking[27] and rank among the highest twenty states in crime rates except MN.[36]

The increasing trend in FL and MA in our study was due to increase in firearm homicides. According to data from CDC, rates of suicides in FL remained constant from 2000-2010 while in MA these rates doubled from 1.92 to 3.15.[1] In 2010, 71% of homicides in FL were by firearms,[28] and in MA, 22% of the homicides were by firearm.[38] In CA, where all racial and ethnic groups revealing declining trends, was driven by reduction in suicide-FRF and is associated with the states' increased effort in implementing "The Mental Health Services Act" to reduce suicide rates.[40] In our study, reduction in homicides was caused by declines in AZ, IL, NV, NY, NC and DC. These declining patterns are similar to the reduction in all-cause homicide rates from 2000-2010 that occurred in a smaller magnitude among AZ, IL, NV, NY, NC and in a much larger magnitude in DC.[1]

There are several limitations in our study. Under reporting of firearm fatal events is a known phenomenon and a limitation of this study, which cannot be verified. There is, however, no reason to suspect that blacks and Hispanics are more likely than whites and non-Hispanic individuals to have a fatal firearm injury misclassified on the death certificate, so this under-reporting should not have biased our findings. Another limitation is that, despite the considerable state-specific heterogeneity, the actual variation in firearm mortality may be a feature of cities and counties with varying crime rates, and we do not address the variation existing at such level. Finally, comparisons made between other races may not be usefully interpreted due to the heterogeneity and the small frequency of events in this sub-

population. However, as other race makes up about 10% of the US population, the results are discussed in relation to blacks and Hispanics.

In summary, we showed no change in national firearm mortality rates during 2000-2010, but showed distinct state-specific patterns with racial and ethnic variation and by intent. The distinctive state-specific firearm fatality profiles vary by race, ethnicity and intent adding another layer of complexity to the FRF trends. This calls for specific studies to identify the drivers of the state-specific temporal trends followed by introducing tailored programs that target specific racial and ethnic groups in specific states.

Table 1: Trends in firearm deaths in the United States, WISQARS 2000-2010.

	Age-adjusted firearm deaths per 100,000 population												Change			
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total	Annual	95% CI	SMD	P-trend
All	10.14	10.31	10.43	10.29	9.99	10.27	10.22	10.24	10.23	10.05	10.07	10.21	-0.017	-0.044, 0.010	-0.44	0.181
Race																
White	8.97	9.21	9.19	9.05	8.84	8.98	8.80	8.98	9.18	9.13	9.20	9.05	0.006	-0.027, 0.039	0.11	0.705
Black	18.30	18.32	19.22	19.01	18.31	19.34	19.98	19.31	18.19	17.15	16.90	18.51	-0.114	-0.311, 0.082	-0.40	0.220
Other	4.76	3.89	4.19	4.03	3.70	3.88	3.83	3.38	3.25	3.37	3.25	3.38	-0.121	-0.166, -0.076	-1.83	<0.0001
Ethnicity																
Hispanic	7.81	7.73	7.63	7.68	7.42	7.51	7.19	7.21	6.60	6.38	5.86	7.13	-0.179	-0.236, -0.122	-2.13	<0.0001
Non-Hispanic	10.31	10.50	10.67	10.50	10.23	10.53	10.54	10.61	10.74	10.55	10.71	10.54	0.027	-0.002, 0.056	0.63	0.068
Intent																
Homicide/Legal Intervention	3.88	4.05	4.17	4.19	4.05	4.28	4.40	4.32	4.14	3.89	3.73	4.10	-0.008	-0.054, 0.038	-0.12	0.705
Suicide	5.90	5.90	5.92	5.77	5.65	5.66	5.54	5.63	5.82	5.91	6.06	5.80	0.001	-0.035, 0.038	0.03	0.932
Undetermined	0.08	0.08	0.08	0.08	0.08	0.07	0.07	0.09	0.09	0.07	0.08	0.08	-0.0001	-0.002, 0.002	-0.02	0.944
Unintentional	0.27	0.28	0.26	0.25	0.22	0.27	0.21	0.20	0.19	0.18	0.20	0.23	-0.010	-0.014, -0.006	-1.70	<0.0001

All values are age-adjusted rates per 100,000 persons. Change denotes annual change in rate per 100,000. Negative value indicates decline in firearm death rates per 100,000 from 2000-2010 and positive value indicates increase in firearm death rate per 100,000 from 2000-2010. CI denotes confidence intervals of the annual change in firearm death rate per 100,000. SMD indicates standardized mean difference; is equal to annual change/standard deviation. P-trend calculated using meta-regression indicates the significance of the decline or the increase in firearm related death rates from 2000-2010.Data are from Center for Disease Control and Prevention (CDC)'s National center for Injury Prevention and Control Web-based Injury Statistics Query and Reporting System (WISQARS).

Contributorship:

Galea and Kalesan conceived and supervised the study. Kalesan and Vasan completed the analyses. Kalesan, Galea and Villarreal led the writing. Fagan, Teperman, Mobily and Hlavacek assisted with the study and analyses. Hlavacek assisted with obtaining state gun laws.

Competing interests:

None of the authors have competing interests to report

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Figure legends

Figure 1: Firearm related fatality rates from 2000-2010.

Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia ranging from 3.02 (HI) to 21.71 (DC) per 100,000. The colors represent increasing rates from blue to red. Significant decline in 7 states (AZ, CA, IL, MD, NV, NY and NC and DC) are represented as gold stars and significant increase in FL and MA as black stars within the map and in the table.
The table summarizes the rates per 100,000, annual change in rate and p-trend for those states that show significant increase or decrease. "FRF" denotes firearm related fatality. "Change" indicates the annual change in rates from 2000 to 2010. "P-trend" indicates the significance of the decline or the increase in firearm related fatality rates from 2000 to 2010 and was calculated using meta-regression. Negative values for change indicate a decrease while positive values indicate increase in rates across the years. The intent-specific rates of firearm related fatality is denoted with arrows in the table below: downward arrow denotes reduction in rates, upward arrows indicate an increase and two-way arrows indicate no change. "ne" represents data which cannot be estimated due to frequency <10. HI (11-year=3.02, change=-0.057, p-trend=0.36) and AK (11-year=18.09, change=0.10, p-trend=0.64) are not represented in the map.

Figure 2: Firearm related fatality rates from 2000-2010 according to race.

Whites:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 2.57 (MA) to 16.30 (NV) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10 among whites. Significant decline in 4 states (CA, NY, IL and NC) are represented as gold stars and significant increase in MA and FL as black stars. HI (11-year=4.29, change=0.03, p-trend=0.84) and AK (11-year=15.77, change=0.15, p-trend=0.56) are not represented in the map.

Blacks:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 2.93 (HI) to 40.95 (DC) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10 among blacks. Significant decline in 8 states (CA, NV, AZ, KA, MN, IN, NC and DC) are represented as gold stars and significant increase in OK, OH and DL as black stars. HI (11-year=2.93) and AK (11-year=12.36) are not represented in the map.

Other race:

Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 0.82 (NY) to 22.54 (AK) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10 among other race. Significant decline in 2 states (CA and TX) are represented as gold stars and there were no states with significant increase. HI (11-year=2.18, change=-0.04, p-trend=0.50) and AK (11-year=22.54, change=-0.15, p-trend=0.75) are not represented in the map.

Figure 3: Firearm related fatality rates from 2000-2010 according to ethnicity.

Hispanic:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 3.13 (NJ) to 15.63 (ND) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10 among Hispanics. Significant decline in 9 states (CA, AZ, NV, OR, UT, TX, IL, GA and NY) are represented as gold stars and there were no states with significant increase. HI (11-year=3.84) and AK (11-year=8.95) are not represented in the map.

Non-Hispanic:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 2.95 (HI) to 23.45 (DC) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10 among non-Hispanics. Significant decline in 3 states (CA, NC and DC) are represented as gold stars and significant increase in 7 states (TX, OK, FL, OH, PA, DL, and MA) as black stars. HI (11-year=2.95, change=-0.05, p-trend=0.50) and AK (11-year=18.44, change=0.13, p-trend=0.57) are not represented in the map.

Figure 4: Firearm related fatality rates from 2000-2010 according to intent.

Homicide:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 0.65 (NH) to 19.75 (DC) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10. Significant decline in 5 states (NV, IL, NC, NY and DC) are represented as gold stars and significant increase in MO, FL, OH, MA, CT, and DL as black stars. HI (11-year=0.79, change=-0.01, p-trend=0.68) and AK (11-year=3.54, change=0.001, p-trend=0.95) are not represented in the map.

Suicide:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 1.61 (MA) to 13.79 (AK) per 100,000. The colors represent increasing

rates from blue to red. White represents no data or states where the frequency was <10. Significant decline in 2 states (CA and NC) are represented as gold stars and there were no states with significant increase. HI (11-year=2.10, change=-0.001, p-trend=0.95) and AK (11-year=13.79, change=0.11, p-trend=0.61) are not represented in the map.

Undetermined:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 0.01 (NJ) to 0.47 (AK) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10. There was no significant decline or increasing state-specific trends. HI (11-year=ne) and AK (11-year=0.47) are not represented in the map.

Unintentional:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 0.04 (MA) to 0.83 (LO) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10. Significant decline in 3 states (OH, KN and TN) are represented as gold stars and there were no states with significant increase. HI (11-year=0.08) and AK (11-year=0.29) are not represented in the map.

Supplementary Figure 1A:

Firearm deaths from 2000 to 2010 by U.S census regions among whites

Supplementary Figure1B:

Firearm deaths from 2000 to 2010 by U.S census regions among blacks

Supplementary Figure1C:

Firearm deaths from 2000 to 2010 by U.S census regions among other race

Supplementary Figure 2A:

Firearm deaths from 2000 to 2010 by U.S census regions among hispanics

Supplementary Figure 2B:

Firearm deaths from 2000 to 2010 by U.S census regions among non-hispanics

Supplementary Figure 3A:

Firearm deaths due to homicide from 2000 to 2010 by U.S census regions

Supplementary Figure 3B:

Firearm deaths due to suicides from 2000 to 2010 by U.S census regions

Supplementary Figure 3C:

Undetermined firearm deaths from 2000 to 2010 by U.S census regions

Supplementary Figure 3D:

Unintentional firearm deaths from 2000 to 2010 by U.S census regions

~~May~~ July 02~~10~~, 2014

Title: State-specific~~,~~ ~~and~~ racial~~/~~ and ethnic heterogeneity in trends of firearm-related fatality rates in the United States from 2000-2010

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~~Galea and Kalesan conceived and supervised the study. Kalesan and Vasan completed the analyses. Kalesan, Galea and Villarreal led the writing. Fagan, Teperman, Mobily and Hlavacek assisted with the study and analyses. Hlavacek assisted with obtaining state gun laws.~~

Abstract:

Objectives: To document overall, racial, /ethnic and intent-specific spatio-temporal trends of firearm related fatality rates (FRF-rate) in the United States.

Design: Cross-sectional study per year from 2000 to 2010.

Setting: United States.

Participants: Aggregate count of aAll people in the US from 2000 to 2010.

Outcome measures: Data from the Web-based Injury Statistics Query and Reporting System from 2000-2010 was used to determine annual FRF-rates per 100,000 and by states, race, /ethnicity and intent.

Results: The average nNational 11-year FRF-rate was 10.21 per 100,000, from 3.02 to in Hawaii to 18.62 in Louisiana: 60% of states had higher than national rates and 41 states showed no temporal change. The average nNational FRF-rates among blacks and whites were 18.51 and 9.05 per 100,000 and among Hispanics and non-Hispanics were 7.13 and 10.13 per 100,000; Hispanics had a decreasing change of -0.18, p-trend<0.0001. In states with increasing trends (Florida and Massachusetts), whites and non-Hispanics drove the rise; while in states with decreasing trends (California, North Carolina, Arizona, Nevada, New York, Illinois, Maryland), Hispanics and blacks drove the fall. The average nNational FRF-rates due to homicides (4.1 per 100,000) and suicides (5.8 per 100,000) remained constant, but varied between states.

Conclusion: Endemic national FRF-rates mask a wide variation in time trends between states. FRF-rates were twice as high in blacks than whites but decreased

among Hispanics. Efforts to identify state-specific best practices can contribute to changes in national FRF-rates that remain high.

Strengths of this study

- This study uses the best available data reporting system for surveillance of firearm mortality in US.
- Brings into light the overall state-specific variability of temporal trends of firearm mortality, which was obscured by the endemic national firearm fatality rates during 2000-2010 and according to race, ethnicity and intent from a seemingly stable national burden of firearm deaths.
- This is the first report that documents firearm fatality trends by ethnicity
- Our results call for identification of drivers of state-specific temporal trends to introduce tailored programs targeted to reduce deaths and injury due to firearms.

Limitations of this study

- Possible under reporting of firearm fatal events, which cannot be verified.
- Despite the considerable state-specific heterogeneity, the actual variation in firearm mortality may be a feature of cities and counties with varying crime rates, and we do not address the variation existing at such level.
- Finally, comparisons made between other races may not be usefully interpreted due to the heterogeneity and the small frequency of events in this sub-population.

Firearm violence increased during the 1980s and peaked in 1993, with 39,595 firearm deaths in the US and a firearm-related fatality rate (FRF-rate) of 15.0 per 100,000.[1] Since the turn of the 21st century, FRF-rates in the US have become endemic around 10.3 per 100,000 accounting for 17.5% of all injury deaths,[2] while the intent of firearm deaths was mainly suicide and homicide.[3]

The FRF-rate in 1993 among blacks was three-times greater than whites, but similar among Hispanics and non-Hispanics.[1 4] The overall fall in FRF after 2000 corresponded to a related narrowing of the racial gap between blacks and whites, where, by 2010, the FRF-rates among blacks was twice greater than whites.[1] Several factors have been posited that might explain these persistent racial differences, including socioeconomic determinants and increased firearm availability.[5 6]

Although the national temporal trends in FRF have been previously well documented,[3 7 8] there is ample reason to suspect substantial heterogeneity in FRF across states, such as dramatic differences in gun laws controlling access to firearms, variability in enforcement of national standards across states,[8 9] changing demographics and violence.[10] It is likely that some of the state-to-state heterogeneity in the potential determinants of FRF may also contribute to variability in racial and ~~/~~ethnic differences in FRF within states.

With this in mind, this study had two distinct aims. First, we aimed to document national and state-specific trends in FRF-rates along with the annual change in FRF-rates from 2000-2010 and second, to determine the racial, ethnic and

intent-specific differences in FRF-rates within each state during the same time period.

METHODS

Data source

We accessed the restricted fatal injury data reports from the Web-based Injury Statistics Query and Reporting System (WISQARS™), an interactive database system provided by Centers for Disease Control and Prevention's (CDC) Injury Prevention and Control Unit (http://www.cdc.gov/injury/wisqars/).[1] The data in the WISQARS system is derived from CDC annual mortality data from National Vital Statistics System (NVSS), National Center for Health Statistics (NCHS) (http://www.cdc.gov/nchs/) and CDC. The NCHS and the National Association of Public Health Statistics and Information Systems restricts reporting NVSS data for cumulative frequencies <10 for sub-national geographic areas to prevent unintentional disclosure of cases. International Classification of Disease-10th Revision (ICD-10) was used for coding mortality data including intent of injury.[11]

Study population and variables

Our study population consisted of national and state-specific fatal firearm injuries from 2000-2010 obtained from querying the WISQARS data system. Aggregate information such as number of firearm deaths, total population and age-adjusted rates according to~~by~~ race (black, white, other), ethnicity (Hispanic and non-Hispanic) and intent (homicide/legal intervention, suicide, undetermined and unintentional) was obtained.

Statistical analysis

The standard errors (SE) for national and state-specific age-adjusted FRF-rates per 100,000 persons were derived for the overall 11-year period and annually and by race, ethnicity and intent. Age-adjusted rates are obtained by direct standardization using the 2000 population. The overall 11-year rates were assessed as ~~obtained by~~ total firearm deaths ~~during the 11 years~~ over the total population during the 11-years. Since only aggregate data could be obtained from WISQARS without individual patient data, we used random effects meta-analysis and meta-regression.[12] The rates in each category and the SEs were meta-analyzed using random-effects meta-analysis. Heterogeneity between states was assessed using I^2 statistic; which ranges from 0 to 100% and denotes the proportion of variation across states other than by chance.[13 14] In order to assess the temporal trends from 2000-2010, we assumed linear trends across 11 years and used meta-regression to calculate the change in rates (slope) and the standard deviation (SD). The p-value from meta-regression was used to assess evidence for trend. Standardized mean difference (SMD) was calculated by dividing the annual change in age-adjusted rate by SD.[15 16] We do not present estimates for those states with number of deaths below 10. Lives-lost or saved are estimated by applying annual change to the total 11-year population (2000-2010). The difference between 11-year national and state-specific FRF-rates (overall and category-specific) were used to spatially represent the variation between states. STATA 13.1 (StataCorp LP, College Station, Texas; 2009) was used to analyze the data.

RESULTS

Between 2000 and 2010, a total of 335,609 firearm-related deaths were recorded and the overall mortality rate was 10.21 per 100,000. The annual change in FRF-rate across 11-years was -0.017 with a 95% confidence interval (95% CI) of -0.044-0.010, p-trend=0.18, indicating no significant change in national FRF-rates. **Table 1** presents national FRF-rates, for 11-years and annually according to race, ethnicity and intent. Cumulative 11-year FRF-rates were disproportionally high among blacks (18.51) as compared to whites and other race groups, and lowest among other races (3.38). Among whites the FRF-rates were lower than the overall national 11-year rate while increasing from 8.97 to 9.20 from 2000-2010. This annual increase was small (0.006, SMD=0.11) but not significant, p-trend=0.71. Even though the FRF-rates among blacks were consistently higher than national FRF-rates, the annual rates reduced from 18.30 to 16.90; and this decline, -0.114 was not significant, SMD=-0.40, p-trend=0.22. The decline in FRF-rates from 4.76 to 3.25 among other races was significant (change=-0.12, SMD=-1.83, p-trend<0.0001). Annual reduction observed among Hispanics showed a significant reduction, -0.179, p-trend<0.0001 alongside an already low 11-year FRF-rate of 7.13. FRF-rates among non-Hispanics remained slightly above the national rates without increase. FRF-rate by intent was highest for suicides (5.80) while the annual change was minimal in all four categories with a small significant reduction for unintentional deaths (change=-0.010, SMD=-1.70, p-trend<0.0001).

State-specific 11-year FRF-rates are represented in **Figure 1** and **Supplementary Table 1**. Hawaii (HI) (3.02) and Massachusetts (MA) (3.24) had the lowest 11-year FRF-rates, while Louisiana (LA) had the highest at 18.62. DC and 7 states showed a significant declining trend in FRF-rate, while MA and FL documented a significant increase. District of Columbia (DC) had the largest significant annual reduction at -1.067 (6.2 lives-saved per year, p-trend = 0.002) though it had the highest rate of 21.71. Although MA had a low FRF-rate, a significant increase was observed, change=0.074, p-trend=0.008. Florida (FL) also showed an increase, change=0.160, 28.2 lives-lost per year, p-trend=0.016. FRF-rates for Delaware (DL) and Ohio (OH) were 8.89 and 9.10, with a near significant increasing trend, changes of 0.20 and 0.12. FRF-rate in New York (NY) was 5.15 with a change=-0.064, 12.3 lives-saved per year, p-trend=0.006. Illinois (IL) had a significant reduction, change=-0.155, 19.6 lives-saved per year, p-trend=0.025). FRF-rates in CA was -0.166 (59.3 lives-saved per year, p-trend=0.001), Arizona (AZ) at -0.230 (13.4 lives-saved per year, p-trend=0.025) and Nevada (NV) at -0.264 (6.4 lives-saved per year, p-trend = 0.008). Maryland (MA) and North Carolina (NC) had a significant decline: change=-0.169, 9.4 lives-saved per year, p-trend=0.048 and -0.174, 15.3 lives-saved per year, p-trend=0.001).

The 11-year FRF-rates for each state by race are presented in **Figures 2A to 2C** and **Supplementary Figures 1A-C**. Among whites, the lowest rate was in MA with a significant increase from 2000-2010 (change=0.05, p-trend=0.037). FL also recorded a significant increase (change=0.12, p-trend=0.045) but had high 11-year

FRF-rate, 10.02. NV recorded the highest and unchanging FRF-rate at 16.30. The four states that showed a significant declining trend from 2000-2010 were NY (change=-0.05, p-trend=0.015), IL (change=-0.12, p-trend=0.028), NC (change=-0.10, p-trend=0.032), and CA (change=-0.12, p-trend=0.001). Among blacks, HI had the lowest 11-year FRF-rates at 2.93 while Missouri (MO) had the highest at 30.12 and DC was at 40.95. Oklahoma (OK), OH and DL had high 11-year rates at 20.04, 20.19 and 13.61 respectively with a significant increasing changes of 0.93, 0.51 and 0.79, p-trends of 0.008, 0.027 and 0.028 respectively. A declining trend was observed among blacks in CA (change=-0.58, p-trend=0.042), AZ (change=-0.83, p-trend=0.019), NV (change=-1.53, p-trend=0.005), NC (change=-0.38, p-trend=0.024), Indiana (IN) (change=-0.66, p-trend=0.012), Kansas (KA) (change=-1.07, p-trend=0.021), Minnesota (MN) (change=-0.61, p-trend=0.038), and DC (change=-1.58, p-trend=0.017), even though their 11-year FRF-rates were high. Among other races, Texas (TX) (change=-0.19, p-trend=0.033) and CA (change=-0.10, p-trend=0.009) showed a significant decline.

Figures 3A-B and **Supplementary Figures 3A-B** presents the 11-year FRF-rates for each state by ethnicity. Georgia (GA) (change=-0.54, p-trend=0.012), CA (change=-0.18, p-trend=0.009), Utah (UT) (change=-0.79, p-trend=0.030), AZ (change=-0.56, p-trend=0.016), and NV (change=-0.48, p-trend=0.007) were five high-FRF-rate states (>7.13) while NY (change=-0.17, p-trend=0.001), IL (change=-0.40, p-trend=0.001), TX (change=-0.21, p-trend=0.004), and Oregon (OR) (change=-0.33, p-trend=0.037) were the four low-FRF-rate states with a significant

declining trend among Hispanics. No states demonstrated an increase among Hispanics, while non-Hispanics showed a significant increasing trend in MA (change=0.07, p-trend=0.033), Pennsylvania (PA) (change=0.08, p-trend=0.039), OH (change=0.13, p-trend=0.048), DL (change=0.25, p-trend=0.036), TX (change=0.14, p-trend=0.022), FL (change=0.23, p-trend=0.002) and OK (change=0.15, p-trend=0.045). A declining trend in non-Hispanics was observed in MD (change=-0.16, p-trend=0.068), NC (change=-0.14, p-trend=0.004) and CA (change=-0.15, p-trend=0.001). In TX, the FRF-rates among Hispanics (change=-0.21, p-trend=0.004) demonstrated a significant decline and a significant increase among non-Hispanics (change=0.14, p-trend=0.022) (**Supplementary Table 2**).

FRF-rates from 2000-2010 and by intent is provided in **Figures 4A-D** and **Supplementary Figures 4A-D**. Most of the northern states had low (<3.73) homicide-FRF while southern states had high FRF. NY (change=-0.05, p-trend=0.004), IL (change=-0.10, p-trend=0.027), NC (change=-0.10, p-trend=0.023), NV (change=-0.15, p-trend=0.031) and DC (change=-1.0, p-trend=0.002) had significant declining trends while MA (change=0.08, p-trend=0.001), Connecticut (CT) (change=0.08, p-trend=0.023), OH (change=0.12, p-trend=0.006), DL (change=0.37, p-trend<0.0001) and FL (change=0.15, p-trend=0.007) had increasing homicide-FRF. A majority of the states had suicide-FRF-rates >5.80; CA (change=-0.07, p-trend=0.009) and NC (change=-0.07, p-trend=0.037) had declining trends. Unintentional-FRF-rates showed a significant decreasing trend in three

states, OH (change=-0.01, p-trend=0.022), Kentucky (KY) (change=-0.06, p-trend=0.009), and Tennessee (TN) (change=-0.05, p-trend=0.002).

DISCUSSION

National 11-year FRF-rate from 2000-2010 was 10.21, was almost three times higher than Switzerland and Finland.[17] There were four main observations that emerge from this analysis. First, while overall, blacks had higher national rates than whites and Hispanics had lower national rates than non-Hispanics, the 11-year FRF-rates declined among Hispanics and non-white non-black races with no significant change observed among whites, blacks or non-Hispanics. Second, a substantial inter-state heterogeneity was evidenced by 11-year state-specific FRF-rates being as low as 3.02 in HI to as high as 21.71 in DC. FL and MA recorded an upward FRF trend while AZ, CA, IL, MD, NV, NY, NC and DC had declining FRF-rates during the study period. Third, racial and ethnic variation was shown to drive many of the state-specific variations. Fourth, changes in different FRF-intent also drove many of the state-specific differences.

Firearm deaths increased from 28,663 in 2000 to 31,672 in 2010, about 30,509 deaths per year and no change in rate. These findings are similar to a report by the Bureau of Justice of a rapid decline in firearm homicides from 1993 to 1999 followed by a leveling of rates from 2000-2011.[18] It is important to bear in mind that these endemic conditions are associated with substantial, long-term cumulative health burden associated with firearm death throughout the US. ~~Taken at face value, this endemic FRF-rate may seem reassuring, evidencing no increase in burden over time, concealing a substantial existing public health burden due to long-term cumulative burden to the country, as a whole surpasses the toll suffered during the~~

~~1980s epidemic stage~~.[19] During 2000-2011 there were 306,946 firearm related deaths. With the endemic annual FRF-rate of 10.3, US-population at 338 million by 2020[20] and 10% decadal population increase, we estimate 336,778 firearm related deaths to occur between 2011 and 2020.

The 11-year FRF-rates we report among blacks was twice greater than that of whites and six-times greater than that of other races is in line with reports showing disproportionately larger firearm fatality and injury rates than whites and other race.[3 21 22] Although there was a plateau of the national FRF-rates, rates among Hispanics and non-white non-black races declined and may be explained by the lack of access to firearms or low firearm ownership among Hispanics and other races.[23] Our results explain the report where Hispanics were least likely to use firearms for suicides albeit being more likely to self-injury than any other race groups.[24] Data from 1981-2010 found that among youths a decline in homicide rates for blacks between was significantly slower than the declines for Hispanics and other racial and ~~/~~ethnic groups[25], suggestive of lower crime.

We found 41 states with no FRF-rate change, while 7 states and DC demonstrated either a significant decline or increase. MA and FL recorded a significant increase, MA with smallest and FL with largest annual increase while MA had the lowest 11-year FRF-rate. The Brady Center to Prevent Gun Violence [9] firearm legislative strength score for 2013, has MA to be third with score of 65 among all states in restrictive firearm legislation, while FL has a score of 3. After MA

passed the toughest firearm-control legislation in 1998, firearm ownership rates plummeted but violent crimes (476.1 to 468.9) and homicides (2.2 to 3.3) rose.[26] The significant FRF-rate increase in MA may be explained ~~due to~~ by the influx of firearms from the two neighboring states (Maine and New Hampshire) with weak firearm control legislation.[27] FL is a "shall issue", weak legislature state with just 2 laws to prevent illegal gun-trafficking.[27] In contrast to the increasing FRF-rates, the aggregate violent crimes in FL declined from 801.1 to 542.9,[28] emphasizing a particularly concerning public health problem of increasing gun violence even in a climate of reducing violence.

CA, NY, IL, AZ, NV, MD, NC, and DC had declining trends but the most marked reduction was observed in CA and may be directly linked to strength of firearm legislature, a score of 81.[9] CA has eight state laws to prevent illegal gun trafficking[27] and a reduction in homicide crime rate in CA by 25.4% from 2001-2010.[29] An emergency department study from 2004-2008 reporting reduction of firearm death rate in CA echoing the results of our study.[30] NY and IL had similar trend profiles and an overall decline in FRF-rates, but the Brady scores were 62 and 35[9] with 10 and 8 policies preventing illegal firearm trafficking respectively.[27] FRF-rate reduction in AZ and NV is in contrast to CA and NY, having no laws preventing illegal gun trafficking,[27] with Brady scores 0 and 5 respectively.[9] In AZ violent crime rate dropped from 544.5 offenses in 2002 to 372.2 in 2010,[31 32] and NV had reductions in index crimes.[33] This reduction and our results may be attributed to policing strategies.[34] Our reported reduction in firearm death rates in DC may be attributed

to 9 laws preventing illegal gun trafficking.[27] Firearm policies are not stringent in NC, strength of firearm legislature being 16[9] with only 5 illegal gun trafficking laws.[27] However, the violent crime rate in NC dropped from 493 to 363 from 2000-2010,[35] suggesting that the factors that led to reduction in crime rates may have also driven FRF-rate reduction.

We found that the state-specific increasing trend in FL was driven by an increase among whites, blacks and non-Hispanics and can be explained by violent crime rates in FL which ranks 4th in violent crime.[36] The racial gap in arrests for major crimes widened in FL from 2000-2010: 6,175 blacks and 6,071 whites were arrested in 2000 to 2,398 and 3,192 in 2010.[37] The increase in FRF-rates in MA driven by whites and non-Hispanics is in contrast to the racial differences observed in violent deaths with non-Hispanic blacks having the highest rate of 21.6 as compared to 4.9 among whites.[38] MA has relatively low violent crime rate (ranks 20th in US),[36] and stringent firearm control.[9] Even though nationally no significant reduction in FRF-rates among blacks was observed in our study, FRF-rates among blacks drove the state-specific declines in AZ, NV, CA, NC and DC. Declining trends among Hispanics in AZ, NV, CA, NY and IL contributing to state-specific declines may be due to a combination of low firearm ownership[23] and racially targeted crime-control activities.[39] In IN, KS, MN and OK, with no statewide reduction, the FRF-rates fell solely among blacks, with no change among whites. These states have very few laws to prevent firearm violence and trafficking[27] and rank among the highest twenty states in crime rates except MN.[36]

The increasing trend in FL and MA in our study was due to increase in firearm homicides. According to data from CDC, rates of suicides in FL remained constant from 2000-2010 while in MA these rates doubled from 1.92 to 3.15.[1] In 2010, 71% of homicides in FL were by firearms,[28] and in MA, 22% of the homicides were by firearm.[38] In CA, where all racial and ethnic groups revealing declining trends, was driven by reduction in suicide-FRF and is associated with the states' increased effort in implementing "The Mental Health Services Act" to reduce suicide rates.[40] In our study, reduction in homicides was caused by declines in AZ, IL, NV, NY, NC and DC. These declining patterns are similar to the reduction in all-cause homicide rates from 2000-2010 that occurred in a smaller magnitude among AZ, IL, NV, NY, NC and in a much larger magnitude in DC.[1]

There are several limitations in our study. Under reporting of firearm fatal events is a known phenomenon and a limitation of this study, which cannot be verified. There is, however, no reason to suspect that blacks and Hispanics are more likely than whites and non-Hispanic individuals to have a fatal firearm injury misclassified on the death certificate, so this under-reporting should not have biased our findings. Another limitation is that, despite the considerable state-specific heterogeneity, the actual variation in firearm mortality may be a feature of cities and counties with varying crime rates, and we do not address the variation existing at such level. Finally, comparisons made between other races may not be usefully interpreted due to the heterogeneity and the small frequency of events in this sub-

population. However, as other race makes up about 10% of the US population, the results are discussed in relation to blacks and Hispanics.

In summary, we showed no change in national firearm mortality rates during 2000-2010, but showed distinct state-specific patterns with racial and ~~/~~ethnic variation and by intent. ~~The patterns observed do not map neatly onto known firearm control efforts by individual states. While some of the states with most stringent gun laws showed an expected decrease in firearm death rates, some states with strong gun control laws reported an increase in death rates. This may have a direct implication for a public health approach to gun violence prevention that more broadly needs to grapple with firearm available and porous cross-state borders that permit firearm carriage across states.~~ The distinctive state-specific firearm fatality profiles vary by race, ethnicity and intent adding another layer of complexity to the FRF trends. This calls for specific studies to identify the drivers of the state-specific temporal trends followed by introducing tailored programs that target specific racial and ~~-~~ethnic groups in specific states.

Table 1: Trends in firearm deaths in the United States, WISQARS 2000-2010.

	Age-adjusted firearm deaths per 100,000 population												Change			
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total	Annual	95% CI	SMD	P-trend
All	10.14	10.31	10.43	10.29	9.99	10.27	10.22	10.24	10.23	10.05	10.07	10.21	-0.017	-0.044, 0.010	-0.44	0.181
Race																
White	8.97	9.21	9.19	9.05	8.84	8.98	8.80	8.98	9.18	9.13	9.20	9.05	0.006	-0.027, 0.039	0.11	0.705
Black	18.30	18.32	19.22	19.01	18.31	19.34	19.98	19.31	18.19	17.15	16.90	18.51	-0.114	-0.311, 0.082	-0.40	0.220
Other	4.76	3.89	4.19	4.03	3.70	3.88	3.83	3.38	3.25	3.37	3.25	3.38	-0.121	-0.166, -0.076	-1.83	<0.0001
Ethnicity																
Hispanic	7.81	7.73	7.63	7.68	7.42	7.51	7.19	7.21	6.60	6.38	5.86	7.13	-0.179	-0.236, -0.122	-2.13	<0.0001
Non-Hispanic	10.31	10.50	10.67	10.50	10.23	10.53	10.54	10.61	10.74	10.55	10.71	10.54	0.027	-0.002, 0.056	0.63	0.068
Intent																
Homicide/Legal Intervention	3.88	4.05	4.17	4.19	4.05	4.28	4.40	4.32	4.14	3.89	3.73	4.10	-0.008	-0.054, 0.038	-0.12	0.705
Suicide	5.90	5.90	5.92	5.77	5.65	5.66	5.54	5.63	5.82	5.91	6.06	5.80	0.001	-0.035, 0.038	0.03	0.932
Undetermined	0.08	0.08	0.08	0.08	0.08	0.07	0.07	0.09	0.09	0.07	0.08	0.08	-0.0001	-0.002, 0.002	-0.02	0.944
Unintentional	0.27	0.28	0.26	0.25	0.22	0.27	0.21	0.20	0.19	0.18	0.20	0.23	-0.010	-0.014, -0.006	-1.70	<0.0001

All values are age-adjusted rates per 100,000 persons. Change denotes annual change in rate per 100,000. Negative value indicates decline in firearm death rates per 100,000 from 2000-2010 and positive value indicates increase in firearm death rate per 100,000 from 2000-2010. CI denotes confidence intervals of the annual change in firearm death rate per 100,000. SMD indicates standardized mean difference; is equal to annual change/standard deviation. P-trend calculated using meta-regression indicates the significance of the decline or the increase in firearm related death rates from 2000-2010.Data are from Center for Disease Control and Prevention (CDC)'s National center for Injury Prevention and Control Web-based Injury Statistics Query and Reporting System (WISQARS).

Figure legends

Figure 1: Firearm related fatality rates from 2000-2010.

Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia ranging from 3.02 (HI) to 21.71 (DC) per 100,000. The colors represent increasing rates from blue to red. Significant decline in 7 states (AZ, CA, IL, MD, NV, NY and NC and DC) are represented as gold stars and significant increase in FL and MA as black stars within the map and in the table.

The table summarizes the rates per 100,000, annual change in rate and p-trend for those states that show significant increase or decrease. "FRF" denotes firearm related fatality. "Change" indicates the annual change in rates from 2000 to 2010. "P-trend" indicates the significance of the decline or the increase in firearm related fatality rates from 2000 to 2010 and was calculated using meta-regression. Negative values for change indicate a decrease while positive values indicate increase in rates across the years. The intent-specific rates of firearm related fatality is denoted with arrows in the table below: downward arrow denotes reduction in rates, upward arrows indicate an increase and two-way arrows indicate no change. "ne" represents data which cannot be estimated due to frequency <10. HI (11-year=3.02, change=-0.057, p-trend=0.36) and AK (11-year=18.09, change=0.10, p-trend=0.64) are not represented in the map.

Figure 2: Firearm related fatality rates from 2000-2010 according to race.

Whites:

Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 2.57 (MA) to 16.30 (NV) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was ≤10 among whites. Significant decline in 4 states (CA, NY, IL and NC) are represented as gold stars and significant increase in MA and FL as black stars. HI (11-year=4.29, change=0.03, p-trend=0.84) and AK (11-year=15.77, change=0.15, p-trend=0.56) are not represented in the map.

Blacks:

Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 2.93 (HI) to 40.95 (DC) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was ≤10 among blacks. Significant decline in 8 states (CA, NV, AZ, KA, MN, IN, NC and DC) are represented as gold stars and significant increase in OK, OH and DL as black stars. HI (11-year=2.93) and AK (11-year=12.36) are not represented in the map.

Other race:

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Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 0.82 (NY) to 22.54 (AK) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10 among other race. Significant decline in 2 states (CA and TX) are represented as gold stars and there were no states with significant increase. HI (11-year=2.18, change=-0.04, p-trend=0.50) and AK (11-year=22.54, change=-0.15, p-trend=0.75) are not represented in the map.

Figure 3: Firearm related fatality rates from 2000-2010 according to ethnicity.

Hispanic:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 3.13 (NJ) to 15.63 (ND) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10 among Hispanics. Significant decline in 9 states (CA, AZ, NV, OR, UT, TX, IL, GA and NY) are represented as gold stars and there were no states with significant increase. HI (11-year=3.84) and AK (11-year=8.95) are not represented in the map.

Non-Hispanic:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 2.95 (HI) to 23.45 (DC) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10 among non-Hispanics. Significant decline in 3 states (CA, NC and DC) are represented as gold stars and significant increase in 7 states (TX, OK, FL, OH, PA, DL, and MA) as black stars. HI (11-year=2.95, change=-0.05, p-trend=0.50) and AK (11-year=18.44, change=0.13, p-trend=0.57) are not represented in the map.

Figure 4: Firearm related fatality rates from 2000-2010 according to intent.

Homicide:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 0.65 (NH) to 19.75 (DC) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10. Significant decline in 5 states (NV, IL, NC, NY and DC) are represented as gold stars and significant increase in MO, FL, OH, MA, CT, and DL as black stars. HI (11-year=0.79, change=-0.01, p-trend=0.68) and AK (11-year=3.54, change=0.001, p-trend=0.95) are not represented in the map.

Suicide:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 1.61 (MA) to 13.79 (AK) per 100,000. The colors represent increasing

rates from blue to red. White represents no data or states where the frequency was <10. Significant decline in 2 states (CA and NC) are represented as gold stars and there were no states with significant increase. HI (11-year=2.10, change=-0.001, p-trend=0.95) and AK (11-year=13.79, change=0.11, p-trend=0.61) are not represented in the map.

Undetermined:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 0.01 (NJ) to 0.47 (AK) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10. There was no significant decline or increasing state-specific trends. HI (11-year=ne) and AK (11-year=0.47) are not represented in the map.

Unintentional:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 0.04 (MA) to 0.83 (LO) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10. Significant decline in 3 states (OH, KN and TN) are represented as gold stars and there were no states with significant increase. HI (11-year=0.08) and AK (11-year=0.29) are not represented in the map.

Contributorship:

Galea and Kalesan conceived and supervised the study. Kalesan and Vasan completed the analyses. Kalesan, Galea and Villarreal led the writing. Fagan, Teperman, Mobily and Hlavacek assisted with the study and analyses. Hlavacek assisted with obtaining state gun laws.

Competing interests:

None of the authors have competing interests to report

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Data sharing:

All data used for the analysis are publicly available and there is no further data for data sharing purposes.

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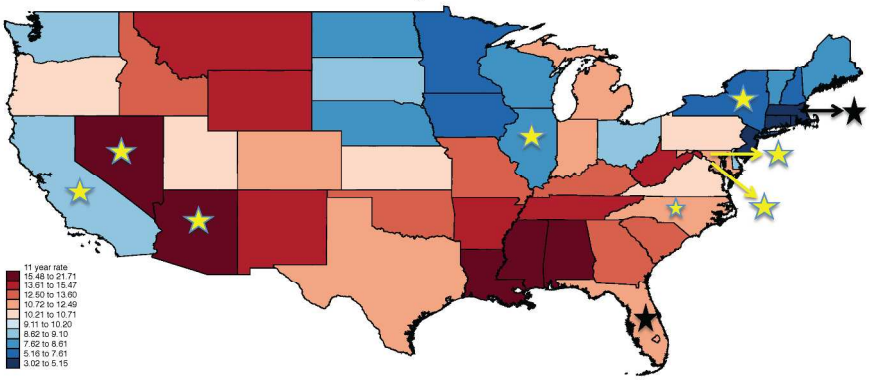
Figure 1



		AZ	CA	DC	IL	MD	NV	NY	NC	FL	MA
Overall	FRF rate	15.47	9.01	21.71	8.61	11.39	16.07	5.15	12.49	11.12	3.24
	Change, P-trend	**-0.23, 0.025**	**-0.17, 0.001**	**-1.07, 0.002**	**-0.16, 0.025**	**-0.17, 0.048**	**-0.26, 0.008**	**-0.06, 0.006**	**-0.17, 0.001**	**0.16, 0.016**	**0.07, 0.008**
Whites	FRF rate	15.73	8.73	3.03	5.80	6.81	16.80	4.05	13.63	10.02	2.57
	Change, P-trend	-0.19, 0.081	**-0.12, 0.001**	-0.03, 0.89	**-0.12, 0.028**	-0.05, 0.29	-0.08, 0.38	**-0.05, 0.015**	**-0.10, 0.032**	**0.12, 0.045**	**0.05, 0.037**
Blacks	FRF rate	18.97	23.43	40.85	24.48	21.18	22.36	10.73	14.77	15.16	10.65
	Change, P-trend	**-0.83, 0.019**	**-0.58, 0.042**	**-1.58, 0.017**	-0.32, 0.14	**-0.42, 0.067**	**-1.53, 0.005**	-0.06, 0.27	**-0.38, 0.024**	**0.29, 0.056**	0.25, 0.097
Other	FRF rate	7.83	2.88	2.78	0.90	2.17	4.93	0.82	7.73	3.67	0.97
	Change, P-trend	**-0.43, 0.053**	**-0.10, 0.009**	ne, ne	ne, ne	-0.12, 0.60	-0.48, 0.19	-0.05, 0.20	-0.30, 0.11	-0.08, 0.49	-1.06, 0.26
Hispanic	FRF rate	14.73	7.42	4.71	6.05	3.36	10.05	3.63	8.12	6.24	4.00
	Change, P-trend	**-0.56, 0.016**	**-0.18, 0.009**	ne, ne	**-0.40, 0.001**	-0.25, 0.10	**-0.48, 0.007**	**-0.17, 0.001**	-0.24, 0.20	0.03, 0.34	0.09, 0.34
Non-Hispanic	FRF rate	16.58	9.19	23.43	8.60	11.95	16.93	5.36	12.62	12.31	3.08
	Change, P-trend	-0.05, 0.57	**-0.15, 0.001**	**-1.20, 0.003**	-0.06, 0.28	**-0.16, 0.068**	-0.11, 0.27	-0.04, 0.094	**-0.14, 0.004**	**0.23, 0.002**	**0.07, 0.033**
Intent	Homicide	↓	↔	↓	↓	↔	↓	↓	↓	↑	↑
	Suicides	↔	↓	↔	↔	↔	↔	↔	↓	↔	↔
	Undetermined	↔	↔	ne	↔	ne	ne	ne	ne	↔	↔
	Unintentional	ne	↔	ne	↔	ne	ne	ne	↔	↔	↔

Figure 1: Firearm related fatality rates from 2000-2010.

Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia ranging from 3.02 (HI) to 21.71 (DC) per 100,000. The colors represent increasing rates from blue to red. Significant decline in 7 states (AZ, CA, IL, MD, NV, NY and NC and DC) are represented as gold stars and significant increase in FL and MA as black stars within the map and in the table.

The table summarizes the rates per 100,000, annual change in rate and p-trend for those states that show significant increase or decrease. "FRF" denotes firearm related fatality. "Change" indicates the annual change in rates from 2000 to 2010. "P-trend" indicates the significance of the decline or the increase in firearm related fatality rates from 2000 to 2010 and was calculated using meta-regression. Negative values for change indicate a decrease while positive values indicate increase in rates across the years. The intent-specific rates of firearm related fatality is denoted with arrows in the table below: downward arrow denotes reduction in rates, upward arrows indicate an increase and two-way arrows indicate no change. "ne" represents data which cannot be estimated due to frequency <10. HI (11-year=3.02, change=-0.057, p-trend=0.36) and AK (11-year=18.09, change=0.10, p-trend=0.64) are not represented in the map.

254x190mm (300 x 300 DPI)

Figure 2

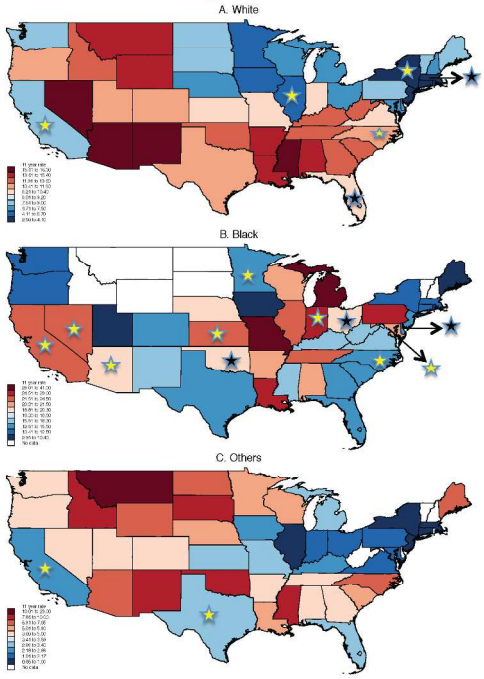


Figure 2: Firearm related fatality rates from 2000-2010 according to race.

Whites:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 2.57 (MA) to 16.30 (NV) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10 among whites. Significant decline in 4 states (CA, NY, IL and NC) are represented as gold stars and significant increase in MA and FL as black stars. HI (11-year=4.29, change=0.03, p-trend=0.84) and AK (11-year=15.77, change=0.15, p-trend=0.56) are not represented in the map.

Blacks:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 2.93 (HI) to 40.95 (DC) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10 among blacks. Significant decline in 8 states (CA, NV, AZ, KA, MN, IN, NC and DC) are represented as gold stars and significant increase in OK, OH and DL as black stars. HI (11-year=2.93) and AK (11-year=12.36) are not represented in the map.

Other race:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 0.82 (NY) to 22.54 (AK) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10 among other race. Significant decline in 2 states (CA and TX) are represented as gold stars and there were no states with significant increase. HI (11-year=2.18, change=-0.04, p-trend=0.50) and AK (11-year=22.54, change=-0.15, p-trend=0.75) are not represented in the map.
254x190mm (300 x 300 DPI)

Figure 3

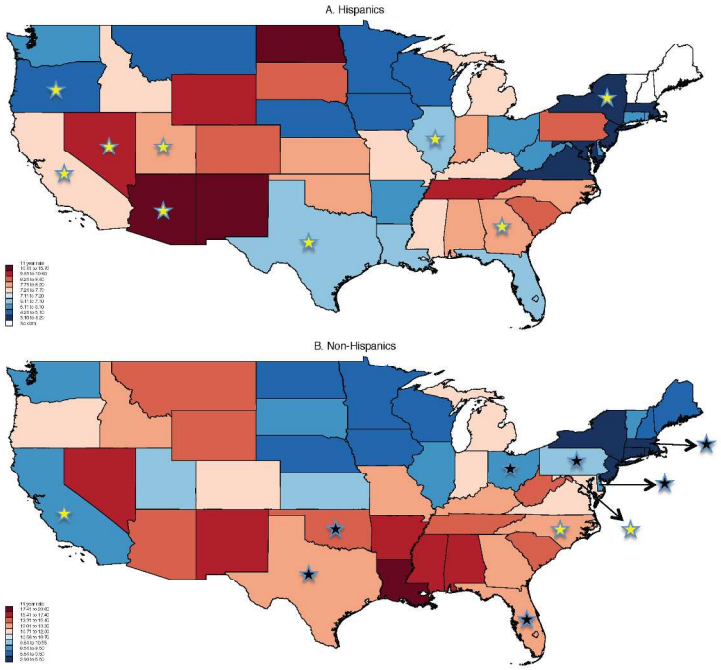


Figure 3: Firearm related fatality rates from 2000-2010 according to ethnicity.

Hispanic:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 3.13 (NJ) to 15.63 (ND) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10 among Hispanics. Significant decline in 9 states (CA, AZ, NV, OR, UT, TX, IL, GA and NY) are represented as gold stars and there were no states with significant increase. HI (11-year=3.84) and AK (11-year=8.95) are not represented in the map.

Non-Hispanic:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 2.95 (HI) to 23.45 (DC) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10 among non-Hispanics. Significant decline in 3 states (CA, NC and DC) are represented as gold stars and significant increase in 7 states (TX, OK, FL, OH, PA, DL, and MA) as black stars. HI (11-year=2.95, change=-0.05, p-trend=0.50) and AK (11-year=18.44, change=0.13, p-trend=0.57) are not represented in the map.
254x190mm (300 x 300 DPI)

Figure 4

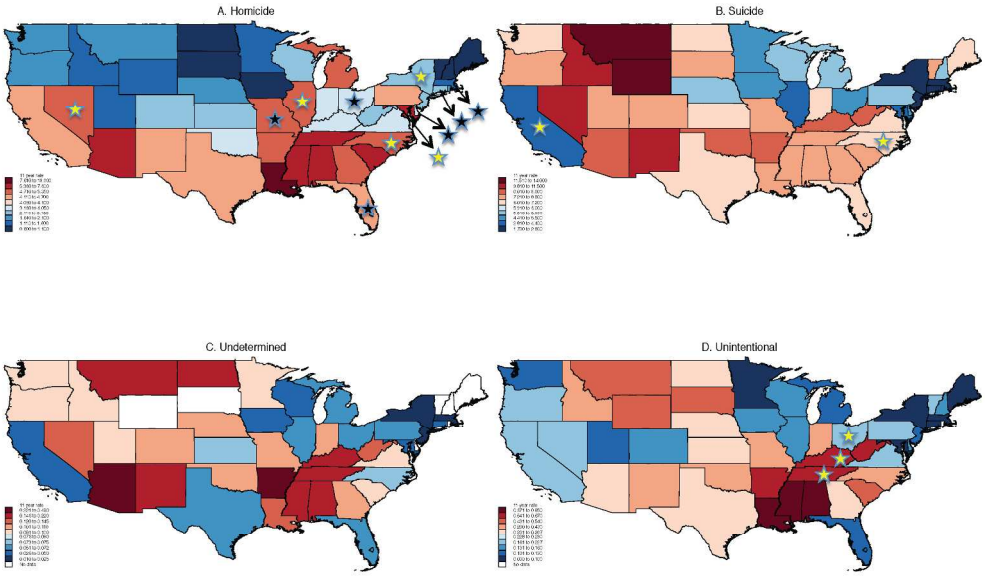


Figure 4: Firearm related fatality rates from 2000-2010 according to intent.

Homicide:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 0.65 (NH) to 19.75 (DC) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10. Significant decline in 5 states (NV, IL, NC, NY and DC) are represented as gold stars and significant increase in MO, FL, OH, MA, CT, and DL as black stars. HI (11-year=0.79, change=-0.01, p-trend=0.68) and AK (11-year=3.54, change=0.001, p-trend=0.95) are not represented in the map.

Suicide:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 1.61 (MA) to 13.79 (AK) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10. Significant decline in 2 states (CA and NC) are represented as gold stars and there were no states with significant increase. HI (11-year=2.10, change=-0.001, p-trend=0.95) and AK (11-year=13.79, change=0.11, p-trend=0.61) are not represented in the map.

Undetermined:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 0.01 (NJ) to 0.47 (AK) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10. There was no significant decline or increasing state-specific trends. HI (11-year=ne) and AK (11-year=0.47) are not represented in the map.

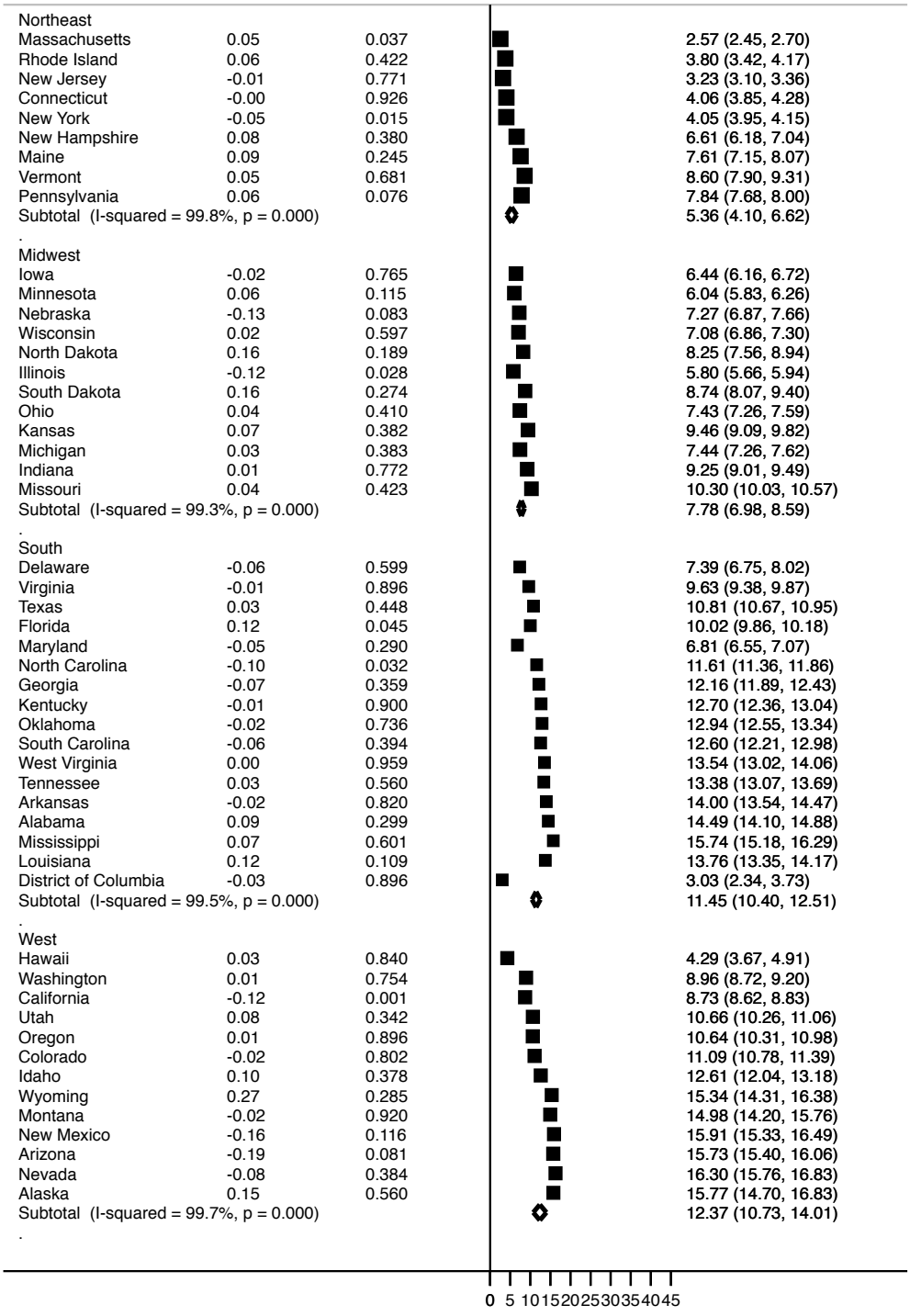
Unintentional:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 0.04 (MA) to 0.83 (LO) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10. Significant decline in 3 states (OH, KN and TN) are represented as gold stars and there

were no states with significant increase. HI (11-year=0.08) and AK (11-year=0.29) are not represented in the map.
254x190mm (300 x 300 DPI)

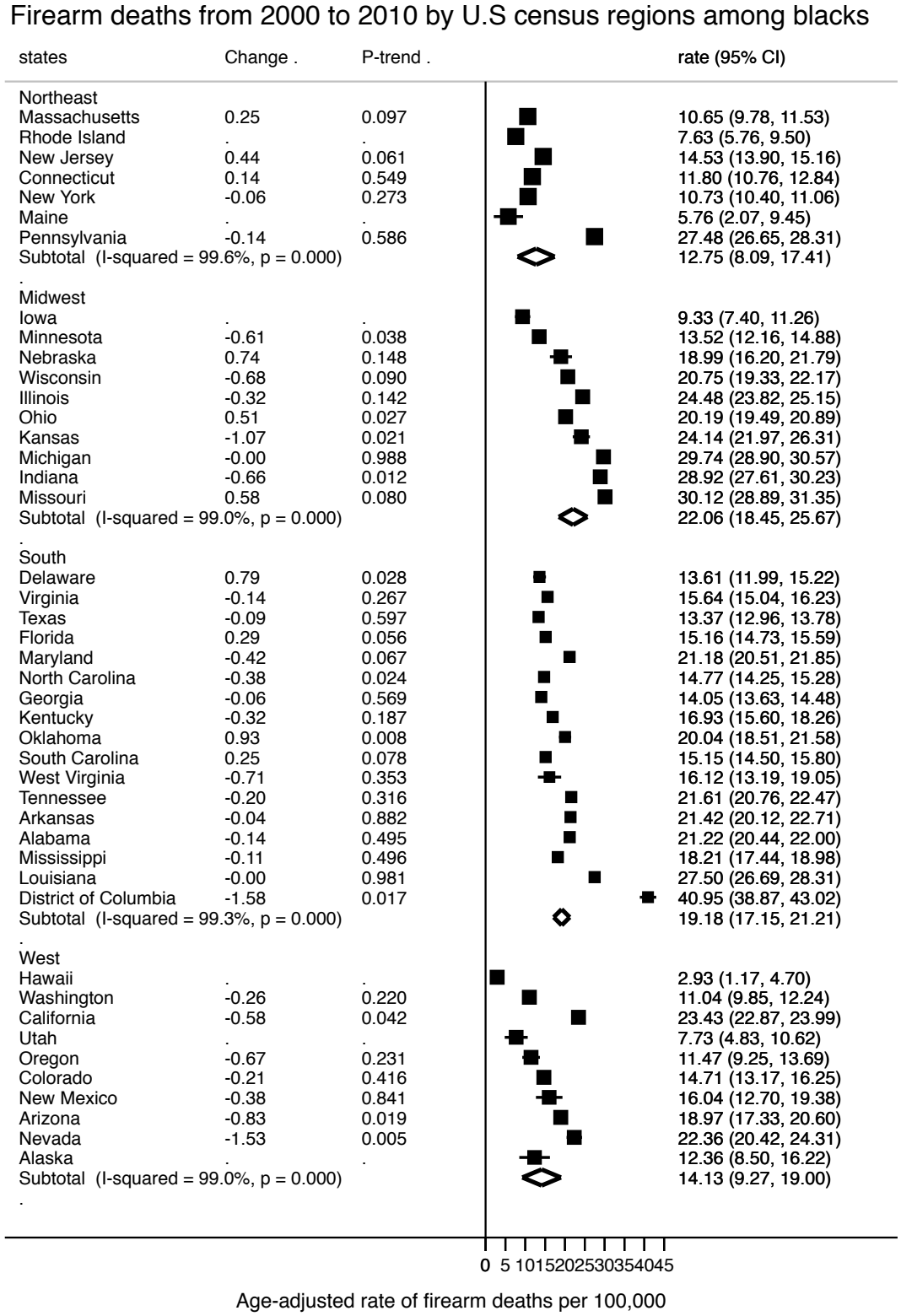
Supplementary Figure 1A:

Firearm deaths from 2000 to 2010 by U.S census regions among whites

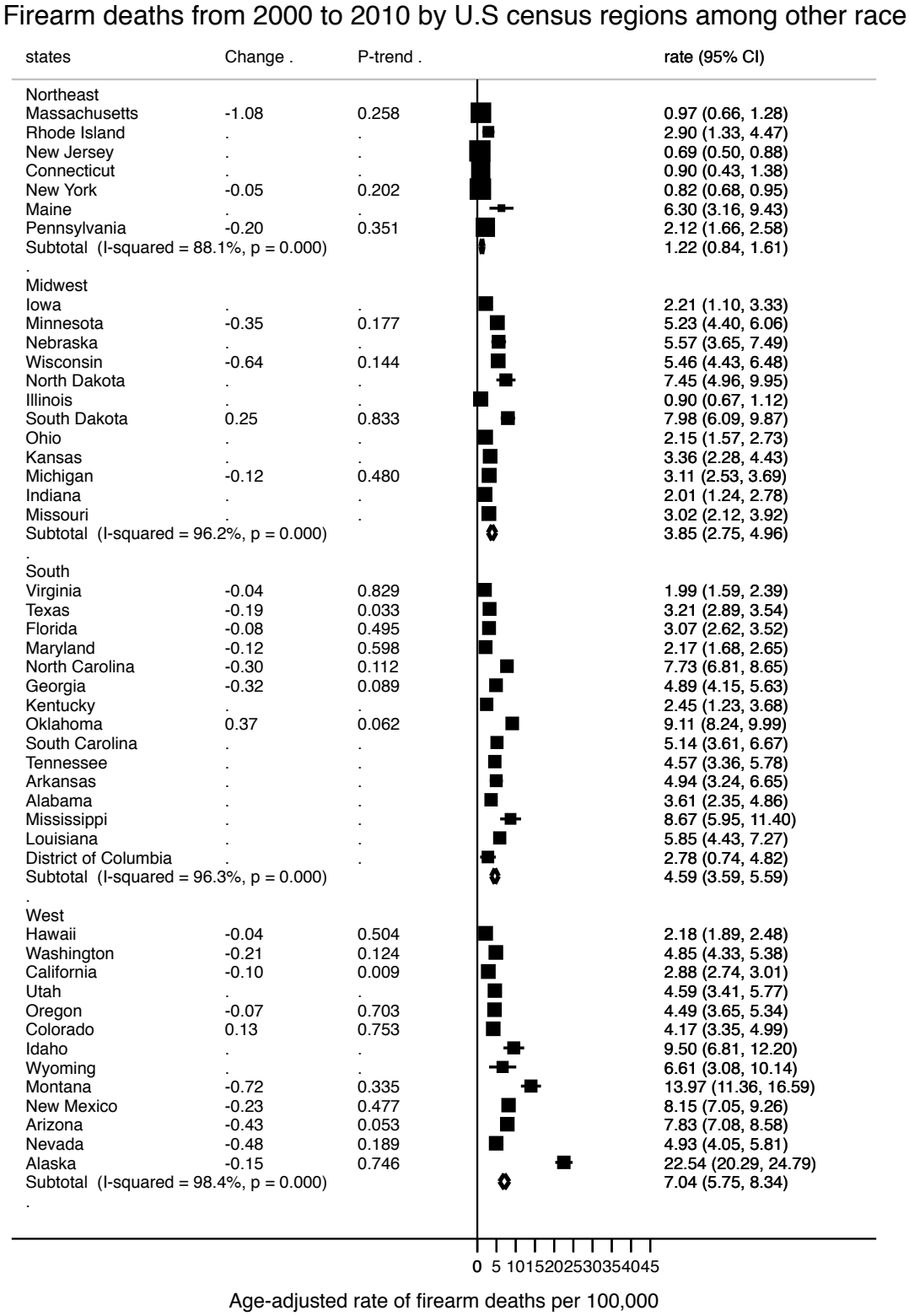
states	Change .	P-trend .	rate (95% CI)
Northeast			
Massachusetts	0.05	0.037	2.57 (2.45, 2.70)
Rhode Island	0.06	0.422	3.80 (3.42, 4.17)
New Jersey	-0.01	0.771	3.23 (3.10, 3.36)
Connecticut	-0.00	0.926	4.06 (3.85, 4.28)
New York	-0.05	0.015	4.05 (3.95, 4.15)
New Hampshire	0.08	0.380	6.61 (6.18, 7.04)
Maine	0.09	0.245	7.61 (7.15, 8.07)
Vermont	0.05	0.681	8.60 (7.90, 9.31)
Pennsylvania	0.06	0.076	7.84 (7.68, 8.00)
Subtotal (I-squared = 99.8%, p = 0.000)			5.36 (4.10, 6.62)
.			
Midwest			
Iowa	-0.02	0.765	6.44 (6.16, 6.72)
Minnesota	0.06	0.115	6.04 (5.83, 6.26)
Nebraska	-0.13	0.083	7.27 (6.87, 7.66)
Wisconsin	0.02	0.597	7.08 (6.86, 7.30)
North Dakota	0.16	0.189	8.25 (7.56, 8.94)
Illinois	-0.12	0.028	5.80 (5.66, 5.94)
South Dakota	0.16	0.274	8.74 (8.07, 9.40)
Ohio	0.04	0.410	7.43 (7.26, 7.59)
Kansas	0.07	0.382	9.46 (9.09, 9.82)
Michigan	0.03	0.383	7.44 (7.26, 7.62)
Indiana	0.01	0.772	9.25 (9.01, 9.49)
Missouri	0.04	0.423	10.30 (10.03, 10.57)
Subtotal (I-squared = 99.3%, p = 0.000)			7.78 (6.98, 8.59)
.			
South			
Delaware	-0.06	0.599	7.39 (6.75, 8.02)
Virginia	-0.01	0.896	9.63 (9.38, 9.87)
Texas	0.03	0.448	10.81 (10.67, 10.95)
Florida	0.12	0.045	10.02 (9.86, 10.18)
Maryland	-0.05	0.290	6.81 (6.55, 7.07)
North Carolina	-0.10	0.032	11.61 (11.36, 11.86)
Georgia	-0.07	0.359	12.16 (11.89, 12.43)
Kentucky	-0.01	0.900	12.70 (12.36, 13.04)
Oklahoma	-0.02	0.736	12.94 (12.55, 13.34)
South Carolina	-0.06	0.394	12.60 (12.21, 12.98)
West Virginia	0.00	0.959	13.54 (13.02, 14.06)
Tennessee	0.03	0.560	13.38 (13.07, 13.69)
Arkansas	-0.02	0.820	14.00 (13.54, 14.47)
Alabama	0.09	0.299	14.49 (14.10, 14.88)
Mississippi	0.07	0.601	15.74 (15.18, 16.29)
Louisiana	0.12	0.109	13.76 (13.35, 14.17)
District of Columbia	-0.03	0.896	3.03 (2.34, 3.73)
Subtotal (I-squared = 99.5%, p = 0.000)			11.45 (10.40, 12.51)
.			
West			
Hawaii	0.03	0.840	4.29 (3.67, 4.91)
Washington	0.01	0.754	8.96 (8.72, 9.20)
California	-0.12	0.001	8.73 (8.62, 8.83)
Utah	0.08	0.342	10.66 (10.26, 11.06)
Oregon	0.01	0.896	10.64 (10.31, 10.98)
Colorado	-0.02	0.802	11.09 (10.78, 11.39)
Idaho	0.10	0.378	12.61 (12.04, 13.18)
Wyoming	0.27	0.285	15.34 (14.31, 16.38)
Montana	-0.02	0.920	14.98 (14.20, 15.76)
New Mexico	-0.16	0.116	15.91 (15.33, 16.49)
Arizona	-0.19	0.081	15.73 (15.40, 16.06)
Nevada	-0.08	0.384	16.30 (15.76, 16.83)
Alaska	0.15	0.560	15.77 (14.70, 16.83)
Subtotal (I-squared = 99.7%, p = 0.000)			12.37 (10.73, 14.01)
.			



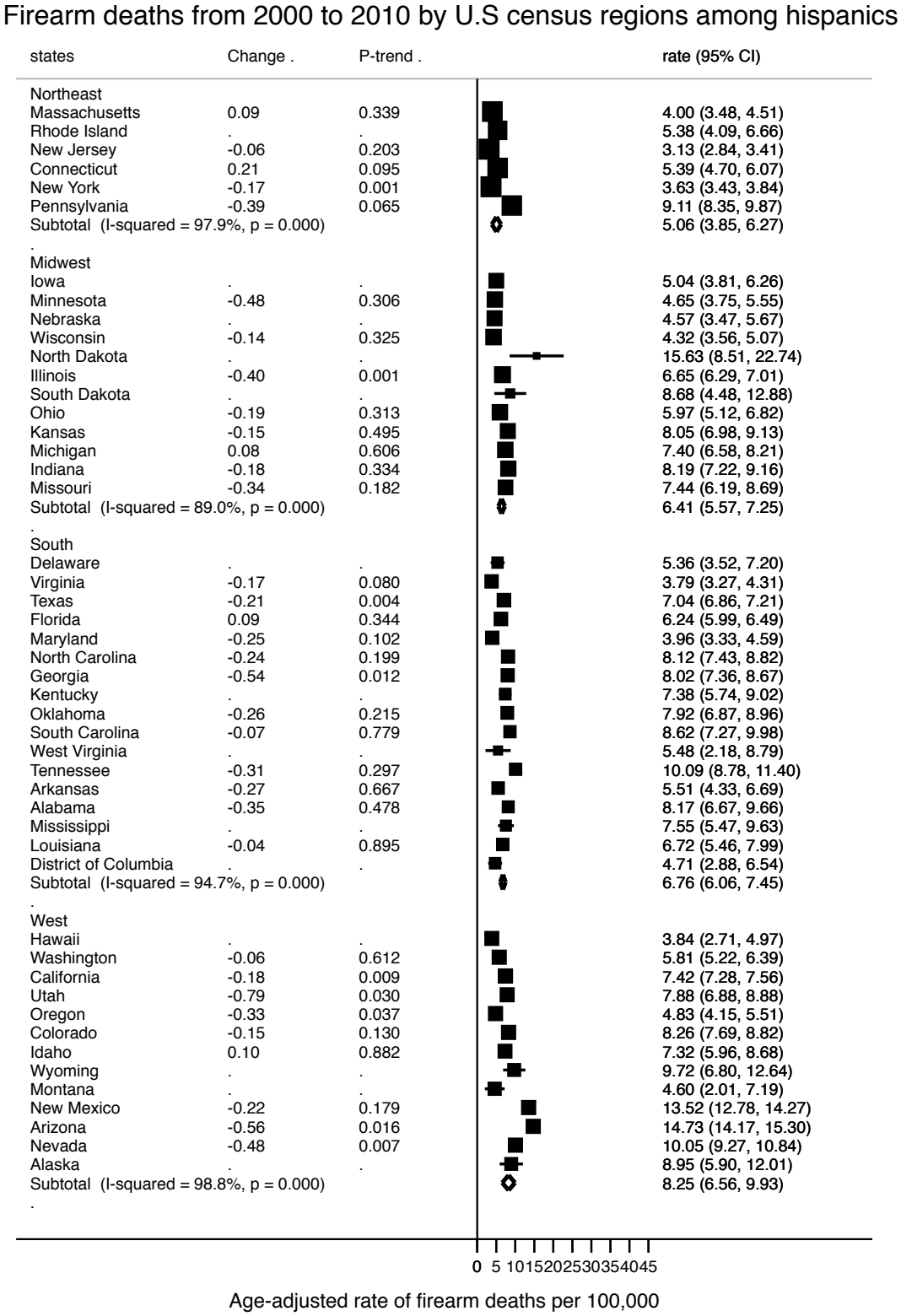
Supplementary Figure 1B:



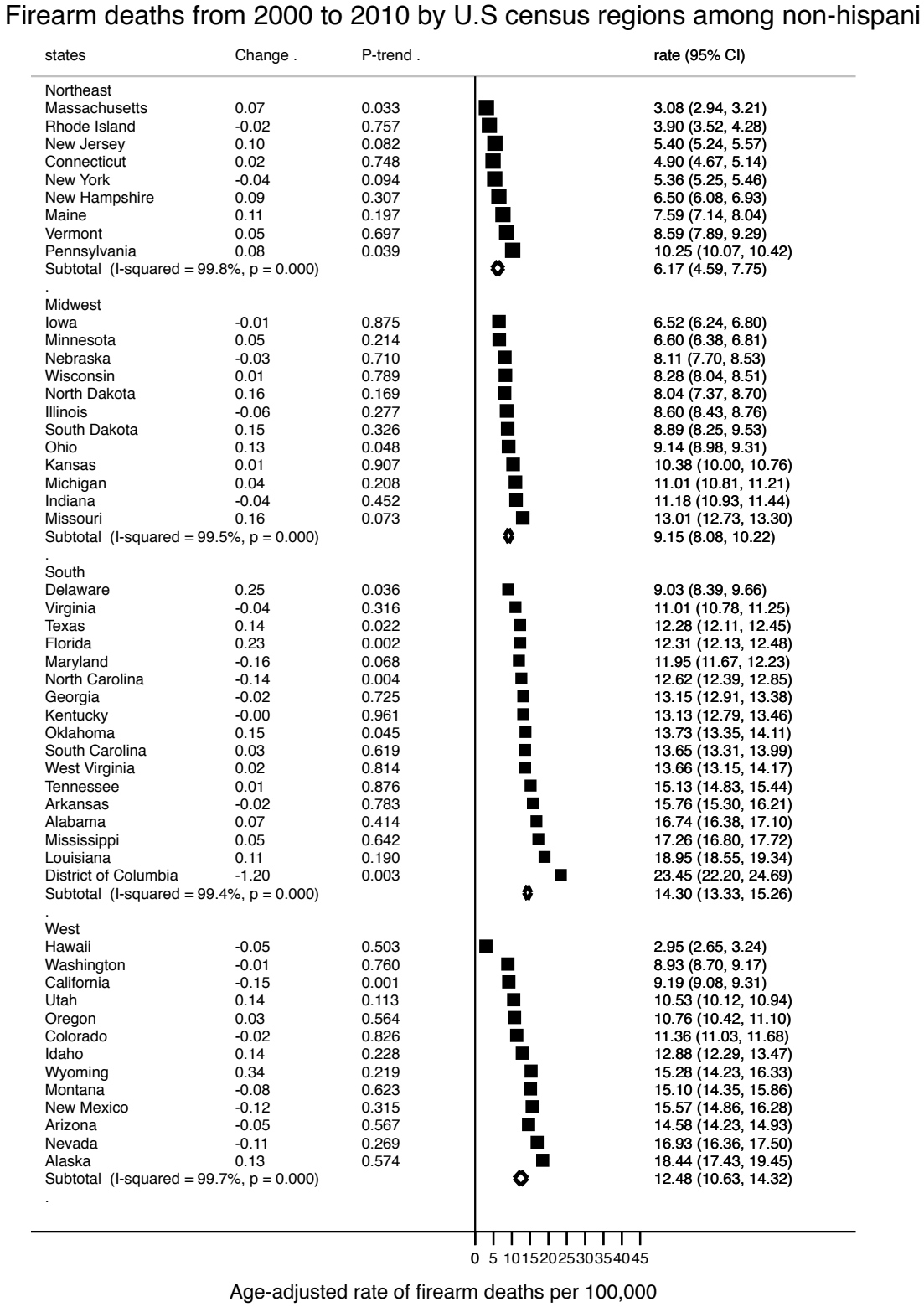
Supplementary Figure 1C



Supplementary Figure 2A:

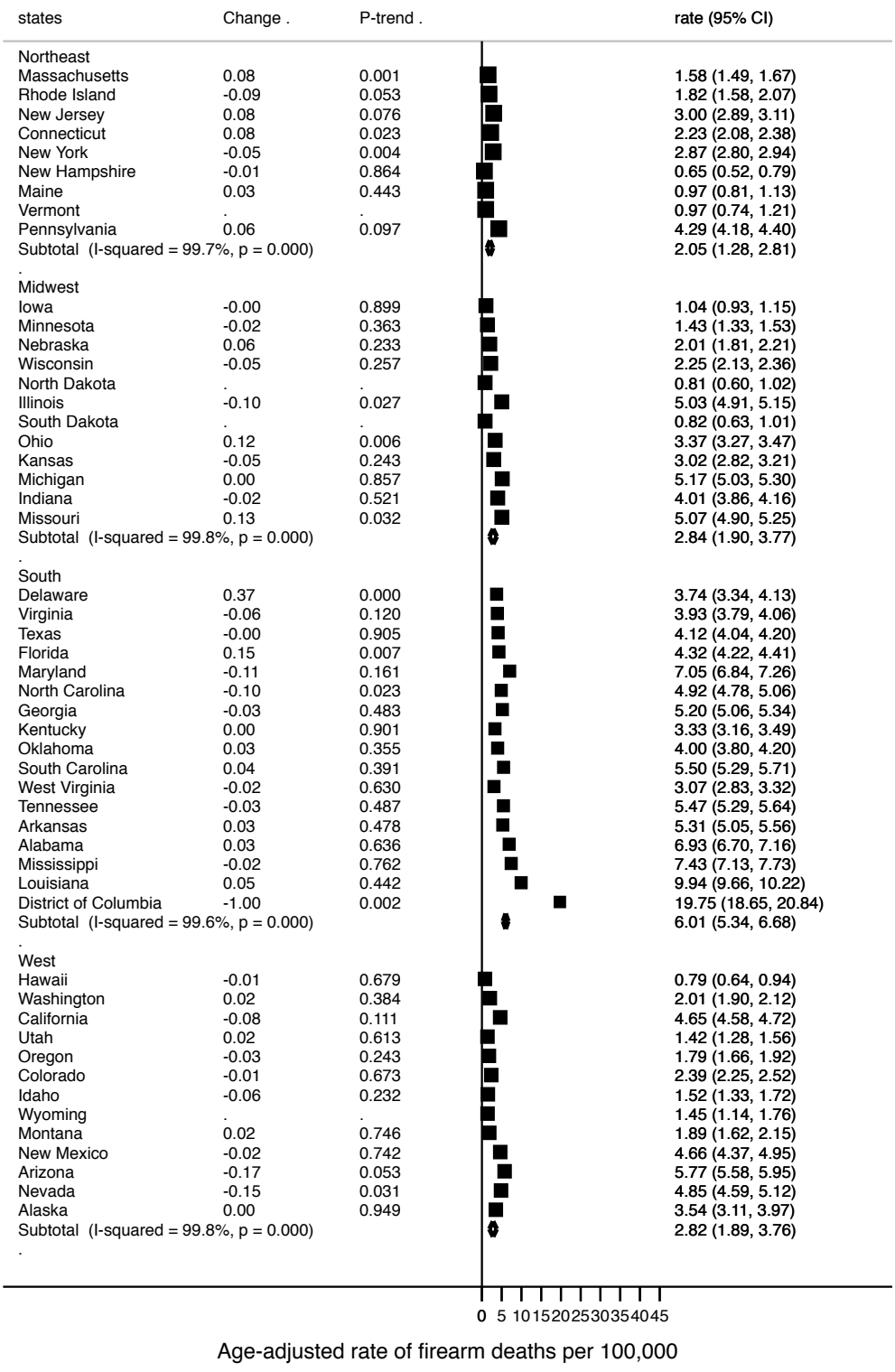


Supplementary Figure 2B:



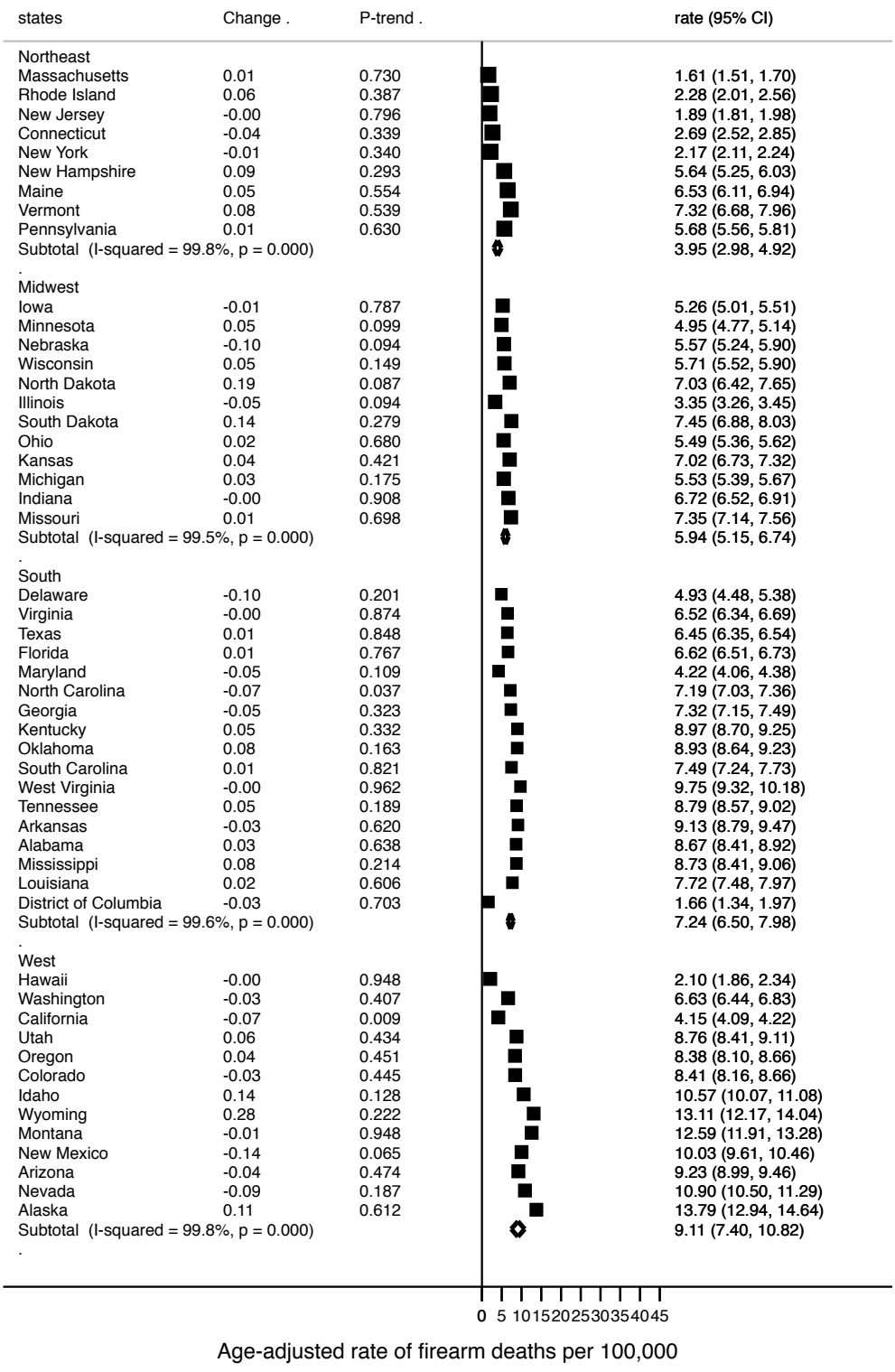
Supplementary Figure 3A:

Firearm deaths due to homicide from 2000 to 2010 by U.S census regions

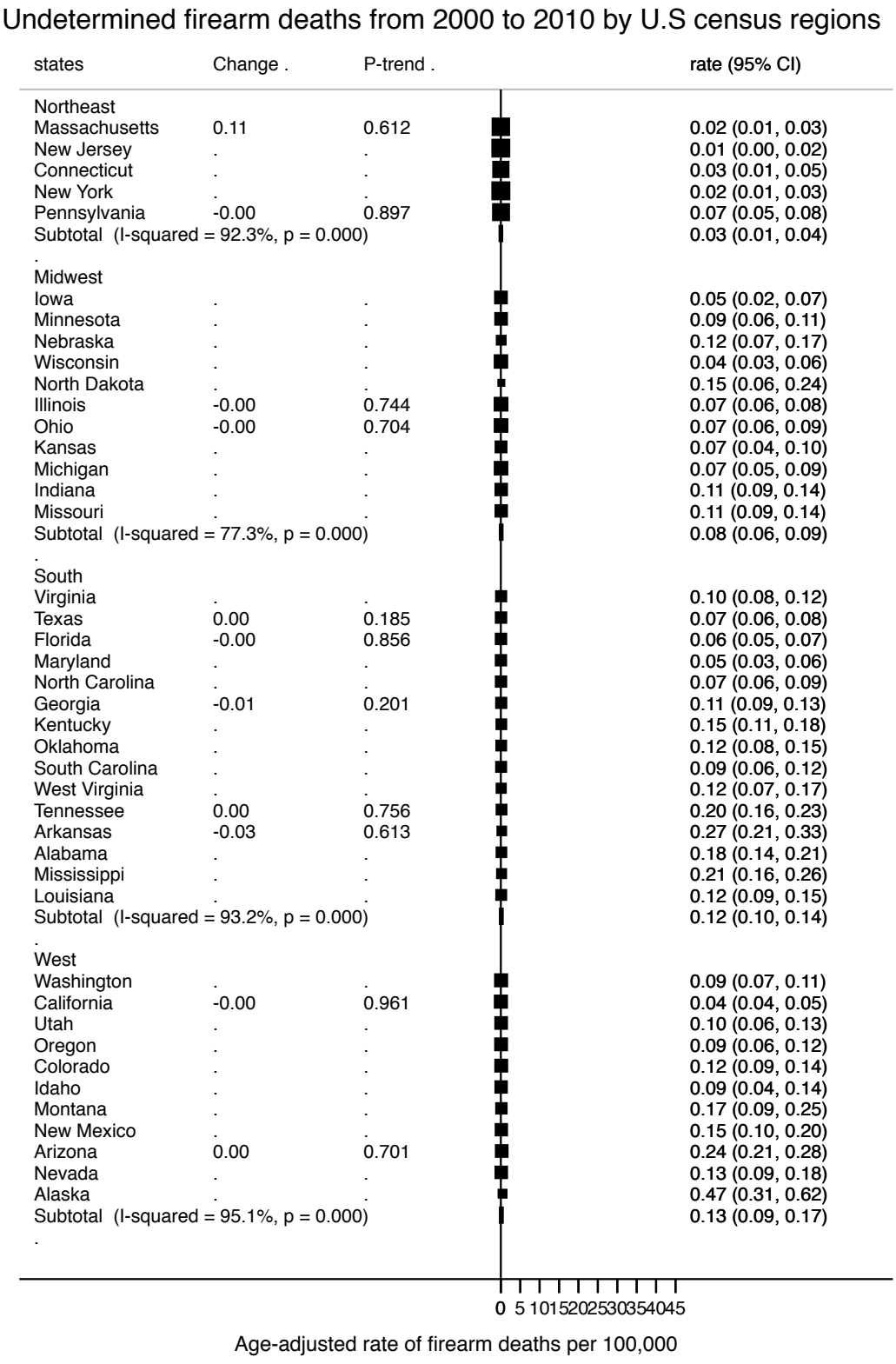


Supplementary Figure 3B:

Firearm deaths due to suicides from 2000 to 2010 by U.S census regions



Supplementary Figure 3C:



Supplementary Figure 3D:

Unintentional firearm deaths from 2000 to 2010 by U.S census regions

states	Change .	P-trend .	rate (95% CI)
Northeast			
Massachusetts	0.00	0.701	0.04 (0.02, 0.05)
New Jersey	-0.00	0.898	0.12 (0.10, 0.14)
Connecticut	.	.	0.09 (0.06, 0.12)
New York	.	.	0.09 (0.08, 0.10)
New Hampshire	.	.	0.15 (0.09, 0.22)
Maine	.	.	0.09 (0.04, 0.14)
Vermont	.	.	0.17 (0.07, 0.27)
Pennsylvania	-0.00	0.865	0.23 (0.20, 0.25)
Subtotal (I-squared = 96.2%, p = 0.000)			0.12 (0.07, 0.16)
.			
Midwest			
Iowa	.	.	0.15 (0.11, 0.19)
Minnesota	.	.	0.09 (0.07, 0.12)
Nebraska	.	.	0.24 (0.17, 0.31)
Wisconsin	-0.01	0.709	0.14 (0.11, 0.17)
North Dakota	.	.	0.23 (0.12, 0.35)
Illinois	0.00	0.507	0.15 (0.13, 0.17)
South Dakota	.	.	0.53 (0.38, 0.68)
Ohio	-0.01	0.022	0.18 (0.15, 0.20)
Kansas	0.00	0.933	0.25 (0.20, 0.31)
Michigan	-0.00	0.617	0.13 (0.11, 0.15)
Indiana	-0.00	0.538	0.30 (0.25, 0.34)
Missouri	-0.01	0.433	0.35 (0.30, 0.39)
Subtotal (I-squared = 94.0%, p = 0.000)			0.21 (0.17, 0.25)
.			
South			
Delaware	.	.	0.15 (0.07, 0.23)
Virginia	-0.01	0.224	0.17 (0.14, 0.20)
Texas	-0.01	0.103	0.25 (0.23, 0.27)
Florida	-0.00	0.268	0.12 (0.11, 0.14)
Maryland	.	.	0.08 (0.06, 0.10)
North Carolina	-0.01	0.119	0.29 (0.26, 0.33)
Georgia	0.01	0.525	0.29 (0.25, 0.32)
Kentucky	-0.06	0.009	0.61 (0.54, 0.68)
Oklahoma	0.00	0.758	0.41 (0.34, 0.47)
South Carolina	-0.02	0.233	0.47 (0.41, 0.53)
West Virginia	0.02	0.512	0.66 (0.55, 0.77)
Tennessee	-0.05	0.002	0.57 (0.51, 0.63)
Arkansas	-0.02	0.124	0.61 (0.52, 0.69)
Alabama	-0.03	0.066	0.76 (0.68, 0.83)
Mississippi	-0.02	0.300	0.69 (0.60, 0.78)
Louisiana	0.00	0.882	0.83 (0.75, 0.91)
District of Columbia	.	.	0.25 (0.13, 0.37)
Subtotal (I-squared = 98.8%, p = 0.000)			0.42 (0.33, 0.51)
.			
West			
Hawaii	.	.	0.08 (0.03, 0.12)
Washington	.	.	0.12 (0.09, 0.14)
California	-0.01	0.110	0.17 (0.16, 0.18)
Utah	.	.	0.11 (0.07, 0.15)
Oregon	.	.	0.19 (0.15, 0.23)
Colorado	.	.	0.14 (0.10, 0.17)
Idaho	.	.	0.37 (0.28, 0.47)
Wyoming	.	.	0.45 (0.28, 0.63)
Montana	.	.	0.46 (0.33, 0.59)
New Mexico	-0.01	0.875	0.38 (0.30, 0.47)
Arizona	.	.	0.23 (0.20, 0.27)
Nevada	.	.	0.19 (0.14, 0.24)
Alaska	.	.	0.29 (0.17, 0.41)
Subtotal (I-squared = 90.8%, p = 0.000)			0.21 (0.17, 0.25)
.			

Age-adjusted rate of firearm deaths per 100,000

Supplementary Table 1: Firearm related trends in death, annual rate of change in death, lives lost and saved in the United States by states, WISQARS 2000 to 2010.

	Age-adjusted firearm deaths per 100,000 population												Change in rate			Lives lost/ saved (-)	
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total	Annual	95% CI	P-trend	11 years	Per year
All	10.14	10.31	10.43	10.29	9.99	10.27	10.22	10.24	10.23	10.05	10.07	10.21	-0.17	-0.044, 0.010	0.181	-5527.8	-502.5
Northeast																	
Massachusetts	2.73	3.00	3.13	3.09	3.16	3.42	3.22	3.55	3.34	3.1	4.03	3.24	0.074	0.025, 0.122	0.008	52.4	4.8
Rhode Island	5.10	4.30	5.14	3.12	3.61	3.60	4.21	3.40	3.94	5.02	4.60	4.18	-0.013	-0.180, 0.155	0.869	-1.5	-0.1
New Jersey	4.11	4.44	4.88	5.42	5.37	5.15	5.82	5.25	4.94	4.70	5.20	5.03	0.063	-0.035, 0.161	0.182	59.8	5.4
Connecticut	5.32	5.63	4.32	4.37	5.00	5.34	4.99	4.15	5.60	4.90	5.85	5.04	0.028	-0.103, 0.159	0.637	10.8	1.0
New York	5.70	5.54	5.13	5.32	4.88	5.21	5.14	5.04	4.90	4.79	5.07	5.15	-0.064	-0.104, -0.023	0.006	-134.9	-12.3
New Hampshire	6.27	7.23	5.91	6.8	5.02	6.62	6.22	5.56	6.86	6.34	8.22	6.49	0.065	-0.126, 0.255	0.461	9.2	0.8
Maine	8.55	7.29	6.63	6.02	7.9	7.71	7.28	7.61	8.42	8.58	7.86	7.61	0.100	-0.077, 0.277	0.232	14.4	1.3
Vermont	8.74	8.20	9.74	7.58	9.41	6.79	8.14	8.08	8.19	8.72	10.21	8.53	0.037	-0.222, 0.296	0.753	2.5	0.2
Pennsylvania	10.15	9.53	9.96	9.87	10.2	10.76	10.9	10.52	10.53	10.41	10.11	10.27	0.064	-0.014, 0.142	0.095	87.8	8.0
Midwest																.	.
Iowa	6.46	6.37	6.73	6.94	6.45	6.71	6.34	4.99	7.25	6.23	6.8	6.5	-0.017	-0.157, 0.124	0.796	-5.6	-0.5
Minnesota	6.34	6.49	6.06	6.5	7.04	6.94	6.3	6.48	6.97	6.17	6.76	6.57	0.024	-0.053, 0.101	0.495	13.5	1.2
Nebraska	9.77	8.12	8.05	7.64	6.71	7.67	7.69	7.95	8.27	7.26	8.16	7.94	-0.071	-0.231, 0.090	0.346	-13.8	-1.3
Wisconsin	7.99	8.70	8.08	8.44	7.37	8.48	7.56	8.54	7.72	7.91	8.57	8.14	-0.008	-0.113, 0.096	0.859	-4.9	-0.4
North Dakota	6.6	7.6	9.12	8.83	7.5	8.9	6.62	8.27	8.51	8.92	9.56	8.23	0.155	-0.086, 0.395	0.180	11.1	1.0
Illinois	9.00	10.21	9.69	9.01	7.8	8.01	8.08	8.03	8.55	8.17	8.19	8.61	-0.155	-0.286, -0.025	0.025	-215.3	-19.6
South Dakota	7.47	7.1	7.91	9.86	9.97	10.2	9.74	6.14	10.5	9.31	9.23	8.89	0.157	-0.168, 0.481	0.304	13.5	1.2
Ohio	7.81	9.00	9.31	8.12	8.97	9.63	9.66	9.55	9.67	8.5	9.95	9.1	0.122	-0.010, 0.253	0.066	153.8	14.0
Kansas	11.15	9.93	9.7	11.13	10.73	9.25	10.84	10.35	9.7	10.76	10.44	10.37	-0.012	-0.158, 0.135	0.860	-3.6	-0.3
Michigan	10.83	10.83	10.99	10.33	10.52	10.78	11.53	11.03	10.96	11.07	10.98	10.9	0.037	-0.034, 0.109	0.271	40.6	3.7
Indiana	10.88	11.82	11.68	11.19	10.22	11.11	11.63	10.5	11.24	11.33	10.82	11.13	-0.031	-0.143, 0.081	0.546	-21.4	-1.9
Missouri	13.24	13.14	12.21	11.42	11.44	12.9	13	12.79	13.74	13.71	13.93	12.88	0.135	-0.036, 0.306	0.108	86.1	7.8
South																.	.
Delaware	6.66	9.47	9.07	7.86	8.78	8.78	9.19	8.91	10.65	8.76	9.88	8.89	0.201	-0.018, 0.419	0.067	18.7	1.7

Virginia	11.13	10.61	11.01	10.86	10.81	11.48	10.36	10.4	10.18	10.28	10.69	10.71	-0.068	-0.149, 0.014	0.092	-56.6	-5.1
Texas	10.57	11.22	10.83	11.21	10.66	11.09	10.47	10.89	10.83	10.98	10.93	10.89	0.001	-0.054, 0.056	0.976	2.5	0.2
Florida	10.19	10.68	10.97	11.05	10.46	9.95	11.05	12.02	12.18	11.98	11.44	11.12	0.160	0.038, 0.282	0.016	310.1	28.2
Maryland	11.91	11.46	11.54	11.96	11.93	11.86	12.1	12.04	11.61	10.19	9.26	11.39	-0.169	-0.335, -0.002	0.048	-103.5	-9.4
North Carolina	13.56	13.06	13.43	12.35	12.21	12.74	12.55	12.17	12.31	11.59	11.57	12.49	-0.174	-0.255, -0.092	0.001	-168.1	-15.3
Georgia	13.4	13.44	13.39	13.72	12.16	12.05	12.54	13.4	12.43	13.06	12.62	12.92	-0.076	-0.197, 0.045	0.189	-75.0	-6.8
Kentucky	13.25	12.69	13.04	13.38	13.04	12.94	12.47	14.11	13.28	12.78	12.48	13.05	-0.020	-0.140, 0.010	0.713	-9.2	-0.8
Oklahoma	13.21	14.01	12.81	12.77	12.86	13.15	13.26	13.18	13.91	14.33	14.31	13.45	0.105	-0.028, 0.238	0.108	41.3	3.8
South Carolina	12.42	13.72	13.69	14.17	13.5	13.75	13.88	13.09	13.17	13.52	13.92	13.55	0.032	-0.088, 0.152	0.561	15.2	1.4
West Virginia	12.99	13.15	14.67	14.01	13.6	13.72	13.32	14.06	12.66	13.21	14.23	13.6	0.002	-0.183, 0.188	0.978	0.4	0.0
Tennessee	15.63	14.47	15.4	14.11	14.54	16.03	15.3	14.74	15.46	15.06	14.42	15.03	-0.013	-0.148, 0.123	0.837	-8.6	-0.8
Arkansas	15.42	15.27	16.29	14.96	14.65	15.62	15.12	15.09	15.6	16.03	14.39	15.31	-0.033	-0.193, 0.126	0.648	-10.1	-0.9
Alabama	17.14	16.41	16.08	16.8	14.79	15.99	16.7	17.24	17.31	17.18	16.18	16.53	0.045	-0.128, 0.217	0.574	22.8	2.1
Mississippi	16.56	17.64	17.34	16.81	16.41	15.98	16.54	18.28	19.25	16.65	16.05	17.06	0.015	-0.209, 0.239	0.883	4.8	0.4
Louisiana	17.58	17.46	19.31	18.61	19.52	18.35	19.02	19.77	18.34	18.03	19.11	18.62	0.082	-0.081, 0.244	0.286	40.4	3.7
District of Columbia	22.24	25.46	29.79	25.71	22.64	23.47	19.99	21.66	20.01	15.96	14.62	21.71	-1.067	-1.621, -0.512	0.002	-67.7	-6.2
West																.	.
Hawaii	4.2	3.74	2.82	2.88	3.1	2.14	2.38	2.44	3.04	3.34	3.21	3.02	-0.057	-0.190, 0.076	0.359	-8.1	-0.7
Washington	8.94	8.53	9.34	9.17	9.17	8.8	8.37	8.32	8.69	9.14	8.92	8.85	-0.018	-0.099, 0.063	0.623	-12.5	-1.1
California	9.27	9.31	9.75	9.78	9.24	9.52	9.15	8.84	8.5	8.17	7.7	9.01	-0.166	-0.249, -0.083	0.001	-652.3	-59.3
Utah	9.93	10.99	9.6	10.51	10.13	9.91	9.75	10.63	9.68	10.46	12.16	10.39	0.081	-0.077, 0.240	0.276	22.1	2.0
Oregon	10.81	10.16	10.49	10.72	10.36	10.68	10.16	9.91	9.73	10.31	11.33	10.44	-0.011	-0.127, 0.106	0.839	-4.4	-0.4
Colorado	10.36	11.68	11.47	11.13	11.96	11.53	10.33	10.38	10.39	11.58	10.72	11.05	-0.045	-0.183, 0.092	0.474	-23.1	-2.1
Idaho	10.19	13.5	12.42	12.33	13.04	13.94	12.69	12.75	11.4	12.85	12.73	12.56	0.077	-0.148, 0.302	0.459	12.1	1.1
Wyoming	11.72	13.91	18.87	17.46	11.15	13.39	14.85	14.66	16.91	17.59	15.54	15.09	0.267	-0.257, 0.791	0.279	15.3	1.4
Montana	14.85	17.77	14.61	15.68	13.05	16.85	12.25	13.54	15.73	16.04	15.56	15.11	-0.040	-0.420, 0.341	0.819	-4.2	-0.4
New Mexico	16.08	15.26	16.61	17.55	15.15	13.89	14.45	14.85	14.68	14.48	14.84	15.23	-0.184	-0.376, 0.008	0.058	-39.2	-3.6
Arizona	15.58	15.92	17.89	15.29	15.84	16	16.22	15.38	14.36	13.49	14.53	15.47	-0.230	-0.423, -0.036	0.025	-147.2	-13.4
Nevada	17.26	16.54	17.06	17.04	16.74	16.09	16.3	15.87	15.15	15.11	14.49	16.07	-0.264	-0.441, -0.086	0.008	-69.9	-6.4

Alaska	17.96	14.83	19.89	19.24	17.51	17.47	16.94	18.22	20.92	14.68	20.51	18.09	0.102	-0.375, 0.580	0.639	7.5	0.7

All values are age-adjusted rates per 100,000 population.
Change denotes annual change in rate per 100,000. Negative value indicates decline in firearm death rates per 100,000 from 2000 to 2010 and positive value indicates increase in firearm death rate per 100,000 from 2000 to 2010.
CI denotes confidence intervals of the annual change in firearm death rate per 100,000.
P-trend calculated using meta-regression indicates the significance of the decline or the increase in firearm related death rates from 2000 to 2010.
Lives lost or saved are calculated by applying annual change to the total 11-year population from 2000 to 2010. The annual lives lost or saved are the total/ 11 years. Negative denotes lives saved and positive values are lives lost.
Data are from Center for Disease Control and Prevention (CDC)'s National center for Injury Prevention and Control Web-based Injury Statistics Query and Reporting System (WISQARS).

Supplementary Table 2: US states with significant racial and ethnic trends within firearm fatality rates

		GA	IN	KA	MN	OK	OR	PA	TX	UT
Overall	FRF rate	12.92	11.13	10.37	6.57	13.45	10.44	10.27	10.89	10.39
	Change	-0.08	-0.03	-0.01	0.02	0.11	-0.01	0.06	0.001	0.08
	P-trend	0.19	0.55	0.86	0.49	0.11	0.84	0.095	0.98	0.28
Whites	FRF rate	12.16	9.25	9.46	6.04	12.94	10.64	7.84	10.81	10.66
	Change	-0.07	0.01	0.07	0.06	-0.02	0.01	0.06	0.03	0.08
	P-trend	0.36	0.77	0.38	0.12	0.74	0.89	0.076	0.45	0.34
	Pop % change	-3.8	-2.0	-1.7	-3.3	-2.2	-2.0	-2.6	-2.3	-1.4
Blacks	FRF rate	14.05	28.92	24.14	13.52	20.04	11.47	27.48	13.37	7.73
	Change	-0.06	**-0.66**	**-1.07**	**-0.61**	**0.93**	-0.67	-0.14	-0.09	ne
	P-trend	0.57	**0.012**	**0.021**	**0.038**	**0.008**	0.23	0.59	0.60	ne
	Pop % change	2.3	1.2	0.6	1.9	0.4	0.4	1.3	0.6	0.5
Other	FRF rate	4.89	2.01	3.36	5.23	9.11	4.49	2.12	3.21	4.59
	Change	-0.32	ne	ne	-0.35	**0.37**	-0.07	-0.20	**-0.19**	ne
	P-trend	0.089	ne	ne	0.18	**0.062**	0.70	0.35	**0.033**	ne
	Pop % change	1.5	0.8	1.0	1.4	1.8	1.5	1.2	1.7	0.9
Hispanic	FRF rate	8.02	8.19	8.05	4.65	7.92	4.83	9.11	7.04	7.88
	Change	**-0.54**	-0.18	-0.15	-0.48	-0.26	**-0.33**	**-0.39**	**-0.21**	**-0.79**
	P-trend	**0.012**	0.33	0.49	0.31	0.21	**0.037**	**0.065**	**0.004**	**0.030**
	Pop % change	3.5	2.5	3.5	1.8	3.7	3.7	2.5	5.6	3.9
Non-Hispanic	FRF rate	13.15	11.18	10.38	6.60	13.73	10.76	10.25	12.28	10.53
	Change	-0.02	-0.04	0.01	0.05	**0.15**	0.03	**0.08**	**0.14**	**-0.15**
	P-trend	0.73	0.45	0.91	0.21	**0.045**	0.56	**0.039**	**0.022**	**0.001**
	Pop % change	-3.5	-2.5	-3.5	-1.8	-3.7	-3.7	-2.5	-5.6	-3.9
Intent	Homicide	↔	↔	↔	↔	↔	↔	↔	↔	↔
	Suicides	↔	↔	↔	↔	↔	↔	↔	↔	↔
	Undetermined	↔	ne	ne	ne	ne	ne	↔	↔	ne
	Unintentional	↔	↔	↔	ne	↔	ne	↔	↔	ne

FRF: firearm related fatality, Pop % change: change in population percentage from 2000 to 2010. All values are age-adjusted rates per 100,000 population. Change denotes annual change in rate per 100,000. Negative value indicates decline in firearm death rates per 100,000 from 2000 to 2010 and positive value indicates increase in firearm death rate per 100,000 from 2000 to 2010. CI denotes confidence intervals of the annual change in firearm death rate per 100,000. SMD indicates standardized mean difference; is equal to annual change/standard deviation. P-trend calculated using meta-regression indicates the significance of the decline or the increase in firearm related death rates from 2000 to 2010.Data are from Center for Disease Control and Prevention (CDC)'s National center for Injury Prevention and Control Web-based Injury Statistics Query and Reporting System (WISQARS)

STROBE 2007 (v4) checklist of items to be included in reports of observational studies in epidemiology*

Checklist for cohort, case-control, and cross-sectional studies (combined)

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	3
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5
Objectives	3	State specific objectives, including any pre-specified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	6
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*6*
Bias	9	Describe any efforts to address potential sources of bias	16-17
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7
		(*b*) Describe any methods used to examine subgroups and interactions	7
		(*c*) Explain how missing data were addressed	na
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed	7

		Cross-sectional study—If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	na
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	na
		(c) Consider use of a flow diagram	na
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	na
		(b) Indicate number of participants with missing data for each variable of interest	na
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	na
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	na
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	na
		Cross-sectional study—Report numbers of outcome events or summary measures	8-11
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-11
		(*b*) Report category boundaries when continuous variables were categorized	na
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	na
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	8-11
Discussion			
Key results	18	Summarise key results with reference to study objectives	12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	16-17
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12-16
Generalisability	21	Discuss the generalisability (external validity) of the study results	na
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	na

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.
Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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State-specific, racial and ethnic heterogeneity in trends of firearm-related fatality rates in the United States from 2000-2010

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Title: State-specific, racial and ethnic heterogeneity in trends of firearm-related fatality rates in the United States from 2000-2010

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Abstract:

Objectives: To document overall, racial, ethnic and intent-specific spatio-temporal trends of firearm related fatality rates (FRF-rate) in the United States.

Design: Cross-sectional study per year from 2000 to 2010.

Setting: United States.

Participants: Aggregate count of all people in the US from 2000 to 2010.

Outcome measures: Data from the Web-based Injury Statistics Query and Reporting System from 2000-2010 was used to determine annual FRF-rates per 100,000 and by states, race, ethnicity and intent.

Results: The average national 11-year FRF-rate was 10.21 per 100,000, from 3.02 to in Hawaii to 18.62 in Louisiana: 60% of states had higher than national rates and 41 states showed no temporal change. The average national FRF-rates among blacks and whites were 18.51 and 9.05 per 100,000 and among Hispanics and non-Hispanics were 7.13 and 10.13 per 100,000; Hispanics had a decreasing change of -0.18, p-trend<0.0001. In states with increasing trends (Florida and Massachusetts), whites and non-Hispanics drove the rise; while in states with decreasing trends (California, North Carolina, Arizona, Nevada, New York, Illinois, Maryland), Hispanics and blacks drove the fall. The average national FRF-rates due to homicides (4.1 per 100,000) and suicides (5.8 per 100,000) remained constant, but varied between states.

Conclusion: Endemic national FRF-rates mask a wide variation in time trends between states. FRF-rates were twice as high in blacks than whites but decreased

among Hispanics. Efforts to identify state-specific best practices can contribute to changes in national FRF-rates that remain high.

Strengths of this study

- This study uses the best available data reporting system for surveillance of firearm mortality in US.
- Brings into light the overall state-specific variability of temporal trends of firearm mortality, which was obscured by the endemic national firearm fatality rates during 2000-2010 and according to race, ethnicity and intent from a seemingly stable national burden of firearm deaths.
- This is the first report that documents firearm fatality trends by ethnicity
- Our results call for identification of drivers of state-specific temporal trends to introduce tailored programs targeted to reduce deaths and injury due to firearms.

Limitations of this study

- Possible under reporting of firearm fatal events, which cannot be verified.
- Despite the considerable state-specific heterogeneity, the actual variation in firearm mortality may be a feature of cities and counties with varying crime rates, and we do not address the variation existing at such level.
- Finally, comparisons made between other races may not be usefully interpreted due to the heterogeneity and the small frequency of events in this sub-population.

Firearm violence increased during the 1980s and peaked in 1993, with 39,595 firearm deaths in the US and a firearm-related fatality rate (FRF-rate) of 15.0 per 100,000.[1] Since the turn of the 21st century, FRF-rates in the US have become endemic around 10.3 per 100,000 accounting for 17.5% of all injury deaths,[2] while the intent of firearm deaths was mainly suicide and homicide.[3]

The FRF-rate in 1993 among blacks was three-times greater than whites, but similar among Hispanics and non-Hispanics.[1 4] The overall fall in FRF after 2000 corresponded to a related narrowing of the racial gap between blacks and whites, where, by 2010, the FRF-rates among blacks was twice greater than whites.[1] Several factors have been posited that might explain these persistent racial differences, including socioeconomic determinants and increased firearm availability.[5 6]

Although the national temporal trends in FRF have been previously well documented,[3 7 8] there is ample reason to suspect substantial heterogeneity in FRF across states, such as dramatic differences in gun laws controlling access to firearms, variability in enforcement of national standards across states,[8 9] changing demographics and violence.[10] It is likely that some of the state-to-state heterogeneity in the potential determinants of FRF may also contribute to variability in racial and ethnic differences in FRF within states.

With this in mind, this study had two distinct aims. First, we aimed to document national and state-specific trends in FRF-rates along with the annual change in FRF-rates from 2000-2010 and second, to determine the racial, ethnic and intent-specific differences in FRF-rates within each state during the same time period.

METHODS

Data source

We accessed the restricted fatal injury data reports from the Web-based Injury Statistics Query and Reporting System (WISQARS™), an interactive database system provided by Centers for Disease Control and Prevention's (CDC) Injury Prevention and Control Unit (http://www.cdc.gov/injury/wisqars/).[1] The data in the WISQARS system is derived from CDC annual mortality data from National Vital Statistics System (NVSS), National Center for Health Statistics (NCHS) (http://www.cdc.gov/nchs/) and CDC. The NCHS and the National Association of Public Health Statistics and Information Systems restricts reporting NVSS data for cumulative frequencies <10 for sub-national geographic areas to prevent unintentional disclosure of cases. International Classification of Disease-10th Revision (ICD-10) was used for coding mortality data including intent of injury.[11]

Study population and variables

Our study population consisted of national and state-specific fatal firearm injuries from 2000-2010 obtained from querying the WISQARS data system. Aggregate information such as number of firearm deaths, total population and age-adjusted rates according to race (black, white, other), ethnicity (Hispanic and non-Hispanic) and intent (homicide/legal intervention, suicide, undetermined and unintentional) was obtained.

Statistical analysis

The standard errors (SE) for national and state-specific age-adjusted FRF-rates per 100,000 persons were derived for the overall 11-year period and annually and by race, ethnicity and intent. Age-adjusted rates are obtained by direct standardization using the 2000 population. The overall 11-year rates were assessed as total firearm deaths over the total population during the 11-years. Since only aggregate data could be obtained from WISQARS without individual patient data, we used random effects meta-analysis and meta-regression.[12] The rates in each category and the SEs were meta-analyzed using random-effects meta-analysis. Heterogeneity between states was assessed using I^2 statistic; which ranges from 0 to 100% and denotes the proportion of variation across states other than by chance.[13] [14] In order to assess the temporal trends from 2000-2010, we assumed linear trends across 11 years and used meta-regression to calculate the change in rates (slope) and the standard deviation (SD). The p-value from meta-regression was used to assess evidence for trend. Standardized mean difference (SMD) was calculated by dividing the annual change in age-adjusted rate by SD.[15] [16] We do not present estimates for those states with number of deaths below 10. Lives-lost or saved are estimated by applying annual change to the total 11-year population (2000-2010). The difference between 11-year national and state-specific FRF-rates (overall and category-specific) were used to spatially represent the variation between states. STATA 13.1 (StataCorp LP, College Station, Texas; 2009) was used to analyze the data.

RESULTS

Between 2000 and 2010, a total of 335,609 firearm-related deaths were recorded and the overall mortality rate was 10.21 per 100,000. The annual change in FRF-rate across 11-years was -0.017 with a 95% confidence interval (95% CI) of -0.044-0.010, p-trend=0.18, indicating no significant change in national FRF-rates. **Table 1** presents national FRF-rates, for 11-years and annually according to race, ethnicity and intent. Cumulative 11-year FRF-rates were disproportionally high among blacks (18.51) as compared to whites and other race groups, and lowest among other races (3.38). Among whites the FRF-rates were lower than the overall national 11-year rate while increasing from 8.97 to 9.20 from 2000-2010. This annual increase was small (0.006, SMD=0.11) but not significant, p-trend=0.71. Even though the FRF-rates among blacks were consistently higher than national FRF-rates, the annual rates reduced from 18.30 to 16.90; and this decline, -0.114 was not significant, SMD=-0.40, p-trend=0.22. The decline in FRF-rates from 4.76 to 3.25 among other races was significant (change=-0.12, SMD=-1.83, p-trend<0.0001). Annual reduction observed among Hispanics showed a significant reduction, -0.179, p-trend<0.0001 alongside an already low 11-year FRF-rate of 7.13. FRF-rates among non-Hispanics remained slightly above the national rates without increase. FRF-rate by intent was highest for suicides (5.80) while the annual change was minimal in all four categories with a small significant reduction for unintentional deaths (change=-0.010, SMD=-1.70, p-trend<0.0001).

State-specific 11-year FRF-rates are represented in **Figure 1** and **Supplementary Table 1**. Hawaii (HI) (3.02) and Massachusetts (MA) (3.24) had the lowest 11-year FRF-rates, while Louisiana (LA) had the highest at 18.62. DC and 7 states showed a significant declining trend in FRF-rate, while MA and FL documented a significant increase. District of Columbia (DC) had the largest significant annual reduction at -1.067 (6.2 lives-saved per year, p-trend = 0.002) though it had the highest rate of 21.71. Although MA had a low FRF-rate, a significant increase was observed, change=0.074, p-trend=0.008. Florida (FL) also showed an increase, change=0.160, 28.2 lives-lost per year, p-trend=0.016. FRF-rates for Delaware (DL) and Ohio (OH) were 8.89 and 9.10, with a near significant increasing trend, changes of 0.20 and 0.12. FRF-rate in New York (NY) was 5.15 with a change=-0.064, 12.3 lives-saved per year, p-trend=0.006. Illinois (IL) had a significant reduction, change=-0.155, 19.6 lives-saved per year, p-trend=0.025). FRF-rates in CA was -0.166 (59.3 lives-saved per year, p-trend=0.001), Arizona (AZ) at -0.230 (13.4 lives-saved per year, p-trend=0.025) and Nevada (NV) at -0.264 (6.4 lives-saved per year, p-trend = 0.008). Maryland (MA) and North Carolina (NC) had a significant decline: change=-0.169, 9.4 lives-saved per year, p-trend=0.048 and -0.174, 15.3 lives-saved per year, p-trend=0.001).

The 11-year FRF-rates for each state by race are presented in **Figures 2A to 2C** and **Supplementary Figures 1A-C**. Among whites, the lowest rate was in MA with a significant increase from 2000-2010 (change=0.05, p-trend=0.037). FL also recorded a significant increase (change=0.12, p-trend=0.045) but had high 11-year

FRF-rate, 10.02. NV recorded the highest and unchanging FRF-rate at 16.30. The four states that showed a significant declining trend from 2000-2010 were NY (change=-0.05, p-trend=0.015), IL (change=-0.12, p-trend=0.028), NC (change=-0.10, p-trend=0.032), and CA (change=-0.12, p-trend=0.001). Among blacks, HI had the lowest 11-year FRF-rates at 2.93 while Missouri (MO) had the highest at 30.12 and DC was at 40.95. Oklahoma (OK), OH and DL had high 11-year rates at 20.04, 20.19 and 13.61 respectively with a significant increasing changes of 0.93, 0.51 and 0.79, p-trends of 0.008, 0.027 and 0.028 respectively. A declining trend was observed among blacks in CA (change=-0.58, p-trend=0.042), AZ (change=-0.83, p-trend=0.019), NV (change=-1.53, p-trend=0.005), NC (change=-0.38, p-trend=0.024), Indiana (IN) (change=-0.66, p-trend=0.012), Kansas (KA) (change=-1.07, p-trend=0.021), Minnesota (MN) (change=-0.61, p-trend=0.038), and DC (change=-1.58, p-trend=0.017), even though their 11-year FRF-rates were high. Among other races, Texas (TX) (change=-0.19, p-trend=0.033) and CA (change=-0.10, p-trend=0.009) showed a significant decline.

Figures 3A-B and **Supplementary Figures 3A-B** presents the 11-year FRF-rates for each state by ethnicity. Georgia (GA) (change=-0.54, p-trend=0.012), CA (change=-0.18, p-trend=0.009), Utah (UT) (change=-0.79, p-trend=0.030), AZ (change=-0.56, p-trend=0.016), and NV (change=-0.48, p-trend=0.007) were five high-FRF-rate states (>7.13) while NY (change=-0.17, p-trend=0.001), IL (change=-0.40, p-trend=0.001), TX (change=-0.21, p-trend=0.004), and Oregon (OR) (change=-0.33, p-trend=0.037) were the four low-FRF-rate states with a significant

declining trend among Hispanics. No states demonstrated an increase among Hispanics, while non-Hispanics showed a significant increasing trend in MA (change=0.07, p-trend=0.033), Pennsylvania (PA) (change=0.08, p-trend=0.039), OH (change=0.13, p-trend=0.048), DL (change=0.25, p-trend=0.036), TX (change=0.14, p-trend=0.022), FL (change=0.23, p-trend=0.002) and OK (change=0.15, p-trend=0.045). A declining trend in non-Hispanics was observed in MD (change=-0.16, p-trend=0.068), NC (change=-0.14, p-trend=0.004) and CA (change=-0.15, p-trend=0.001). In TX, the FRF-rates among Hispanics (change=-0.21, p-trend=0.004) demonstrated a significant decline and a significant increase among non-Hispanics (change=0.14, p-trend=0.022) (**Supplementary Table 2**).

FRF-rates from 2000-2010 and by intent is provided in **Figures 4A-D** and **Supplementary Figures 4A-D**. Most of the northern states had low (<3.73) homicide-FRF while southern states had high FRF. NY (change=-0.05, p-trend=0.004), IL (change=-0.10, p-trend=0.027), NC (change=-0.10, p-trend=0.023), NV (change=-0.15, p-trend=0.031) and DC (change=-1.0, p-trend=0.002) had significant declining trends while MA (change=0.08, p-trend=0.001), Connecticut (CT) (change=0.08, p-trend=0.023), OH (change=0.12, p-trend=0.006), DL (change=0.37, p-trend<0.0001) and FL (change=0.15, p-trend=0.007) had increasing homicide-FRF. A majority of the states had suicide-FRF-rates >5.80; CA (change=-0.07, p-trend=0.009) and NC (change=-0.07, p-trend=0.037) had declining trends. Unintentional-FRF-rates showed a significant decreasing trend in three

states, OH (change=-0.01, p-trend=0.022), Kentucky (KY) (change=-0.06, p-trend=0.009), and Tennessee (TN) (change=-0.05, p-trend=0.002).

DISCUSSION

National 11-year FRF-rate from 2000-2010 was 10.21, was almost three times higher than Switzerland and Finland.[17] There were four main observations that emerge from this analysis. First, while overall, blacks had higher national rates than whites and Hispanics had lower national rates than non-Hispanics, the 11-year FRF-rates declined among Hispanics and non-white non-black races with no significant change observed among whites, blacks or non-Hispanics. Second, a substantial inter-state heterogeneity was evidenced by 11-year state-specific FRF-rates being as low as 3.02 in HI to as high as 21.71 in DC. FL and MA recorded an upward FRF trend while AZ, CA, IL, MD, NV, NY, NC and DC had declining FRF-rates during the study period. Third, racial and ethnic variation was shown to drive many of the state-specific variations. Fourth, changes in different FRF-intent also drove many of the state-specific differences.

Firearm deaths increased from 28,663 in 2000 to 31,672 in 2010, about 30,509 deaths per year and no change in rate. These findings are similar to a report by the Bureau of Justice of a rapid decline in firearm homicides from 1993 to 1999 followed by a leveling of rates from 2000-2011.[18] It is important to bear in mind that these endemic conditions are associated with substantial, long-term cumulative health burden associated with firearm death throughout the US.[19] During 2000-2011 there were 306,946 firearm related deaths. With the endemic annual FRF-rate of 10.3, US-population at 338 million by 2020[20] and 10% decadal population

increase, we estimate 336,778 firearm related deaths to occur between 2011 and 2020.

The 11-year FRF-rates we report among blacks was twice greater than that of whites and six-times greater than that of other races is in line with reports showing disproportionately larger firearm fatality and injury rates than whites and other race.[3 21 22] Although there was a plateau of the national FRF-rates, rates among Hispanics and non-white non-black races declined and may be explained by the lack of access to firearms or low firearm ownership among Hispanics and other races.[23] Our results explain the report where Hispanics were least likely to use firearms for suicides albeit being more likely to self-injury than any other race groups.[24] Data from 1981-2010 found that among youths a decline in homicide rates for blacks between was significantly slower than the declines for Hispanics and other racial and ethnic groups[25], suggestive of lower crime.

We found 41 states with no FRF-rate change, while 7 states and DC demonstrated either a significant decline or increase. MA and FL recorded a significant increase, MA with smallest and FL with largest annual increase while MA had the lowest 11-year FRF-rate. The Brady Center to Prevent Gun Violence [9] firearm legislative strength score for 2013, has MA to be third with score of 65 among all states in restrictive firearm legislation, while FL has a score of 3. After MA passed the toughest firearm-control legislation in 1998, firearm ownership rates plummeted but violent crimes (476.1 to 468.9) and homicides (2.2 to 3.3) rose.[26]

The significant FRF-rate increase in MA may be explained by the influx of firearms from the two neighboring states (Maine and New Hampshire) with weak firearm control legislation.[27] FL is a "shall-issue", weak legislature state with just 2 laws to prevent illegal gun-trafficking.[27] "Shall-issue" jurisdiction requires a license to carry a concealed firearm, where the license must be issued if the subject meets determinate criteria in the law and the issuing authority has no discretion to reject.[28] In contrast to the increasing FRF-rates, the aggregate violent crimes in FL declined from 801.1 to 542.9,[29] emphasizing a particularly concerning public health problem of increasing gun violence even in a climate of reducing violence.

CA, NY, IL, AZ, NV, MD, NC, and DC had declining trends but the most marked reduction was observed in CA and may be directly linked to strength of firearm legislature, a score of 81.[9] CA has eight state laws to prevent illegal gun trafficking[27] and a reduction in homicide crime rate in CA by 25.4% from 2001-2010.[30] An emergency department study from 2004-2008 reporting reduction of firearm death rate in CA echoing the results of our study.[31] NY and IL had similar trend profiles and an overall decline in FRF-rates, but the Brady scores were 62 and 35[9] with 10 and 8 policies preventing illegal firearm trafficking respectively.[27] FRF-rate reduction in AZ and NV is in contrast to CA and NY, having no laws preventing illegal gun trafficking,[27] with Brady scores 0 and 5 respectively.[9] In AZ violent crime rate dropped from 544.5 offenses in 2002 to 372.2 in 2010,[32 33] and NV had reductions in index crimes.[34] This reduction and our results may be attributed to policing strategies.[35] Our reported reduction in firearm death rates in DC may be attributed

to 9 laws preventing illegal gun trafficking.[27] Firearm policies are not stringent in NC, strength of firearm legislature being 16[9] with only 5 illegal gun trafficking laws.[27] However, the violent crime rate in NC dropped from 493 to 363 from 2000-2010,[36] suggesting that the factors that led to reduction in crime rates may have also driven FRF-rate reduction.

We found that the state-specific increasing trend in FL was driven by an increase among whites, blacks and non-Hispanics and can be explained by violent crime rates in FL which ranks 4th in violent crime.[37] The racial gap in arrests for major crimes widened in FL from 2000-2010: 6,175 blacks and 6,071 whites were arrested in 2000 to 2,398 and 3,192 in 2010.[38] The increase in FRF-rates in MA driven by whites and non-Hispanics is in contrast to the racial differences observed in violent deaths with non-Hispanic blacks having the highest rate of 21.6 as compared to 4.9 among whites.[39] MA has relatively low violent crime rate (ranks 20th in US),[37] and stringent firearm control.[9] Even though nationally no significant reduction in FRF-rates among blacks was observed in our study, FRF-rates among blacks drove the state-specific declines in AZ, NV, CA, NC and DC. Declining trends among Hispanics in AZ, NV, CA, NY and IL contributing to state-specific declines may be due to a combination of low firearm ownership[23] and racially targeted crime-control activities.[40] In IN, KS, MN and OK, with no statewide reduction, the FRF-rates fell solely among blacks, with no change among whites. These states have very few laws to prevent firearm violence and trafficking[27] and rank among the highest twenty states in crime rates except MN.[37]

The increasing trend in FL and MA in our study was due to increase in firearm homicides. According to data from CDC, rates of suicides in FL remained constant from 2000-2010 while in MA these rates doubled from 1.92 to 3.15.[1] In 2010, 71% of homicides in FL were by firearms,[29] and in MA, 22% of the homicides were by firearm.[39] In CA, where all racial and ethnic groups revealing declining trends, was driven by reduction in suicide-FRF and is associated with the states' increased effort in implementing "The Mental Health Services Act" to reduce suicide rates.[41] In our study, reduction in homicides was caused by declines in AZ, IL, NV, NY, NC and DC. These declining patterns are similar to the reduction in all-cause homicide rates from 2000-2010 that occurred in a smaller magnitude among AZ, IL, NV, NY, NC and in a much larger magnitude in DC.[1]

There are several limitations in our study. Under reporting of firearm fatal events is a known phenomenon and a limitation of this study, which cannot be verified. There is, however, no reason to suspect that blacks and Hispanics are more likely than whites and non-Hispanic individuals to have a fatal firearm injury misclassified on the death certificate, so this under-reporting should not have biased our findings. Another limitation is that, despite the considerable state-specific heterogeneity, the actual variation in firearm mortality may be a feature of cities and counties with varying crime rates, and we do not address the variation existing at such level. Finally, comparisons made between other races may not be usefully interpreted due to the heterogeneity and the small frequency of events in this sub-

population. However, as other race makes up about 10% of the US population, the results are discussed in relation to blacks and Hispanics.

In summary, we showed no change in national firearm mortality rates during 2000-2010, but showed distinct state-specific patterns with racial and ethnic variation and by intent. The distinctive state-specific firearm fatality profiles vary by race, ethnicity and intent adding another layer of complexity to the FRF trends. This calls for specific studies to identify the drivers of the state-specific temporal trends followed by introducing tailored programs that target specific racial and ethnic groups in specific states.

Table 1: Trends in firearm deaths in the United States, WISQARS 2000-2010.

	Age-adjusted firearm deaths per 100,000 population												Change			
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total	Annual	95% CI	SMD	P-trend
All	10.14	10.31	10.43	10.29	9.99	10.27	10.22	10.24	10.23	10.05	10.07	10.21	-0.017	-0.044, 0.010	-0.44	0.181
Race																
White	8.97	9.21	9.19	9.05	8.84	8.98	8.80	8.98	9.18	9.13	9.20	9.05	0.006	-0.027, 0.039	0.11	0.705
Black	18.30	18.32	19.22	19.01	18.31	19.34	19.98	19.31	18.19	17.15	16.90	18.51	-0.114	-0.311, 0.082	-0.40	0.220
Other	4.76	3.89	4.19	4.03	3.70	3.88	3.83	3.38	3.25	3.37	3.25	3.38	-0.121	-0.166, -0.076	-1.83	<0.0001
Ethnicity																
Hispanic	7.81	7.73	7.63	7.68	7.42	7.51	7.19	7.21	6.60	6.38	5.86	7.13	-0.179	-0.236, -0.122	-2.13	<0.0001
Non-Hispanic	10.31	10.50	10.67	10.50	10.23	10.53	10.54	10.61	10.74	10.55	10.71	10.54	0.027	-0.002, 0.056	0.63	0.068
Intent																
Homicide/Legal Intervention	3.88	4.05	4.17	4.19	4.05	4.28	4.40	4.32	4.14	3.89	3.73	4.10	-0.008	-0.054, 0.038	-0.12	0.705
Suicide	5.90	5.90	5.92	5.77	5.65	5.66	5.54	5.63	5.82	5.91	6.06	5.80	0.001	-0.035, 0.038	0.03	0.932
Undetermined	0.08	0.08	0.08	0.08	0.08	0.07	0.07	0.09	0.09	0.07	0.08	0.08	-0.0001	-0.002, 0.002	-0.02	0.944
Unintentional	0.27	0.28	0.26	0.25	0.22	0.27	0.21	0.20	0.19	0.18	0.20	0.23	-0.010	-0.014, -0.006	-1.70	<0.0001

All values are age-adjusted rates per 100,000 persons. Change denotes annual change in rate per 100,000. Negative value indicates decline in firearm death rates per 100,000 from 2000-2010 and positive value indicates increase in firearm death rate per 100,000 from 2000-2010. CI denotes confidence intervals of the annual change in firearm death rate per 100,000. SMD indicates standardized mean difference; is equal to annual change/standard deviation. P-trend calculated using meta-regression indicates the significance of the decline or the increase in firearm related death rates from 2000-2010.Data are from Center for Disease Control and Prevention (CDC)'s National center for Injury Prevention and Control Web-based Injury Statistics Query and Reporting System (WISQARS).

Contributorship:

Galea and Kalesan conceived and supervised the study. Kalesan, Vasan, and Villarreal completed the analyses. Kalesan, Galea, Mobily, Hlavacek, and Villarreal led the writing. Fagan, Teperman, Mobily, Villarreal and Hlavacek assisted with the study and analyses. Fagan, Teperman, Hlavacek, Villarreal, Mobily, Vasan, Galea, and Kalesan critically revised the work. Hlavacek and Mobily assisted with obtaining state gun laws.

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Figure legends

Figure 1: Firearm related fatality rates from 2000-2010.

Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia ranging from 3.02 (HI) to 21.71 (DC) per 100,000. The colors represent increasing rates from blue to red. Significant decline in 7 states (AZ, CA, IL, MD, NV, NY and NC and DC) are represented as gold stars and significant increase in FL and MA as black stars within the map and in the table.
The table summarizes the rates per 100,000, annual change in rate and p-trend for those states that show significant increase or decrease. "FRF" denotes firearm related fatality. "Change" indicates the annual change in rates from 2000 to 2010. "P-trend" indicates the significance of the decline or the increase in firearm related fatality rates from 2000 to 2010 and was calculated using meta-regression. Negative values for change indicate a decrease while positive values indicate increase in rates across the years. The intent-specific rates of firearm related fatality is denoted with arrows in the table below: downward arrow denotes reduction in rates, upward arrows indicate an increase and two-way arrows indicate no change. "ne" represents data which cannot be estimated due to frequency <10. HI (11-year=3.02, change=-0.057, p-trend=0.36) and AK (11-year=18.09, change=0.10, p-trend=0.64) are not represented in the map.

Figure 2: Firearm related fatality rates from 2000-2010 according to race.

Whites:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 2.57 (MA) to 16.30 (NV) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10 among whites. Significant decline in 4 states (CA, NY, IL and NC) are represented as gold stars and significant increase in MA and FL as black stars. HI (11-year=4.29, change=0.03, p-trend=0.84) and AK (11-year=15.77, change=0.15, p-trend=0.56) are not represented in the map.

Blacks:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 2.93 (HI) to 40.95 (DC) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10 among blacks. Significant decline in 8 states (CA, NV, AZ, KA, MN, IN, NC and DC) are represented as gold stars and significant increase in OK, OH and DL as black stars. HI (11-year=2.93) and AK (11-year=12.36) are not represented in the map.

Other race:

Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 0.82 (NY) to 22.54 (AK) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10 among other race. Significant decline in 2 states (CA and TX) are represented as gold stars and there were no states with significant increase. HI (11-year=2.18, change=-0.04, p-trend=0.50) and AK (11-year=22.54, change=-0.15, p-trend=0.75) are not represented in the map.

Figure 3: Firearm related fatality rates from 2000-2010 according to ethnicity.

Hispanic:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 3.13 (NJ) to 15.63 (ND) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10 among Hispanics. Significant decline in 9 states (CA, AZ, NV, OR, UT, TX, IL, GA and NY) are represented as gold stars and there were no states with significant increase. HI (11-year=3.84) and AK (11-year=8.95) are not represented in the map.

Non-Hispanic:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 2.95 (HI) to 23.45 (DC) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10 among non-Hispanics. Significant decline in 3 states (CA, NC and DC) are represented as gold stars and significant increase in 7 states (TX, OK, FL, OH, PA, DL, and MA) as black stars. HI (11-year=2.95, change=-0.05, p-trend=0.50) and AK (11-year=18.44, change=0.13, p-trend=0.57) are not represented in the map.

Figure 4: Firearm related fatality rates from 2000-2010 according to intent.

Homicide:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 0.65 (NH) to 19.75 (DC) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10. Significant decline in 5 states (NV, IL, NC, NY and DC) are represented as gold stars and significant increase in MO, FL, OH, MA, CT, and DL as black stars. HI (11-year=0.79, change=-0.01, p-trend=0.68) and AK (11-year=3.54, change=0.001, p-trend=0.95) are not represented in the map.

Suicide:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 1.61 (MA) to 13.79 (AK) per 100,000. The colors represent increasing

rates from blue to red. White represents no data or states where the frequency was <10. Significant decline in 2 states (CA and NC) are represented as gold stars and there were no states with significant increase. HI (11-year=2.10, change=-0.001, p-trend=0.95) and AK (11-year=13.79, change=0.11, p-trend=0.61) are not represented in the map.

Undetermined:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 0.01 (NJ) to 0.47 (AK) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10. There was no significant decline or increasing state-specific trends. HI (11-year=ne) and AK (11-year=0.47) are not represented in the map.

Unintentional:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 0.04 (MA) to 0.83 (LO) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10. Significant decline in 3 states (OH, KN and TN) are represented as gold stars and there were no states with significant increase. HI (11-year=0.08) and AK (11-year=0.29) are not represented in the map.

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Title: State-specific, racial and ethnic heterogeneity in trends of firearm-related fatality rates in the United States from 2000-2010

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Abstract:

Objectives: To document overall, racial, ethnic and intent-specific spatio-temporal trends of firearm related fatality rates (FRF-rate) in the United States.

Design: Cross-sectional study per year from 2000 to 2010.

Setting: United States.

Participants: Aggregate count of all people in the US from 2000 to 2010.

Outcome measures: Data from the Web-based Injury Statistics Query and Reporting System from 2000-2010 was used to determine annual FRF-rates per 100,000 and by states, race, ethnicity and intent.

Results: The average national 11-year FRF-rate was 10.21 per 100,000, from 3.02 to in Hawaii to 18.62 in Louisiana: 60% of states had higher than national rates and 41 states showed no temporal change. The average national FRF-rates among blacks and whites were 18.51 and 9.05 per 100,000 and among Hispanics and non-Hispanics were 7.13 and 10.13 per 100,000; Hispanics had a decreasing change of -0.18, p-trend<0.0001. In states with increasing trends (Florida and Massachusetts), whites and non-Hispanics drove the rise; while in states with decreasing trends (California, North Carolina, Arizona, Nevada, New York, Illinois, Maryland), Hispanics and blacks drove the fall. The average national FRF-rates due to homicides (4.1 per 100,000) and suicides (5.8 per 100,000) remained constant, but varied between states.

Conclusion: Endemic national FRF-rates mask a wide variation in time trends between states. FRF-rates were twice as high in blacks than whites but decreased

among Hispanics. Efforts to identify state-specific best practices can contribute to changes in national FRF-rates that remain high.

Strengths of this study

- This study uses the best available data reporting system for surveillance of firearm mortality in US.
- Brings into light the overall state-specific variability of temporal trends of firearm mortality, which was obscured by the endemic national firearm fatality rates during 2000-2010 and according to race, ethnicity and intent from a seemingly stable national burden of firearm deaths.
- This is the first report that documents firearm fatality trends by ethnicity
- Our results call for identification of drivers of state-specific temporal trends to introduce tailored programs targeted to reduce deaths and injury due to firearms.

Limitations of this study

- Possible under reporting of firearm fatal events, which cannot be verified.
- Despite the considerable state-specific heterogeneity, the actual variation in firearm mortality may be a feature of cities and counties with varying crime rates, and we do not address the variation existing at such level.
- Finally, comparisons made between other races may not be usefully interpreted due to the heterogeneity and the small frequency of events in this sub-population.

Firearm violence increased during the 1980s and peaked in 1993, with 39,595 firearm deaths in the US and a firearm-related fatality rate (FRF-rate) of 15.0 per 100,000.[1] Since the turn of the 21st century, FRF-rates in the US have become endemic around 10.3 per 100,000 accounting for 17.5% of all injury deaths,[2] while the intent of firearm deaths was mainly suicide and homicide.[3]

The FRF-rate in 1993 among blacks was three-times greater than whites, but similar among Hispanics and non-Hispanics.[1 4] The overall fall in FRF after 2000 corresponded to a related narrowing of the racial gap between blacks and whites, where, by 2010, the FRF-rates among blacks was twice greater than whites.[1] Several factors have been posited that might explain these persistent racial differences, including socioeconomic determinants and increased firearm availability.[5 6]

Although the national temporal trends in FRF have been previously well documented,[3 7 8] there is ample reason to suspect substantial heterogeneity in FRF across states, such as dramatic differences in gun laws controlling access to firearms, variability in enforcement of national standards across states,[8 9] changing demographics and violence.[10] It is likely that some of the state-to-state heterogeneity in the potential determinants of FRF may also contribute to variability in racial and ethnic differences in FRF within states.

With this in mind, this study had two distinct aims. First, we aimed to document national and state-specific trends in FRF-rates along with the annual change in FRF-rates from 2000-2010 and second, to determine the racial, ethnic and

intent-specific differences in FRF-rates within each state during the same time period.

METHODS

Data source

We accessed the restricted fatal injury data reports from the Web-based Injury Statistics Query and Reporting System (WISQARS™), an interactive database system provided by Centers for Disease Control and Prevention's (CDC) Injury Prevention and Control Unit (http://www.cdc.gov/injury/wisqars/).[1] The data in the WISQARS system is derived from CDC annual mortality data from National Vital Statistics System (NVSS), National Center for Health Statistics (NCHS) (http://www.cdc.gov/nchs/) and CDC. The NCHS and the National Association of Public Health Statistics and Information Systems restricts reporting NVSS data for cumulative frequencies <10 for sub-national geographic areas to prevent unintentional disclosure of cases. International Classification of Disease-10th Revision (ICD-10) was used for coding mortality data including intent of injury.[11]

Study population and variables

Our study population consisted of national and state-specific fatal firearm injuries from 2000-2010 obtained from querying the WISQARS data system. Aggregate information such as number of firearm deaths, total population and age-adjusted rates according to race (black, white, other), ethnicity (Hispanic and non-Hispanic) and intent (homicide/legal intervention, suicide, undetermined and unintentional) was obtained.

Statistical analysis

The standard errors (SE) for national and state-specific age-adjusted FRF-rates per 100,000 persons were derived for the overall 11-year period and annually and by race, ethnicity and intent. Age-adjusted rates are obtained by direct standardization using the 2000 population. The overall 11-year rates were assessed as total firearm deaths over the total population during the 11-years. Since only aggregate data could be obtained from WISQARS without individual patient data, we used random effects meta-analysis and meta-regression.[12] The rates in each category and the SEs were meta-analyzed using random-effects meta-analysis. Heterogeneity between states was assessed using I^2 statistic; which ranges from 0 to 100% and denotes the proportion of variation across states other than by chance.[13] [14] In order to assess the temporal trends from 2000-2010, we assumed linear trends across 11 years and used meta-regression to calculate the change in rates (slope) and the standard deviation (SD). The p-value from meta-regression was used to assess evidence for trend. Standardized mean difference (SMD) was calculated by dividing the annual change in age-adjusted rate by SD.[15] [16] We do not present estimates for those states with number of deaths below 10. Lives-lost or saved are estimated by applying annual change to the total 11-year population (2000-2010). The difference between 11-year national and state-specific FRF-rates (overall and category-specific) were used to spatially represent the variation between states. STATA 13.1 (StataCorp LP, College Station, Texas; 2009) was used to analyze the data.

RESULTS

Between 2000 and 2010, a total of 335,609 firearm-related deaths were recorded and the overall mortality rate was 10.21 per 100,000. The annual change in FRF-rate across 11-years was -0.017 with a 95% confidence interval (95% CI) of -0.044-0.010, p-trend=0.18, indicating no significant change in national FRF-rates. **Table 1** presents national FRF-rates, for 11-years and annually according to race, ethnicity and intent. Cumulative 11-year FRF-rates were disproportionally high among blacks (18.51) as compared to whites and other race groups, and lowest among other races (3.38). Among whites the FRF-rates were lower than the overall national 11-year rate while increasing from 8.97 to 9.20 from 2000-2010. This annual increase was small (0.006, SMD=0.11) but not significant, p-trend=0.71. Even though the FRF-rates among blacks were consistently higher than national FRF-rates, the annual rates reduced from 18.30 to 16.90; and this decline, -0.114 was not significant, SMD=-0.40, p-trend=0.22. The decline in FRF-rates from 4.76 to 3.25 among other races was significant (change=-0.12, SMD=-1.83, p-trend<0.0001). Annual reduction observed among Hispanics showed a significant reduction, -0.179, p-trend<0.0001 alongside an already low 11-year FRF-rate of 7.13. FRF-rates among non-Hispanics remained slightly above the national rates without increase. FRF-rate by intent was highest for suicides (5.80) while the annual change was minimal in all four categories with a small significant reduction for unintentional deaths (change=-0.010, SMD=-1.70, p-trend<0.0001).

State-specific 11-year FRF-rates are represented in **Figure 1** and **Supplementary Table 1**. Hawaii (HI) (3.02) and Massachusetts (MA) (3.24) had the lowest 11-year FRF-rates, while Louisiana (LA) had the highest at 18.62. DC and 7 states showed a significant declining trend in FRF-rate, while MA and FL documented a significant increase. District of Columbia (DC) had the largest significant annual reduction at -1.067 (6.2 lives-saved per year, p-trend = 0.002) though it had the highest rate of 21.71. Although MA had a low FRF-rate, a significant increase was observed, change=0.074, p-trend=0.008. Florida (FL) also showed an increase, change=0.160, 28.2 lives-lost per year, p-trend=0.016. FRF-rates for Delaware (DL) and Ohio (OH) were 8.89 and 9.10, with a near significant increasing trend, changes of 0.20 and 0.12. FRF-rate in New York (NY) was 5.15 with a change=-0.064, 12.3 lives-saved per year, p-trend=0.006. Illinois (IL) had a significant reduction, change=-0.155, 19.6 lives-saved per year, p-trend=0.025). FRF-rates in CA was -0.166 (59.3 lives-saved per year, p-trend=0.001), Arizona (AZ) at -0.230 (13.4 lives-saved per year, p-trend=0.025) and Nevada (NV) at -0.264 (6.4 lives-saved per year, p-trend = 0.008). Maryland (MA) and North Carolina (NC) had a significant decline: change=-0.169, 9.4 lives-saved per year, p-trend=0.048 and -0.174, 15.3 lives-saved per year, p-trend=0.001).

The 11-year FRF-rates for each state by race are presented in **Figures 2A to 2C** and **Supplementary Figures 1A-C**. Among whites, the lowest rate was in MA with a significant increase from 2000-2010 (change=0.05, p-trend=0.037). FL also recorded a significant increase (change=0.12, p-trend=0.045) but had high 11-year

FRF-rate, 10.02. NV recorded the highest and unchanging FRF-rate at 16.30. The four states that showed a significant declining trend from 2000-2010 were NY (change=-0.05, p-trend=0.015), IL (change=-0.12, p-trend=0.028), NC (change=-0.10, p-trend=0.032), and CA (change=-0.12, p-trend=0.001). Among blacks, HI had the lowest 11-year FRF-rates at 2.93 while Missouri (MO) had the highest at 30.12 and DC was at 40.95. Oklahoma (OK), OH and DL had high 11-year rates at 20.04, 20.19 and 13.61 respectively with a significant increasing changes of 0.93, 0.51 and 0.79, p-trends of 0.008, 0.027 and 0.028 respectively. A declining trend was observed among blacks in CA (change=-0.58, p-trend=0.042), AZ (change=-0.83, p-trend=0.019), NV (change=-1.53, p-trend=0.005), NC (change=-0.38, p-trend=0.024), Indiana (IN) (change=-0.66, p-trend=0.012), Kansas (KA) (change=-1.07, p-trend=0.021), Minnesota (MN) (change=-0.61, p-trend=0.038), and DC (change=-1.58, p-trend=0.017), even though their 11-year FRF-rates were high. Among other races, Texas (TX) (change=-0.19, p-trend=0.033) and CA (change=-0.10, p-trend=0.009) showed a significant decline.

Figures 3A-B and **Supplementary Figures 3A-B** presents the 11-year FRF-rates for each state by ethnicity. Georgia (GA) (change=-0.54, p-trend=0.012), CA (change=-0.18, p-trend=0.009), Utah (UT) (change=-0.79, p-trend=0.030), AZ (change=-0.56, p-trend=0.016), and NV (change=-0.48, p-trend=0.007) were five high-FRF-rate states (>7.13) while NY (change=-0.17, p-trend=0.001), IL (change=-0.40, p-trend=0.001), TX (change=-0.21, p-trend=0.004), and Oregon (OR) (change=-0.33, p-trend=0.037) were the four low-FRF-rate states with a significant

declining trend among Hispanics. No states demonstrated an increase among Hispanics, while non-Hispanics showed a significant increasing trend in MA (change=0.07, p-trend=0.033), Pennsylvania (PA) (change=0.08, p-trend=0.039), OH (change=0.13, p-trend=0.048), DL (change=0.25, p-trend=0.036), TX (change=0.14, p-trend=0.022), FL (change=0.23, p-trend=0.002) and OK (change=0.15, p-trend=0.045). A declining trend in non-Hispanics was observed in MD (change=-0.16, p-trend=0.068), NC (change=-0.14, p-trend=0.004) and CA (change=-0.15, p-trend=0.001). In TX, the FRF-rates among Hispanics (change=-0.21, p-trend=0.004) demonstrated a significant decline and a significant increase among non-Hispanics (change=0.14, p-trend=0.022) (**Supplementary Table 2**).

FRF-rates from 2000-2010 and by intent is provided in **Figures 4A-D** and **Supplementary Figures 4A-D**. Most of the northern states had low (<3.73) homicide-FRF while southern states had high FRF. NY (change=-0.05, p-trend=0.004), IL (change=-0.10, p-trend=0.027), NC (change=-0.10, p-trend=0.023), NV (change=-0.15, p-trend=0.031) and DC (change=-1.0, p-trend=0.002) had significant declining trends while MA (change=0.08, p-trend=0.001), Connecticut (CT) (change=0.08, p-trend=0.023), OH (change=0.12, p-trend=0.006), DL (change=0.37, p-trend<0.0001) and FL (change=0.15, p-trend=0.007) had increasing homicide-FRF. A majority of the states had suicide-FRF-rates >5.80; CA (change=-0.07, p-trend=0.009) and NC (change=-0.07, p-trend=0.037) had declining trends. Unintentional-FRF-rates showed a significant decreasing trend in three

states, OH (change=-0.01, p-trend=0.022), Kentucky (KY) (change=-0.06, p-trend=0.009), and Tennessee (TN) (change=-0.05, p-trend=0.002).

DISCUSSION

National 11-year FRF-rate from 2000-2010 was 10.21, was almost three times higher than Switzerland and Finland.[17] There were four main observations that emerge from this analysis. First, while overall, blacks had higher national rates than whites and Hispanics had lower national rates than non-Hispanics, the 11-year FRF-rates declined among Hispanics and non-white non-black races with no significant change observed among whites, blacks or non-Hispanics. Second, a substantial inter-state heterogeneity was evidenced by 11-year state-specific FRF-rates being as low as 3.02 in HI to as high as 21.71 in DC. FL and MA recorded an upward FRF trend while AZ, CA, IL, MD, NV, NY, NC and DC had declining FRF-rates during the study period. Third, racial and ethnic variation was shown to drive many of the state-specific variations. Fourth, changes in different FRF-intent also drove many of the state-specific differences.

Firearm deaths increased from 28,663 in 2000 to 31,672 in 2010, about 30,509 deaths per year and no change in rate. These findings are similar to a report by the Bureau of Justice of a rapid decline in firearm homicides from 1993 to 1999 followed by a leveling of rates from 2000-2011.[18] It is important to bear in mind that these endemic conditions are associated with substantial, long-term cumulative health burden associated with firearm death throughout the US.[19] During 2000-2011 there were 306,946 firearm related deaths. With the endemic annual FRF-rate of 10.3, US-population at 338 million by 2020[20] and 10% decadal population

increase, we estimate 336,778 firearm related deaths to occur between 2011 and 2020.

The 11-year FRF-rates we report among blacks was twice greater than that of whites and six-times greater than that of other races is in line with reports showing disproportionately larger firearm fatality and injury rates than whites and other race.[3 21 22] Although there was a plateau of the national FRF-rates, rates among Hispanics and non-white non-black races declined and may be explained by the lack of access to firearms or low firearm ownership among Hispanics and other races.[23] Our results explain the report where Hispanics were least likely to use firearms for suicides albeit being more likely to self-injury than any other race groups.[24] Data from 1981-2010 found that among youths a decline in homicide rates for blacks between was significantly slower than the declines for Hispanics and other racial and ethnic groups[25], suggestive of lower crime.

We found 41 states with no FRF-rate change, while 7 states and DC demonstrated either a significant decline or increase. MA and FL recorded a significant increase, MA with smallest and FL with largest annual increase while MA had the lowest 11-year FRF-rate. The Brady Center to Prevent Gun Violence [9] firearm legislative strength score for 2013, has MA to be third with score of 65 among all states in restrictive firearm legislation, while FL has a score of 3. After MA passed the toughest firearm-control legislation in 1998, firearm ownership rates plummeted but violent crimes (476.1 to 468.9) and homicides (2.2 to 3.3) rose.[26]

The significant FRF-rate increase in MA may be explained by the influx of firearms from the two neighboring states (Maine and New Hampshire) with weak firearm control legislation.[27] FL is a "shall-issue", weak legislature state with just 2 laws to prevent illegal gun-trafficking.[27] "Shall-issue" jurisdiction requires a license to carry a concealed firearm, where the license must be issued if the subject meets determinate criteria in the law and the issuing authority has no discretion to reject.[28] In contrast to the increasing FRF-rates, the aggregate violent crimes in FL declined from 801.1 to 542.9,[29] emphasizing a particularly concerning public health problem of increasing gun violence even in a climate of reducing violence.

CA, NY, IL, AZ, NV, MD, NC, and DC had declining trends but the most marked reduction was observed in CA and may be directly linked to strength of firearm legislature, a score of 81.[9] CA has eight state laws to prevent illegal gun trafficking[27] and a reduction in homicide crime rate in CA by 25.4% from 2001-2010.[30] An emergency department study from 2004-2008 reporting reduction of firearm death rate in CA echoing the results of our study.[31] NY and IL had similar trend profiles and an overall decline in FRF-rates, but the Brady scores were 62 and 35[9] with 10 and 8 policies preventing illegal firearm trafficking respectively.[27] FRF-rate reduction in AZ and NV is in contrast to CA and NY, having no laws preventing illegal gun trafficking,[27] with Brady scores 0 and 5 respectively.[9] In AZ violent crime rate dropped from 544.5 offenses in 2002 to 372.2 in 2010,[32 33] and NV had reductions in index crimes.[34] This reduction and our results may be attributed to policing strategies.[35] Our reported reduction in firearm death rates in DC may be attributed

to 9 laws preventing illegal gun trafficking.[27] Firearm policies are not stringent in NC, strength of firearm legislature being 16[9] with only 5 illegal gun trafficking laws.[27] However, the violent crime rate in NC dropped from 493 to 363 from 2000-2010,[36] suggesting that the factors that led to reduction in crime rates may have also driven FRF-rate reduction.

We found that the state-specific increasing trend in FL was driven by an increase among whites, blacks and non-Hispanics and can be explained by violent crime rates in FL which ranks 4th in violent crime.[37] The racial gap in arrests for major crimes widened in FL from 2000-2010: 6,175 blacks and 6,071 whites were arrested in 2000 to 2,398 and 3,192 in 2010.[38] The increase in FRF-rates in MA driven by whites and non-Hispanics is in contrast to the racial differences observed in violent deaths with non-Hispanic blacks having the highest rate of 21.6 as compared to 4.9 among whites.[39] MA has relatively low violent crime rate (ranks 20th in US),[37] and stringent firearm control.[9] Even though nationally no significant reduction in FRF-rates among blacks was observed in our study, FRF-rates among blacks drove the state-specific declines in AZ, NV, CA, NC and DC. Declining trends among Hispanics in AZ, NV, CA, NY and IL contributing to state-specific declines may be due to a combination of low firearm ownership[23] and racially targeted crime-control activities.[40] In IN, KS, MN and OK, with no statewide reduction, the FRF-rates fell solely among blacks, with no change among whites. These states have very few laws to prevent firearm violence and trafficking[27] and rank among the highest twenty states in crime rates except MN.[37]

The increasing trend in FL and MA in our study was due to increase in firearm homicides. According to data from CDC, rates of suicides in FL remained constant from 2000-2010 while in MA these rates doubled from 1.92 to 3.15.[1] In 2010, 71% of homicides in FL were by firearms,[29] and in MA, 22% of the homicides were by firearm.[39] In CA, where all racial and ethnic groups revealing declining trends, was driven by reduction in suicide-FRF and is associated with the states' increased effort in implementing "The Mental Health Services Act" to reduce suicide rates.[41] In our study, reduction in homicides was caused by declines in AZ, IL, NV, NY, NC and DC. These declining patterns are similar to the reduction in all-cause homicide rates from 2000-2010 that occurred in a smaller magnitude among AZ, IL, NV, NY, NC and in a much larger magnitude in DC.[1]

There are several limitations in our study. Under reporting of firearm fatal events is a known phenomenon and a limitation of this study, which cannot be verified. There is, however, no reason to suspect that blacks and Hispanics are more likely than whites and non-Hispanic individuals to have a fatal firearm injury misclassified on the death certificate, so this under-reporting should not have biased our findings. Another limitation is that, despite the considerable state-specific heterogeneity, the actual variation in firearm mortality may be a feature of cities and counties with varying crime rates, and we do not address the variation existing at such level. Finally, comparisons made between other races may not be usefully interpreted due to the heterogeneity and the small frequency of events in this sub-

population. However, as other race makes up about 10% of the US population, the results are discussed in relation to blacks and Hispanics.

In summary, we showed no change in national firearm mortality rates during 2000-2010, but showed distinct state-specific patterns with racial and ethnic variation and by intent. The distinctive state-specific firearm fatality profiles vary by race, ethnicity and intent adding another layer of complexity to the FRF trends. This calls for specific studies to identify the drivers of the state-specific temporal trends followed by introducing tailored programs that target specific racial and ethnic groups in specific states.

Table 1: Trends in firearm deaths in the United States, WISQARS 2000-2010.

	Age-adjusted firearm deaths per 100,000 population												Change			
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total	Annual	95% CI	SMD	P-trend
All	10.14	10.31	10.43	10.29	9.99	10.27	10.22	10.24	10.23	10.05	10.07	10.21	-0.017	-0.044, 0.010	-0.44	0.181
Race																
White	8.97	9.21	9.19	9.05	8.84	8.98	8.80	8.98	9.18	9.13	9.20	9.05	0.006	-0.027, 0.039	0.11	0.705
Black	18.30	18.32	19.22	19.01	18.31	19.34	19.98	19.31	18.19	17.15	16.90	18.51	-0.114	-0.311, 0.082	-0.40	0.220
Other	4.76	3.89	4.19	4.03	3.70	3.88	3.83	3.38	3.25	3.37	3.25	3.38	-0.121	-0.166, -0.076	-1.83	<0.0001
Ethnicity																
Hispanic	7.81	7.73	7.63	7.68	7.42	7.51	7.19	7.21	6.60	6.38	5.86	7.13	-0.179	-0.236, -0.122	-2.13	<0.0001
Non-Hispanic	10.31	10.50	10.67	10.50	10.23	10.53	10.54	10.61	10.74	10.55	10.71	10.54	0.027	-0.002, 0.056	0.63	0.068
Intent																
Homicide/Legal Intervention	3.88	4.05	4.17	4.19	4.05	4.28	4.40	4.32	4.14	3.89	3.73	4.10	-0.008	-0.054, 0.038	-0.12	0.705
Suicide	5.90	5.90	5.92	5.77	5.65	5.66	5.54	5.63	5.82	5.91	6.06	5.80	0.001	-0.035, 0.038	0.03	0.932
Undetermined	0.08	0.08	0.08	0.08	0.08	0.07	0.07	0.09	0.09	0.07	0.08	0.08	-0.0001	-0.002, 0.002	-0.02	0.944
Unintentional	0.27	0.28	0.26	0.25	0.22	0.27	0.21	0.20	0.19	0.18	0.20	0.23	-0.010	-0.014, -0.006	-1.70	<0.0001

All values are age-adjusted rates per 100,000 persons. Change denotes annual change in rate per 100,000. Negative value indicates decline in firearm death rates per 100,000 from 2000-2010 and positive value indicates increase in firearm death rate per 100,000 from 2000-2010. CI denotes confidence intervals of the annual change in firearm death rate per 100,000. SMD indicates standardized mean difference; is equal to annual change/standard deviation. P-trend calculated using meta-regression indicates the significance of the decline or the increase in firearm related death rates from 2000-2010.Data are from Center for Disease Control and Prevention (CDC)'s National center for Injury Prevention and Control Web-based Injury Statistics Query and Reporting System (WISQARS).

Figure legends

Figure 1: Firearm related fatality rates from 2000-2010.

Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia ranging from 3.02 (HI) to 21.71 (DC) per 100,000. The colors represent increasing rates from blue to red. Significant decline in 7 states (AZ, CA, IL, MD, NV, NY and NC and DC) are represented as gold stars and significant increase in FL and MA as black stars within the map and in the table.
The table summarizes the rates per 100,000, annual change in rate and p-trend for those states that show significant increase or decrease. "FRF" denotes firearm related fatality. "Change" indicates the annual change in rates from 2000 to 2010. "P-trend" indicates the significance of the decline or the increase in firearm related fatality rates from 2000 to 2010 and was calculated using meta-regression. Negative values for change indicate a decrease while positive values indicate increase in rates across the years. The intent-specific rates of firearm related fatality is denoted with arrows in the table below: downward arrow denotes reduction in rates, upward arrows indicate an increase and two-way arrows indicate no change. "ne" represents data which cannot be estimated due to frequency <10. HI (11-year=3.02, change=-0.057, p-trend=0.36) and AK (11-year=18.09, change=0.10, p-trend=0.64) are not represented in the map.

Figure 2: Firearm related fatality rates from 2000-2010 according to race.

Whites:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 2.57 (MA) to 16.30 (NV) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10 among whites. Significant decline in 4 states (CA, NY, IL and NC) are represented as gold stars and significant increase in MA and FL as black stars. HI (11-year=4.29, change=0.03, p-trend=0.84) and AK (11-year=15.77, change=0.15, p-trend=0.56) are not represented in the map.

Blacks:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 2.93 (HI) to 40.95 (DC) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10 among blacks. Significant decline in 8 states (CA, NV, AZ, KA, MN, IN, NC and DC) are represented as gold stars and significant increase in OK, OH and DL as black stars. HI (11-year=2.93) and AK (11-year=12.36) are not represented in the map.

Other race:

Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 0.82 (NY) to 22.54 (AK) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10 among other race. Significant decline in 2 states (CA and TX) are represented as gold stars and there were no states with significant increase. HI (11-year=2.18, change=-0.04, p-trend=0.50) and AK (11-year=22.54, change=-0.15, p-trend=0.75) are not represented in the map.

Figure 3: Firearm related fatality rates from 2000-2010 according to ethnicity.

Hispanic:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 3.13 (NJ) to 15.63 (ND) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10 among Hispanics. Significant decline in 9 states (CA, AZ, NV, OR, UT, TX, IL, GA and NY) are represented as gold stars and there were no states with significant increase. HI (11-year=3.84) and AK (11-year=8.95) are not represented in the map.

Non-Hispanic:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 2.95 (HI) to 23.45 (DC) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10 among non-Hispanics. Significant decline in 3 states (CA, NC and DC) are represented as gold stars and significant increase in 7 states (TX, OK, FL, OH, PA, DL, and MA) as black stars. HI (11-year=2.95, change=-0.05, p-trend=0.50) and AK (11-year=18.44, change=0.13, p-trend=0.57) are not represented in the map.

Figure 4: Firearm related fatality rates from 2000-2010 according to intent.

Homicide:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 0.65 (NH) to 19.75 (DC) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10. Significant decline in 5 states (NV, IL, NC, NY and DC) are represented as gold stars and significant increase in MO, FL, OH, MA, CT, and DL as black stars. HI (11-year=0.79, change=-0.01, p-trend=0.68) and AK (11-year=3.54, change=0.001, p-trend=0.95) are not represented in the map.

Suicide:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 1.61 (MA) to 13.79 (AK) per 100,000. The colors represent increasing

rates from blue to red. White represents no data or states where the frequency was <10. Significant decline in 2 states (CA and NC) are represented as gold stars and there were no states with significant increase. HI (11-year=2.10, change=-0.001, p-trend=0.95) and AK (11-year=13.79, change=0.11, p-trend=0.61) are not represented in the map.

Undetermined:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 0.01 (NJ) to 0.47 (AK) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10. There was no significant decline or increasing state-specific trends. HI (11-year=ne) and AK (11-year=0.47) are not represented in the map.

Unintentional:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 0.04 (MA) to 0.83 (LO) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10. Significant decline in 3 states (OH, KN and TN) are represented as gold stars and there were no states with significant increase. HI (11-year=0.08) and AK (11-year=0.29) are not represented in the map.

Contributorship:

Galea and Kalesan conceived and supervised the study. Kalesan, Vasan, and Villarreal completed the analyses. Kalesan, Galea, Mobily, Hlavacek, and Villarreal led the writing. Fagan, Teperman, Mobily, Villarreal and Hlavacek assisted with the study and analyses. Fagan, Teperman, Hlavacek, Villarreal, Mobily, Vasan, Galea, and Kalesan critically revised the work. Hlavacek and Mobily assisted with obtaining state gun laws.

~~Galea and Kalesan conceived and supervised the study. Kalesan and Vasan completed the analyses. Kalesan, Galea and Villarreal led the writing. Fagan, Teperman, Mobily and Hlavacek assisted with the study and analyses. Hlavacek assisted with obtaining state gun laws.~~

Competing interests:

None of the authors have competing interests to report

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Data sharing:

All data used for the analysis are publicly available and there is no further data for data sharing purposes.

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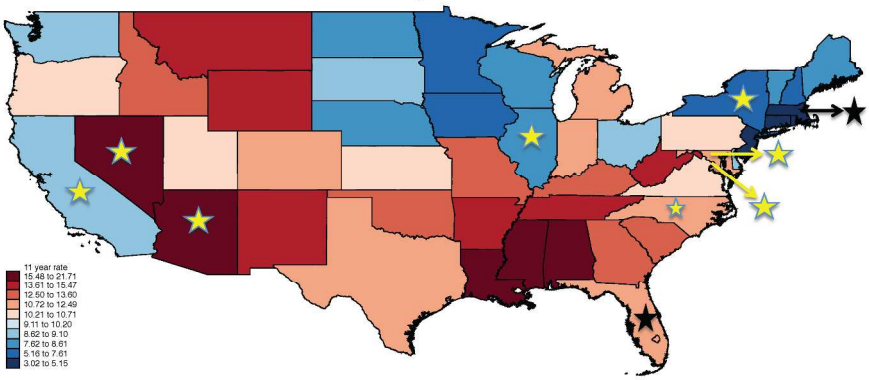
Figure 1



		AZ	CA	DC	IL	MD	NV	NY	NC	FL	MA
Overall	FRF rate	15.47	9.01	21.71	8.61	11.39	16.07	5.15	12.49	11.12	3.24
	Change, P-trend	**-0.23, 0.025**	**-0.17, 0.001**	**-1.07, 0.002**	**-0.16, 0.025**	**-0.17, 0.048**	**-0.26, 0.008**	**-0.06, 0.006**	**-0.17, 0.001**	**0.16, 0.016**	**0.07, 0.008**
Whites	FRF rate	15.73	8.73	3.03	5.80	6.81	16.80	4.05	13.63	10.02	2.57
	Change, P-trend	-0.19, 0.081	**-0.12, 0.001**	-0.03, 0.89	**-0.12, 0.028**	-0.05, 0.29	-0.08, 0.38	**-0.05, 0.015**	**-0.10, 0.032**	**0.12, 0.045**	**0.05, 0.037**
Blacks	FRF rate	18.97	23.43	40.85	24.48	21.18	22.36	10.73	14.77	15.16	10.65
	Change, P-trend	**-0.83, 0.019**	**-0.58, 0.042**	**-1.58, 0.017**	-0.32, 0.14	**-0.42, 0.067**	**-1.53, 0.005**	-0.06, 0.27	**-0.38, 0.024**	**0.29, 0.056**	0.25, 0.097
Other	FRF rate	7.83	2.88	2.78	0.90	2.17	4.93	0.82	7.73	3.67	0.97
	Change, P-trend	**-0.43, 0.053**	**-0.10, 0.009**	ne, ne	ne, ne	-0.12, 0.60	-0.48, 0.19	-0.05, 0.20	-0.30, 0.11	-0.08, 0.49	-1.06, 0.26
Hispanic	FRF rate	14.73	7.42	4.71	6.05	3.36	10.05	3.63	8.12	6.24	4.00
	Change, P-trend	**-0.56, 0.016**	**-0.18, 0.009**	ne, ne	**-0.40, 0.001**	-0.25, 0.10	**-0.48, 0.007**	**-0.17, 0.001**	-0.24, 0.20	0.03, 0.34	0.09, 0.34
Non-Hispanic	FRF rate	16.58	9.19	23.43	8.60	11.95	16.93	5.36	12.62	12.31	3.08
	Change, P-trend	-0.05, 0.57	**-0.15, 0.001**	**-1.20, 0.003**	-0.06, 0.28	**-0.16, 0.068**	-0.11, 0.27	-0.04, 0.094	**-0.14, 0.004**	**0.23, 0.002**	**0.07, 0.033**
Intent:	Homicide	↓	↔	↓	↓	↔	↓	↓	↓	↑	↑
	Suicides	↔	↓	↔	↔	↔	↔	↔	↓	↔	↔
	Undetermined	↔	↔	ne	↔	ne	ne	ne	ne	↔	↔
	Unintentional	ne	↔	ne	↔	ne	ne	ne	↔	↔	↔

Figure 1: Firearm related fatality rates from 2000-2010.

Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia ranging from 3.02 (HI) to 21.71 (DC) per 100,000. The colors represent increasing rates from blue to red. Significant decline in 7 states (AZ, CA, IL, MD, NV, NY and NC and DC) are represented as gold stars and significant increase in FL and MA as black stars within the map and in the table.

The table summarizes the rates per 100,000, annual change in rate and p-trend for those states that show significant increase or decrease. "FRF" denotes firearm related fatality. "Change" indicates the annual change in rates from 2000 to 2010. "P-trend" indicates the significance of the decline or the increase in firearm related fatality rates from 2000 to 2010 and was calculated using meta-regression. Negative values for change indicate a decrease while positive values indicate increase in rates across the years. The intent-specific rates of firearm related fatality is denoted with arrows in the table below: downward arrow denotes reduction in rates, upward arrows indicate an increase and two-way arrows indicate no change. "ne" represents data which cannot be estimated due to frequency <10. HI (11-year=3.02, change=-0.057, p-trend=0.36) and AK (11-year=18.09, change=0.10, p-trend=0.64) are not represented in the map.

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Figure 2

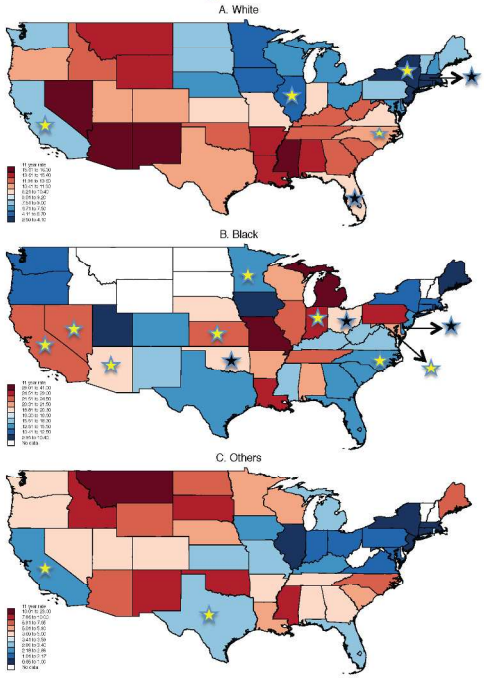

Figure 2: Firearm related fatality rates from 2000-2010 according to race.

Whites:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 2.57 (MA) to 16.30 (NV) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10 among whites. Significant decline in 4 states (CA, NY, IL and NC) are represented as gold stars and significant increase in MA and FL as black stars. HI (11-year=4.29, change=0.03, p-trend=0.84) and AK (11-year=15.77, change=0.15, p-trend=0.56) are not represented in the map.

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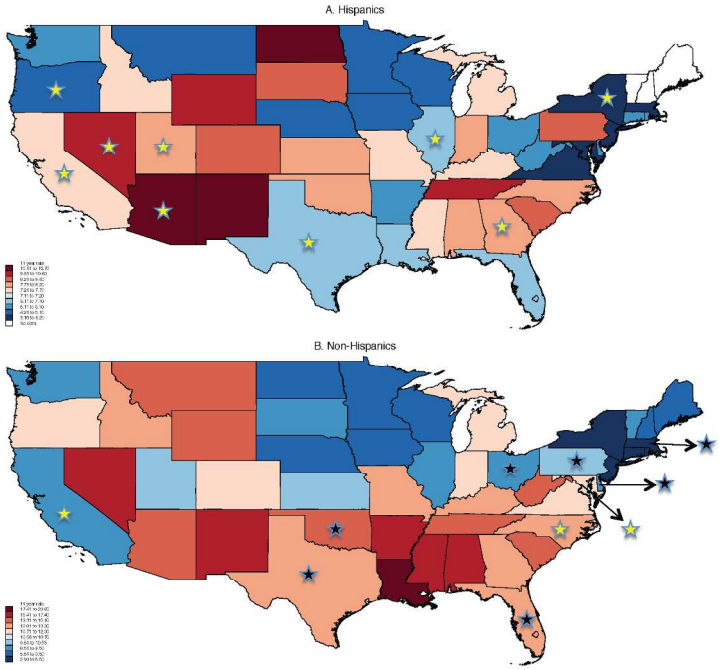
Figure 3



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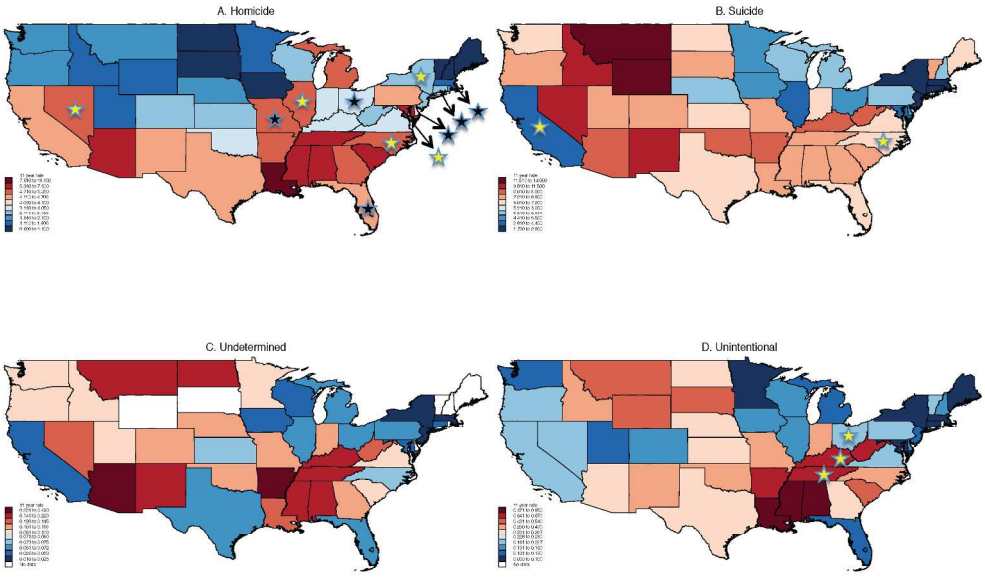
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 3.13 (NJ) to 15.63 (ND) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10 among Hispanics. Significant decline in 9 states (CA, AZ, NV, OR, UT, TX, IL, GA and NY) are represented as gold stars and there were no states with significant increase. HI (11-year=3.84) and AK (11-year=8.95) are not represented in the map.

Non-Hispanic:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 2.95 (HI) to 23.45 (DC) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10 among non-Hispanics. Significant decline in 3 states (CA, NC and DC) are represented as gold stars and significant increase in 7 states (TX, OK, FL, OH, PA, DL, and MA) as black stars. HI (11-year=2.95, change=-0.05, p-trend=0.50) and AK (11-year=18.44, change=0.13, p-trend=0.57) are not represented in the map.
254x190mm (300 x 300 DPI)

Figure 4



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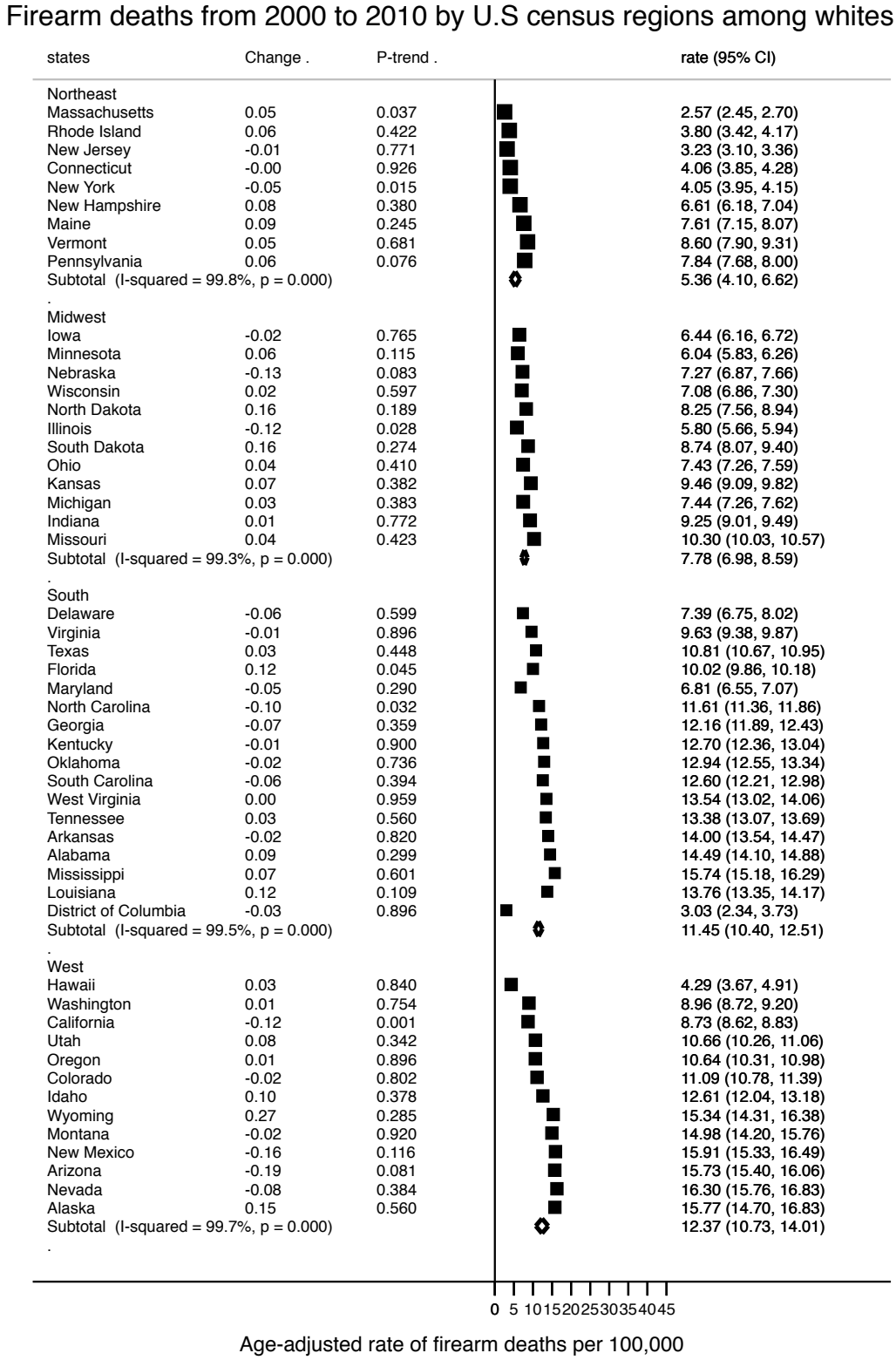
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 1.61 (MA) to 13.79 (AK) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10. Significant decline in 2 states (CA and NC) are represented as gold stars and there were no states with significant increase. HI (11-year=2.10, change=-0.001, p-trend=0.95) and AK (11-year=13.79, change=0.11, p-trend=0.61) are not represented in the map.

Undetermined:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 0.01 (NJ) to 0.47 (AK) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10. There was no significant decline or increasing state-specific trends. HI (11-year=ne) and AK (11-year=0.47) are not represented in the map.

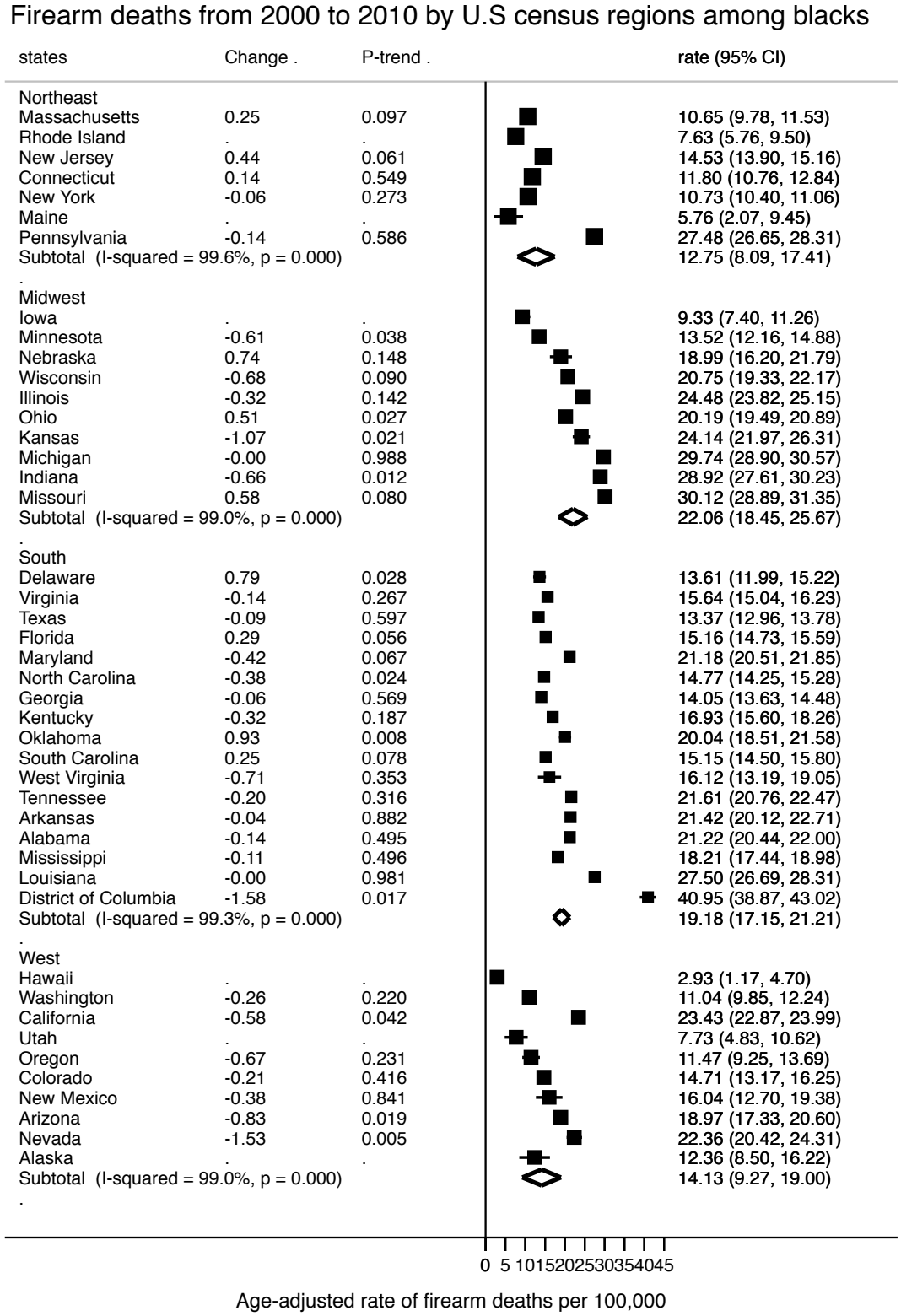
Unintentional:
Firearm related fatality rates are 11-year cumulative age-adjusted rates per 100,000 persons from 2000 to 2010 for each of the 50 states and District of Columbia; ranging from 0.04 (MA) to 0.83 (LO) per 100,000. The colors represent increasing rates from blue to red. White represents no data or states where the frequency was <10. Significant decline in 3 states (OH, KN and TN) are represented as gold stars and there

were no states with significant increase. HI (11-year=0.08) and AK (11-year=0.29) are not represented in the map.
254x190mm (300 x 300 DPI)

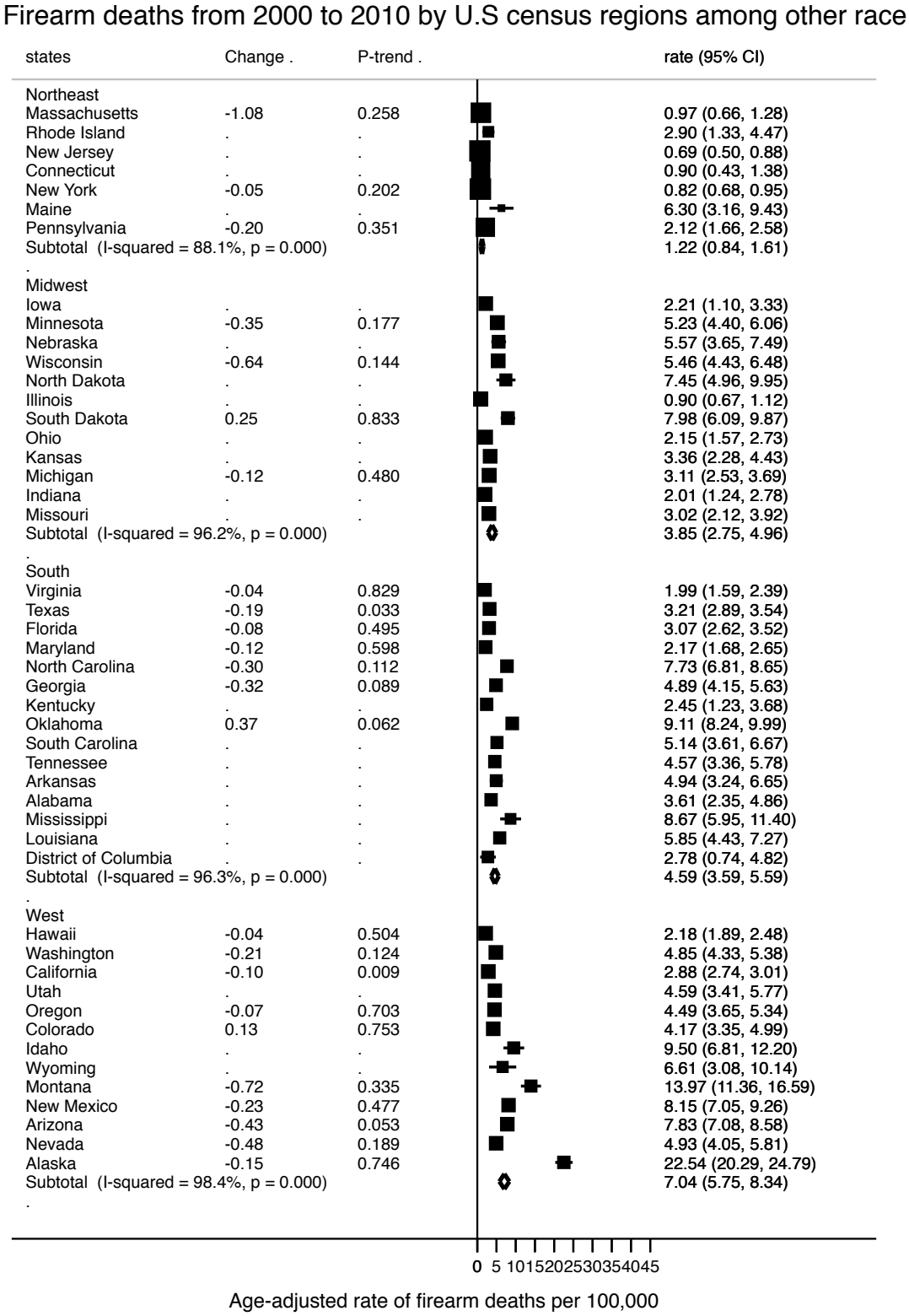
Supplementary Figure 1A:



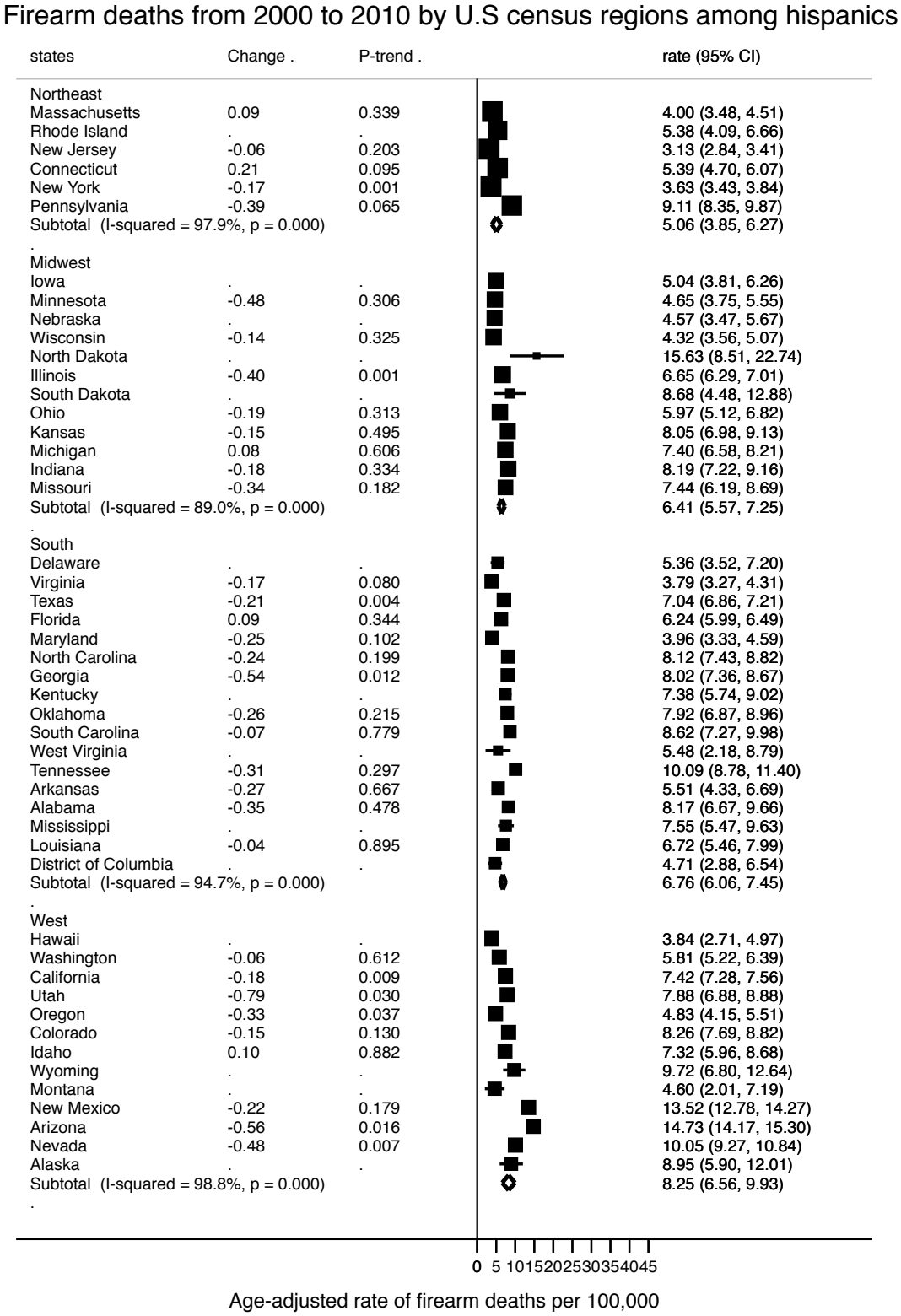
Supplementary Figure 1B:



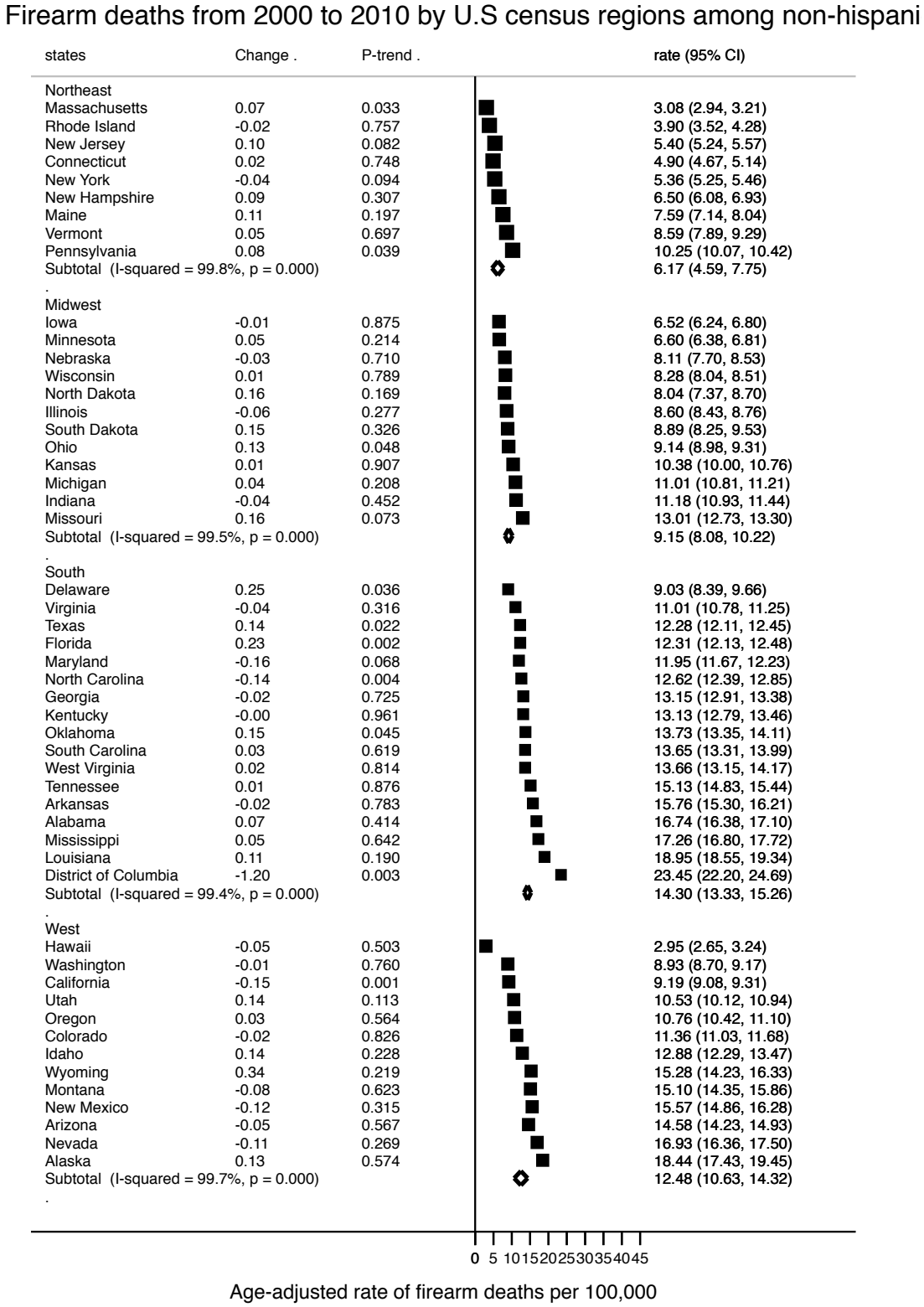
Supplementary Figure 1C



Supplementary Figure 2A:

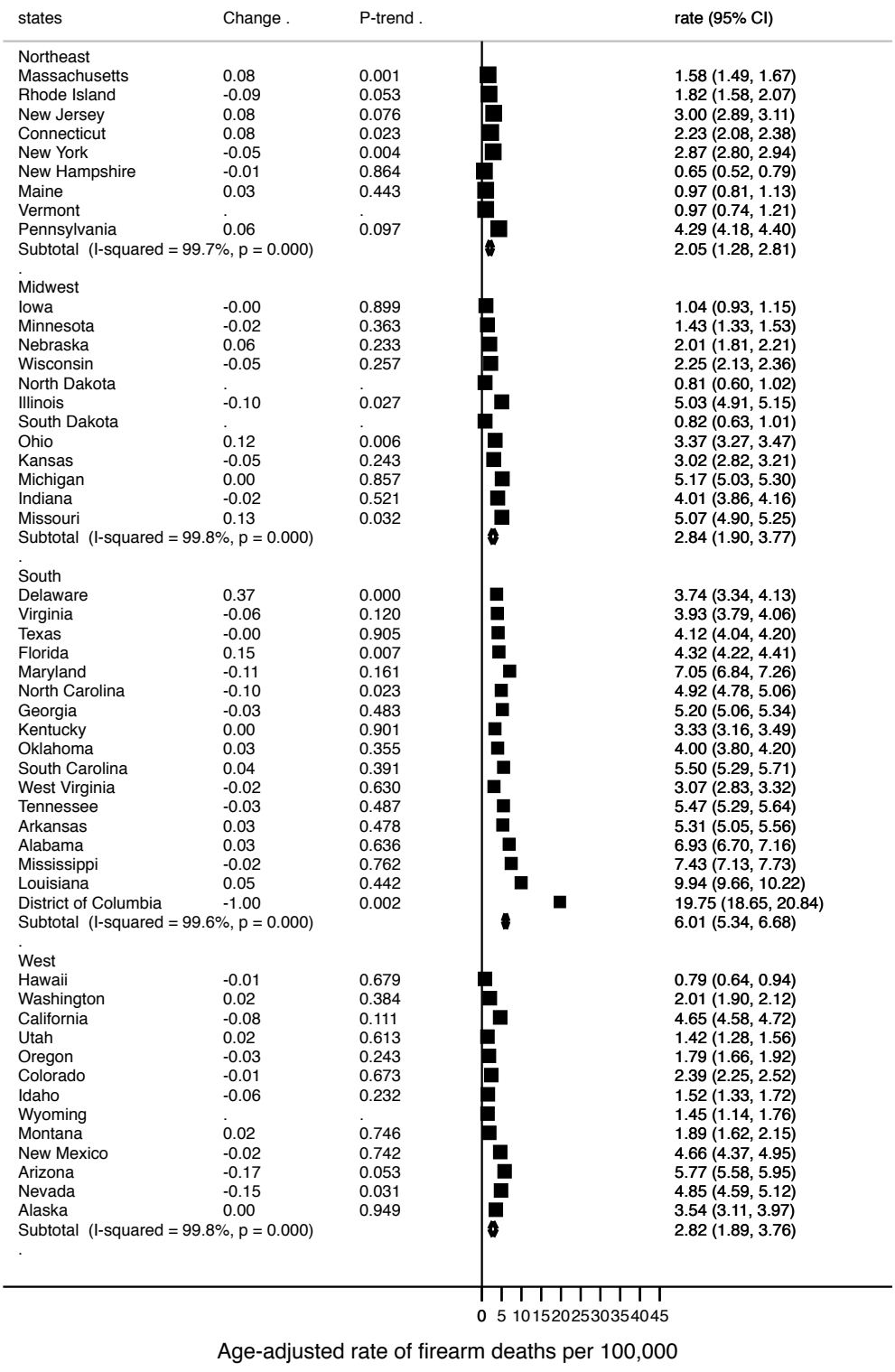


Supplementary Figure 2B:



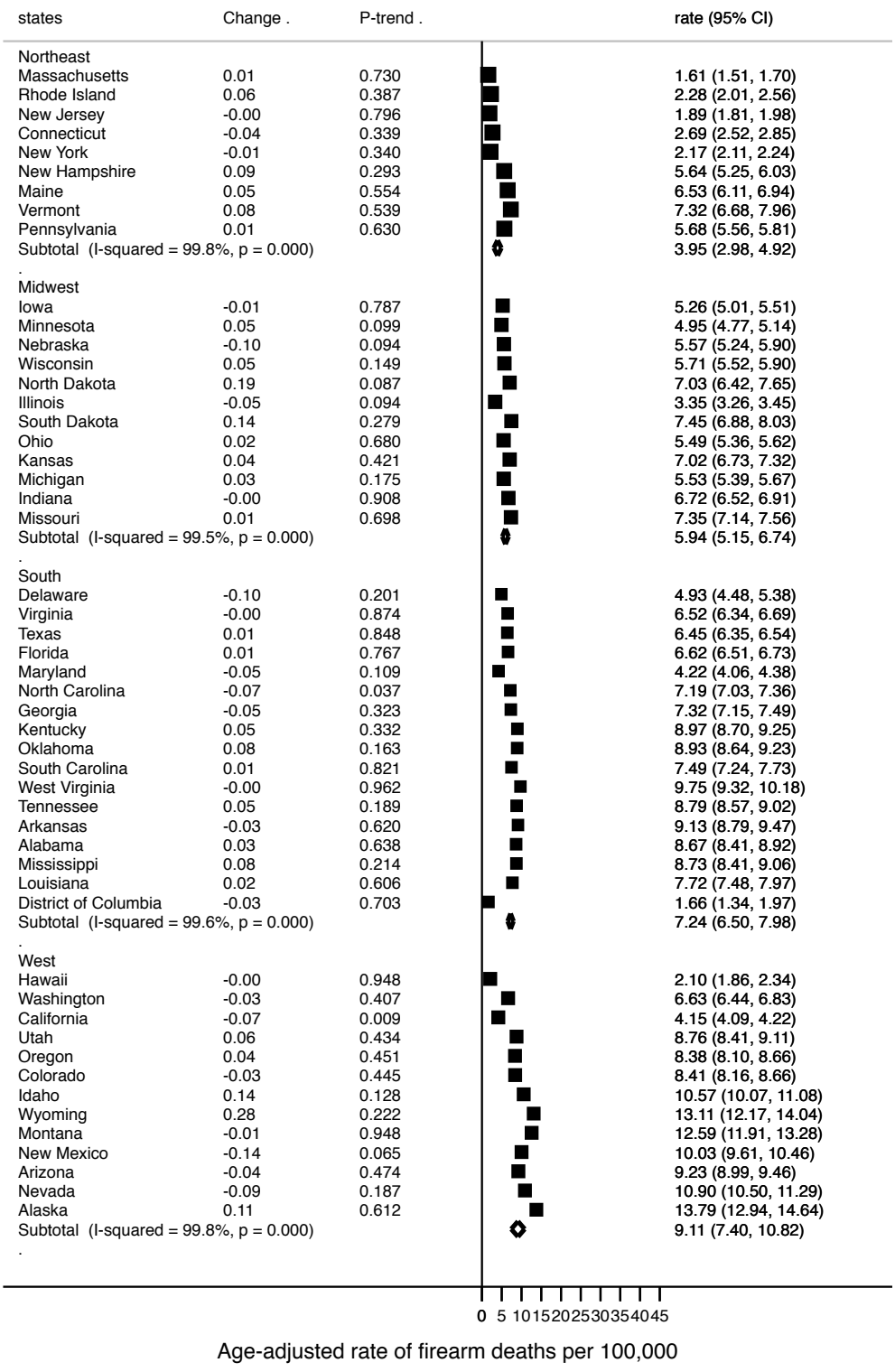
Supplementary Figure 3A:

Firearm deaths due to homicide from 2000 to 2010 by U.S census regions

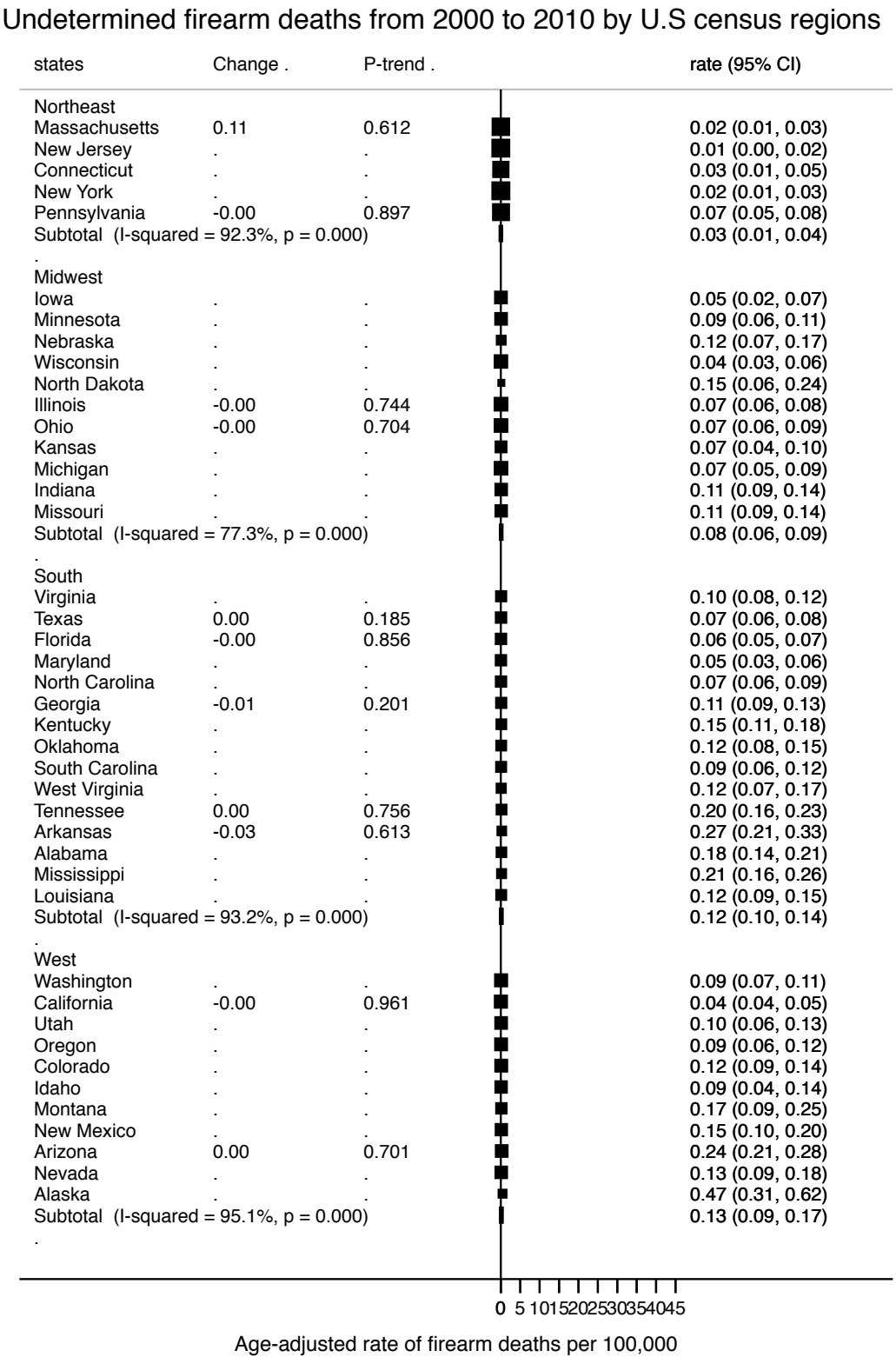


Supplementary Figure 3B:

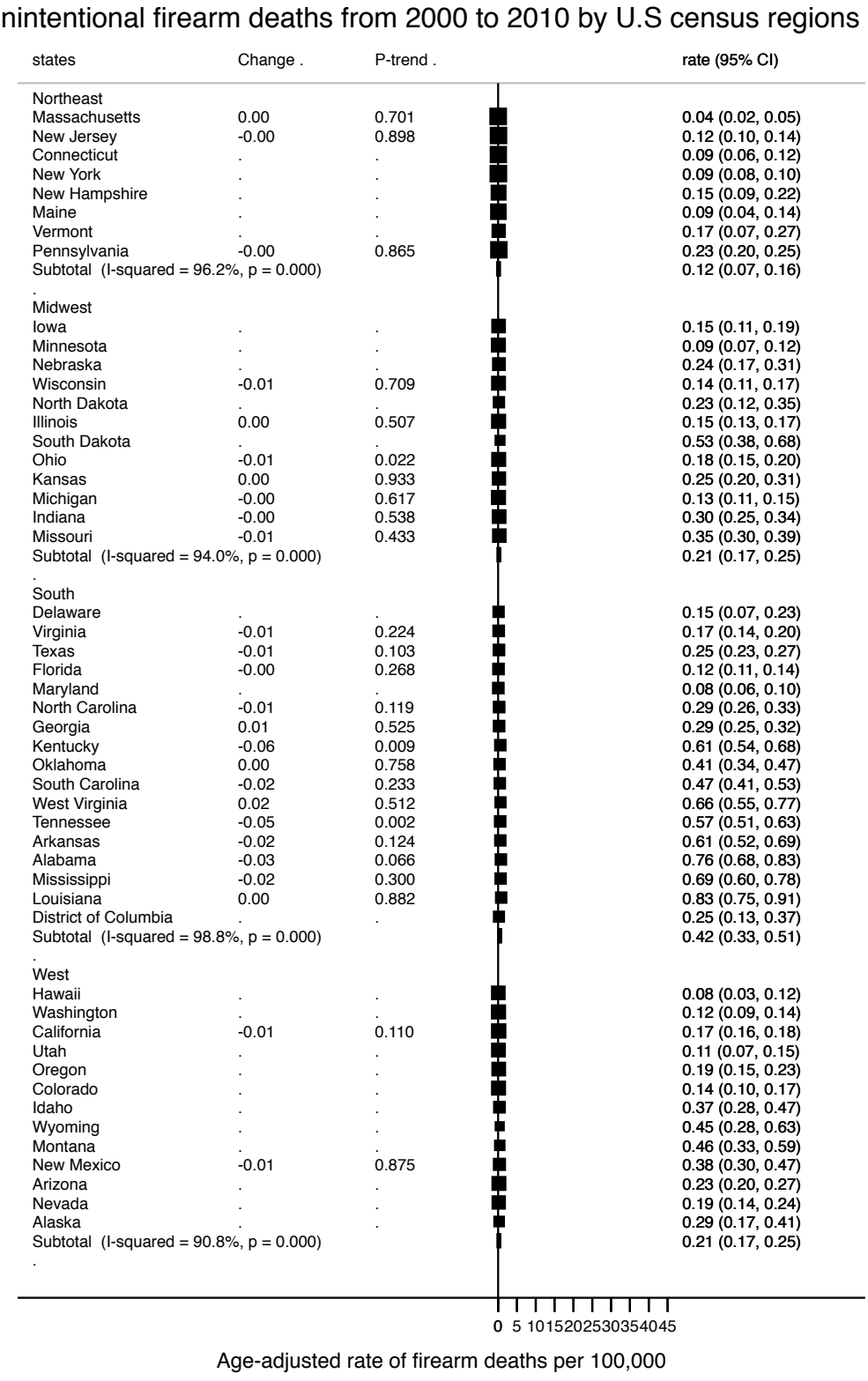
Firearm deaths due to suicides from 2000 to 2010 by U.S census regions



Supplementary Figure 3C:



Supplementary Figure 3D:



Supplementary Table 1: Firearm related trends in death, annual rate of change in death, lives lost and saved in the United States by states, WISQARS 2000 to 2010.

	Age-adjusted firearm deaths per 100,000 population												Change in rate			Lives lost/ saved (-)	
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total	Annual	95% CI	P-trend	11 years	Per year
All	10.14	10.31	10.43	10.29	9.99	10.27	10.22	10.24	10.23	10.05	10.07	10.21	-0.17	-0.044, 0.010	0.181	-5527.8	-502.5
Northeast																	
Massachusetts	2.73	3.00	3.13	3.09	3.16	3.42	3.22	3.55	3.34	3.1	4.03	3.24	0.074	0.025, 0.122	0.008	52.4	4.8
Rhode Island	5.10	4.30	5.14	3.12	3.61	3.60	4.21	3.40	3.94	5.02	4.60	4.18	-0.013	-0.180, 0.155	0.869	-1.5	-0.1
New Jersey	4.11	4.44	4.88	5.42	5.37	5.15	5.82	5.25	4.94	4.70	5.20	5.03	0.063	-0.035, 0.161	0.182	59.8	5.4
Connecticut	5.32	5.63	4.32	4.37	5.00	5.34	4.99	4.15	5.60	4.90	5.85	5.04	0.028	-0.103, 0.159	0.637	10.8	1.0
New York	5.70	5.54	5.13	5.32	4.88	5.21	5.14	5.04	4.90	4.79	5.07	5.15	-0.064	-0.104, -0.023	0.006	-134.9	-12.3
New Hampshire	6.27	7.23	5.91	6.8	5.02	6.62	6.22	5.56	6.86	6.34	8.22	6.49	0.065	-0.126, 0.255	0.461	9.2	0.8
Maine	8.55	7.29	6.63	6.02	7.9	7.71	7.28	7.61	8.42	8.58	7.86	7.61	0.100	-0.077, 0.277	0.232	14.4	1.3
Vermont	8.74	8.20	9.74	7.58	9.41	6.79	8.14	8.08	8.19	8.72	10.21	8.53	0.037	-0.222, 0.296	0.753	2.5	0.2
Pennsylvania	10.15	9.53	9.96	9.87	10.2	10.76	10.9	10.52	10.53	10.41	10.11	10.27	0.064	-0.014, 0.142	0.095	87.8	8.0
Midwest																.	.
Iowa	6.46	6.37	6.73	6.94	6.45	6.71	6.34	4.99	7.25	6.23	6.8	6.5	-0.017	-0.157, 0.124	0.796	-5.6	-0.5
Minnesota	6.34	6.49	6.06	6.5	7.04	6.94	6.3	6.48	6.97	6.17	6.76	6.57	0.024	-0.053, 0.101	0.495	13.5	1.2
Nebraska	9.77	8.12	8.05	7.64	6.71	7.67	7.69	7.95	8.27	7.26	8.16	7.94	-0.071	-0.231, 0.090	0.346	-13.8	-1.3
Wisconsin	7.99	8.70	8.08	8.44	7.37	8.48	7.56	8.54	7.72	7.91	8.57	8.14	-0.008	-0.113, 0.096	0.859	-4.9	-0.4
North Dakota	6.6	7.6	9.12	8.83	7.5	8.9	6.62	8.27	8.51	8.92	9.56	8.23	0.155	-0.086, 0.395	0.180	11.1	1.0
Illinois	9.00	10.21	9.69	9.01	7.8	8.01	8.08	8.03	8.55	8.17	8.19	8.61	-0.155	-0.286, -0.025	0.025	-215.3	-19.6
South Dakota	7.47	7.1	7.91	9.86	9.97	10.2	9.74	6.14	10.5	9.31	9.23	8.89	0.157	-0.168, 0.481	0.304	13.5	1.2
Ohio	7.81	9.00	9.31	8.12	8.97	9.63	9.66	9.55	9.67	8.5	9.95	9.1	0.122	-0.010, 0.253	0.066	153.8	14.0
Kansas	11.15	9.93	9.7	11.13	10.73	9.25	10.84	10.35	9.7	10.76	10.44	10.37	-0.012	-0.158, 0.135	0.860	-3.6	-0.3
Michigan	10.83	10.83	10.99	10.33	10.52	10.78	11.53	11.03	10.96	11.07	10.98	10.9	0.037	-0.034, 0.109	0.271	40.6	3.7
Indiana	10.88	11.82	11.68	11.19	10.22	11.11	11.63	10.5	11.24	11.33	10.82	11.13	-0.031	-0.143, 0.081	0.546	-21.4	-1.9
Missouri	13.24	13.14	12.21	11.42	11.44	12.9	13	12.79	13.74	13.71	13.93	12.88	0.135	-0.036, 0.306	0.108	86.1	7.8
South																.	.
Delaware	6.66	9.47	9.07	7.86	8.78	8.78	9.19	8.91	10.65	8.76	9.88	8.89	0.201	-0.018, 0.419	0.067	18.7	1.7

Virginia	11.13	10.61	11.01	10.86	10.81	11.48	10.36	10.4	10.18	10.28	10.69	10.71	-0.068	-0.149, 0.014	0.092	-56.6	-5.1
Texas	10.57	11.22	10.83	11.21	10.66	11.09	10.47	10.89	10.83	10.98	10.93	10.89	0.001	-0.054, 0.056	0.976	2.5	0.2
Florida	10.19	10.68	10.97	11.05	10.46	9.95	11.05	12.02	12.18	11.98	11.44	11.12	0.160	0.038, 0.282	0.016	310.1	28.2
Maryland	11.91	11.46	11.54	11.96	11.93	11.86	12.1	12.04	11.61	10.19	9.26	11.39	-0.169	-0.335, -0.002	0.048	-103.5	-9.4
North Carolina	13.56	13.06	13.43	12.35	12.21	12.74	12.55	12.17	12.31	11.59	11.57	12.49	-0.174	-0.255, -0.092	0.001	-168.1	-15.3
Georgia	13.4	13.44	13.39	13.72	12.16	12.05	12.54	13.4	12.43	13.06	12.62	12.92	-0.076	-0.197, 0.045	0.189	-75.0	-6.8
Kentucky	13.25	12.69	13.04	13.38	13.04	12.94	12.47	14.11	13.28	12.78	12.48	13.05	-0.020	-0.140, 0.010	0.713	-9.2	-0.8
Oklahoma	13.21	14.01	12.81	12.77	12.86	13.15	13.26	13.18	13.91	14.33	14.31	13.45	0.105	-0.028, 0.238	0.108	41.3	3.8
South Carolina	12.42	13.72	13.69	14.17	13.5	13.75	13.88	13.09	13.17	13.52	13.92	13.55	0.032	-0.088, 0.152	0.561	15.2	1.4
West Virginia	12.99	13.15	14.67	14.01	13.6	13.72	13.32	14.06	12.66	13.21	14.23	13.6	0.002	-0.183, 0.188	0.978	0.4	0.0
Tennessee	15.63	14.47	15.4	14.11	14.54	16.03	15.3	14.74	15.46	15.06	14.42	15.03	-0.013	-0.148, 0.123	0.837	-8.6	-0.8
Arkansas	15.42	15.27	16.29	14.96	14.65	15.62	15.12	15.09	15.6	16.03	14.39	15.31	-0.033	-0.193, 0.126	0.648	-10.1	-0.9
Alabama	17.14	16.41	16.08	16.8	14.79	15.99	16.7	17.24	17.31	17.18	16.18	16.53	0.045	-0.128, 0.217	0.574	22.8	2.1
Mississippi	16.56	17.64	17.34	16.81	16.41	15.98	16.54	18.28	19.25	16.65	16.05	17.06	0.015	-0.209, 0.239	0.883	4.8	0.4
Louisiana	17.58	17.46	19.31	18.61	19.52	18.35	19.02	19.77	18.34	18.03	19.11	18.62	0.082	-0.081, 0.244	0.286	40.4	3.7
District of Columbia	22.24	25.46	29.79	25.71	22.64	23.47	19.99	21.66	20.01	15.96	14.62	21.71	-1.067	-1.621, -0.512	0.002	-67.7	-6.2
West																.	.
Hawaii	4.2	3.74	2.82	2.88	3.1	2.14	2.38	2.44	3.04	3.34	3.21	3.02	-0.057	-0.190, 0.076	0.359	-8.1	-0.7
Washington	8.94	8.53	9.34	9.17	9.17	8.8	8.37	8.32	8.69	9.14	8.92	8.85	-0.018	-0.099, 0.063	0.623	-12.5	-1.1
California	9.27	9.31	9.75	9.78	9.24	9.52	9.15	8.84	8.5	8.17	7.7	9.01	-0.166	-0.249, -0.083	0.001	-652.3	-59.3
Utah	9.93	10.99	9.6	10.51	10.13	9.91	9.75	10.63	9.68	10.46	12.16	10.39	0.081	-0.077, 0.240	0.276	22.1	2.0
Oregon	10.81	10.16	10.49	10.72	10.36	10.68	10.16	9.91	9.73	10.31	11.33	10.44	-0.011	-0.127, 0.106	0.839	-4.4	-0.4
Colorado	10.36	11.68	11.47	11.13	11.96	11.53	10.33	10.38	10.39	11.58	10.72	11.05	-0.045	-0.183, 0.092	0.474	-23.1	-2.1
Idaho	10.19	13.5	12.42	12.33	13.04	13.94	12.69	12.75	11.4	12.85	12.73	12.56	0.077	-0.148, 0.302	0.459	12.1	1.1
Wyoming	11.72	13.91	18.87	17.46	11.15	13.39	14.85	14.66	16.91	17.59	15.54	15.09	0.267	-0.257, 0.791	0.279	15.3	1.4
Montana	14.85	17.77	14.61	15.68	13.05	16.85	12.25	13.54	15.73	16.04	15.56	15.11	-0.040	-0.420, 0.341	0.819	-4.2	-0.4
New Mexico	16.08	15.26	16.61	17.55	15.15	13.89	14.45	14.85	14.68	14.48	14.84	15.23	-0.184	-0.376, 0.008	0.058	-39.2	-3.6
Arizona	15.58	15.92	17.89	15.29	15.84	16	16.22	15.38	14.36	13.49	14.53	15.47	-0.230	-0.423, -0.036	0.025	-147.2	-13.4
Nevada	17.26	16.54	17.06	17.04	16.74	16.09	16.3	15.87	15.15	15.11	14.49	16.07	-0.264	-0.441, -0.086	0.008	-69.9	-6.4

Alaska	17.96	14.83	19.89	19.24	17.51	17.47	16.94	18.22	20.92	14.68	20.51	18.09	0.102	-0.375, 0.580	0.639	7.5	0.7

All values are age-adjusted rates per 100,000 population.
Change denotes annual change in rate per 100,000. Negative value indicates decline in firearm death rates per 100,000 from 2000 to 2010 and positive value indicates increase in firearm death rate per 100,000 from 2000 to 2010.
CI denotes confidence intervals of the annual change in firearm death rate per 100,000.
P-trend calculated using meta-regression indicates the significance of the decline or the increase in firearm related death rates from 2000 to 2010.
Lives lost or saved are calculated by applying annual change to the total 11-year population from 2000 to 2010. The annual lives lost or saved are the total/ 11 years. Negative denotes lives saved and positive values are lives lost.
Data are from Center for Disease Control and Prevention (CDC)'s National center for Injury Prevention and Control Web-based Injury Statistics Query and Reporting System (WISQARS).

Supplementary Table 2: US states with significant racial and ethnic trends within firearm fatality rates

		GA	IN	KA	MN	OK	OR	PA	TX	UT
Overall	FRF rate	12.92	11.13	10.37	6.57	13.45	10.44	10.27	10.89	10.39
	Change	-0.08	-0.03	-0.01	0.02	0.11	-0.01	0.06	0.001	0.08
	P-trend	0.19	0.55	0.86	0.49	0.11	0.84	0.095	0.98	0.28
Whites	FRF rate	12.16	9.25	9.46	6.04	12.94	10.64	7.84	10.81	10.66
	Change	-0.07	0.01	0.07	0.06	-0.02	0.01	0.06	0.03	0.08
	P-trend	0.36	0.77	0.38	0.12	0.74	0.89	0.076	0.45	0.34
	Pop % change	-3.8	-2.0	-1.7	-3.3	-2.2	-2.0	-2.6	-2.3	-1.4
Blacks	FRF rate	14.05	28.92	24.14	13.52	20.04	11.47	27.48	13.37	7.73
	Change	-0.06	**-0.66**	**-1.07**	**-0.61**	**0.93**	-0.67	-0.14	-0.09	ne
	P-trend	0.57	**0.012**	**0.021**	**0.038**	**0.008**	0.23	0.59	0.60	ne
	Pop % change	2.3	1.2	0.6	1.9	0.4	0.4	1.3	0.6	0.5
Other	FRF rate	4.89	2.01	3.36	5.23	9.11	4.49	2.12	3.21	4.59
	Change	-0.32	ne	ne	-0.35	**0.37**	-0.07	-0.20	**-0.19**	ne
	P-trend	0.089	ne	ne	0.18	**0.062**	0.70	0.35	**0.033**	ne
	Pop % change	1.5	0.8	1.0	1.4	1.8	1.5	1.2	1.7	0.9
Hispanic	FRF rate	8.02	8.19	8.05	4.65	7.92	4.83	9.11	7.04	7.88
	Change	**-0.54**	-0.18	-0.15	-0.48	-0.26	**-0.33**	**-0.39**	**-0.21**	**-0.79**
	P-trend	**0.012**	0.33	0.49	0.31	0.21	**0.037**	**0.065**	**0.004**	**0.030**
	Pop % change	3.5	2.5	3.5	1.8	3.7	3.7	2.5	5.6	3.9
Non-Hispanic	FRF rate	13.15	11.18	10.38	6.60	13.73	10.76	10.25	12.28	10.53
	Change	-0.02	-0.04	0.01	0.05	**0.15**	0.03	**0.08**	**0.14**	**-0.15**
	P-trend	0.73	0.45	0.91	0.21	**0.045**	0.56	**0.039**	**0.022**	**0.001**
	Pop % change	-3.5	-2.5	-3.5	-1.8	-3.7	-3.7	-2.5	-5.6	-3.9
Intent	Homicide	↔	↔	↔	↔	↔	↔	↔	↔	↔
	Suicides	↔	↔	↔	↔	↔	↔	↔	↔	↔
	Undetermined	↔	ne	ne	ne	ne	ne	↔	↔	ne
	Unintentional	↔	↔	↔	ne	↔	ne	↔	↔	ne

FRF: firearm related fatality, Pop % change: change in population percentage from 2000 to 2010. All values are age-adjusted rates per 100,000 population. Change denotes annual change in rate per 100,000. Negative value indicates decline in firearm death rates per 100,000 from 2000 to 2010 and positive value indicates increase in firearm death rate per 100,000 from 2000 to 2010. CI denotes confidence intervals of the annual change in firearm death rate per 100,000. SMD indicates standardized mean difference; is equal to annual change/standard deviation. P-trend calculated using meta-regression indicates the significance of the decline or the increase in firearm related death rates from 2000 to 2010.Data are from Center for Disease Control and Prevention (CDC)'s National center for Injury Prevention and Control Web-based Injury Statistics Query and Reporting System (WISQARS)

STROBE 2007 (v4) checklist of items to be included in reports of observational studies in epidemiology*

Checklist for cohort, case-control, and cross-sectional studies (combined)

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	3
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5
Objectives	3	State specific objectives, including any pre-specified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	6
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*6*
Bias	9	Describe any efforts to address potential sources of bias	16-17
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7
		(*b*) Describe any methods used to examine subgroups and interactions	7
		(*c*) Explain how missing data were addressed	na
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed	7

		Cross-sectional study—If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	na
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	na
		(c) Consider use of a flow diagram	na
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	na
		(b) Indicate number of participants with missing data for each variable of interest	na
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	na
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	na
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	na
		Cross-sectional study—Report numbers of outcome events or summary measures	8-11
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-11
		(*b*) Report category boundaries when continuous variables were categorized	na
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	na
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	8-11
Discussion			
Key results	18	Summarise key results with reference to study objectives	12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	16-17
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12-16
Generalisability	21	Discuss the generalisability (external validity) of the study results	na
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	na

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.
Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.