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Original Contribution

The Hidden Epidemic of Firearm Injury: Increasing Firearm Injury Rates During 2001–2013

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Investigating firearm injury trends over the past decade, we examined temporal trends overall and according to race/ethnicity and intent in fatal and nonfatal firearm injuries (FFIs and NFIs) in United States during 2001–2013. Counts of FFIs and estimated counts of NFIs were obtained from the Centers for Disease Control and Prevention's Web-based Injury Statistics Query and Reporting System. Poisson regression was used to analyze overall and subgroup temporal trends and to estimate annual change per 100,000 persons (change). Total firearm injuries (n = 1,328,109) increased annually by 0.36 ($P_{trend} < 0.0001$). FFIs remained constant (change = 0.02; $P_{trend} = 0.22$) while NFIs increased (change = 0.35; $P_{trend} < 0.0001$). Homicide FFIs declined (change = −0.05; $P_{trend} < 0.0001$) while homicide NFIs increased (change = 0.43; $P_{trend} < 0.0001$). Suicide FFIs increased (change = 0.07; $P_{trend} < 0.0001$) while unintentional FFIs and NFIs declined (changes = −0.01 and −0.09, respectively; $P_{trend} < 0.0001$ and 0.005). Among whites, FFIs (change = 0.15; $P_{trend} < 0.0001$) and NFIs (change = 0.13; $P_{trend} < 0.0001$) increased; among blacks, FFIs declined (change = −0.20; $P_{trend} < 0.0001$). Among Hispanics, FFIs declined (change = −0.28; $P_{trend} < 0.0001$) while NFIs increased (change = 0.55; $P_{trend} = 0.014$). The endemic firearm-related injury rates during the first decade of the 21st century mask a shift from firearm deaths towards a rapid rise in nonfatal injuries.

disparities; firearms; injury; race/ethnicity; temporal trends

Abbreviations: CDC, Centers for Disease Control and Prevention; ED, emergency department; FFI, fatal firearm injury; NEISS-AIP, National Electronic Injury Surveillance System–All Injury Program; NFI, nonfatal firearm injury; WISQARS, Web-based Injury Statistics Query and Reporting System.

The majority of firearm violence victims are nonfatally injured, and approximately one third of victims are fatally injured (1, 2). In the United States during 2001–2013, there were 406,496 fatal firearm injuries (FFIs) (10.2 per 100,000 persons) and an estimated 921,613 nonfatal firearm injuries (NFIs) (23.4 per 100,000), compared with a rate of death by any injury of 57.6 per 100,000. The majority of the nonfatally wounded require medical attention, and 80% of those may require hospitalization (3, 4). Despite aggressive resuscitation and treatment being available to these victims, many have poor quality of life and heavy morbidity throughout their remaining life. A substantial proportion of these wounded subsequently die of health consequences directly related to firearm-related trauma (4, 5). Despite this burden of NFI, our understanding of NFI is much more limited than is our understanding of FFI (6, 7). Most of the current evidence on NFI has focused on an evaluation of injury severity and in-hospital outcomes that have used data from trauma centers (5) or nationally representative hospitalizations where firearm injuries do not include minor injuries treated in the emergency department (ED) followed by discharge (3, 8, 9). Despite its importance to understanding the total firearm injury burden, to our knowledge, no study has compared FFI and NFI. In this study, we aimed first to document and compare the temporal trends of national FFI and NFI rates during 2001–2013 and second to assess differences in temporal

trends among subgroups according to race/ethnicity and intent, separately for FFI and NFI.

METHODS

Data sources

We used FFI and NFI data from national counts and estimates that were derived by querying the restricted, publicly available injury data available through the Web-based Injury Statistics Query and Reporting System (WISQARS). WISQARS is an interactive database launched by the National Center for Injury Prevention and Control at the Centers for Disease Control and Prevention (CDC) (6). Fatal injury data for WISQARS are collected through the National Vital Statistics System operated by the National Center for Health Statistics (http://www.cdc.gov/nchs/), which uses *International Classification of Diseases*, *Tenth Revision*, codes for determining the underlying cause of death (10). The data source for NFI reports was the National Electronic Injury Surveillance System–All Injury Program (NEISS-AIP), a collaborative effort between the CDC's National Center for Injury Prevention and Control and the Consumer Product Safety Commission. The NEISS-AIP collects data on nonfatal injuries of all types and external causes, using *International Classification of Diseases*, *Ninth Revision*, classification (1), from 66 of the 100 NEISS-AIP designated hospital EDs. NEISS-AIP hospitals include large inner-city hospitals with trauma centers and large urban, suburban, rural, and children's hospitals. The 66 NEISS-AIP hospitals are a nationally representative, stratified probability sample of all US hospitals that have at least 6 beds and 24-hour emergency services (11). These 66 hospitals provide data on approximately 500,000 ED injury cases annually, weighted by inverse probability of selection to provide national estimates (6). Although the ED cases are monitored and reported for deaths, posthospitalization deaths are not accurately recorded (12). Therefore, we used location-specific FFI data from the CDC's Wide-ranging Online Data for Epidemiologic Research (WONDER) to identify posthospitalization firearm deaths (2). The details are presented in Web Appendix 1, Web Tables 1 and 2 (available at http://aje.oxfordjournals.org/). To protect patient privacy and prevent inadvertent identification of cases, the National Center for Health Statistics and the National Association of Public Health Statistics and Information Systems restrict country- and state-level reporting of deaths to cumulative frequencies of 10 or more (6).

Study population

Our study population was a total of 1,328,109 individuals who sustained firearm injuries between 2001 and 2013, of which 406,496 were FFIs and 921,613 were NFIs. Only 35,662 (2.7%) of FFI deaths occurred in a hospital, hospice facility, or nursing home/long-term care facility, and there may be an overlap between FFIs and NFIs. The annual population and aggregate counts of FFIs and NFIs were obtained separately for overall and according to age, sex, race/ethnicity, and intent of injury. Each case in the fatal injury report corresponds to 1 death and each case in the nonfatal injury report corresponds to 1 ED case, which may have been either treated and released (NFI-ED) or further hospitalized/transferred/left against medical advice (NFI-hospitalizations).

Variables and definitions

All firearm injuries were broadly categorized as FFI or NFI. Age groupings were 0–14 years, 15–44 years, and ≥45 years. Racial/ethnic information for FFI was available separately as race (white, black, or other) and ethnicity (Hispanic or non-Hispanic). These designations were recoded for consistency into the same 4 categories as for NFI: 1) non-Hispanic white, 2) black (both Hispanic and non-Hispanic black), 3) Hispanic (except Hispanic-black), and 4) other. For FFI, intent of injury was available in 4 categories: homicide (assault, including legal intervention), suicide (self-inflicted, intentional), unintentional, and undetermined. For NFIs, unintentional and undetermined were available only as a single category. For comparability between NFI and FFI intent, we collapsed the separate categories of unintentional and undetermined available for FFI injuries to create identical categorizations for intent in NFI and FFI.

Statistical analysis

First we used annual injury counts as numerator and population as denominator to calculate crude rates per 100,000 persons overall and for each subgroup of age, sex, race/ethnicity, and intent of FFI and NFI. We used crude rates to be consistent with the Poisson regression analysis performed using actual counts. We present analyses using crude counts to accurately represent the counts available for analyses in the publicly available data. Second, we assumed linear trends across 13 years in order to assess the temporal trends in firearm injuries, and we used Poisson regression (a log-linear model) to model annual firearm-event counts and predict the firearm injury rates by injury type. We used Poisson regression because there were no zero counts and the mean of the distribution of counts was equivalent to the variance. Additionally, we compared the fit with negative binomial regression models and zero-inflated negative binomial models by first plotting the predicted residuals from both models by the count of FFI and NFI events, and second with goodness-of-fit comparisons using the Akaike information criterion, Bayesian information criterion, and Vuong test (13). Third, using a Poisson regression model, we predicted the annual rates per 100,000 and estimated incidence rate ratios, 95% confidence intervals, and discrete annual change in injury rates per 100,000 persons for overall and by subgroups. The significance of the temporal trend was assessed from the model using P_{trend}. Fourth, we performed 2-way interaction tests to determine whether the temporal trends within each category of the subgroup varied across the categories of the injury type of FFI and NFI. Three-way interaction tests were also performed between temporal trends of each subgroup category across injury type and across all the categories of the subgroups. We used $P_{\text{interaction}}$ to assess the significance of interactions and Pearson's goodness-of-fit to confirm model fit. Fifth, we also performed a sensitivity analysis by

excluding from NFI-hospitalization those FFI deaths that occurred in the hospital, hospice, or nursing homes.

All P values were 2-sided and significance level was <0.05. STATA/MP, version 13.1 (StataCorp LP, College Station, Texas; 2009), was used for data analyses.

RESULTS

During 2001–2013, a total of 1,328,109 firearm-related injuries were recorded. Of these, 406,496 (30.6%) were FFIs. Figure 1 displays the stacked annual rates and temporal trends of FFI and NFI during 2001–2013. The overall FFI rates ranged from 10.4 to 10.6 per 100,000 persons without a significant increase (annual change = 0.02; $P_{trend} = 0.22$) while NFI rates increased from 22.1 to 26.7 per 100,000 (annual change = 0.35; $P_{trend} < 0.0001$), with a significant overall increase (annual change = 0.36; $P_{trend} < 0.0001$). After exclusion of 35,662 cases from the NFI group that may have been misclassified as nonfatal due to a possible later death (Web Appendix 1, Web Tables 1 and 2), the results are comparable (Web Figure 1).

Table 1 presents the temporal trends during 2001–2013 of FFI and NFI within categories of race/ethnicity. According to race/ethnicity, the overall firearm injury trends showed an increase among non-Hispanic whites (annual change = 0.28; $P_{trend} < 0.0001$) and a decline among others (non-Hispanic) (annual change = −0.46; $P_{trend} = 0.006$). Specifically, the increase among whites was for both FFI and NFI, with no differential in trends by injury type ($P_{interaction} = 0.92$). Among blacks, Hispanics, and others (non-Hispanic), FFI showed a declining trend while NFI increased among Hispanics (annual change = 0.55; $P_{trend} = 0.014$) and declined among others (non-Hispanic) (annual change = −0.38; $P_{trend} = 0.024$). Trend for type of firearm injury was significantly different by age ($P_{interaction} = 0.037$) and by race/ethnicity ($P_{interaction} = 0.001$) but not by sex ($P_{interaction} = 0.49$).

Figure 2 demonstrates temporal trends by intent for FFI and NFI during 2001–2013. Homicide firearm injuries increased annually by 0.38 per 100,000 ($P_{trend} < 0.0001$). However, homicide FFI showed an annual decline (−0.05; $P_{trend} < 0.0001$), while homicide NFI increased across 13 years (annual change = 0.43; $P_{trend} < 0.0001$) ($P_{interaction} < 0.0001$). Suicide firearm injuries increased annually at 0.082 per 100,000 ($P_{trend} < 0.0001$), with increasing trends exclusively observed for suicide FFI (annual change = 0.07; $P_{trend} < 0.0001$) and no difference in temporal trends by injury type ($P_{interaction} = 0.53$). Unintentional and undetermined injuries showed an annual decline of −0.10 ($P_{trend} = 0.002$), with declines for both FFI (annual change = −0.01; $P_{trend} < 0.0001$) and NFI (annual change = −0.09; $P_{trend} = 0.005$). The difference in temporal trends by injury type was significant for unintentional and undetermined injuries ($P_{interaction} = 0.014$). The difference between temporal trends of each subgroup category across injury type and across all the categories of the subgroups was significant ($P_{interaction} < 0.0001$).

Table 2 compares temporal trends in FFI and NFI injuries during 2001–2013 by intent and race/ethnicity. Homicide firearm injury trends showed no change among whites,

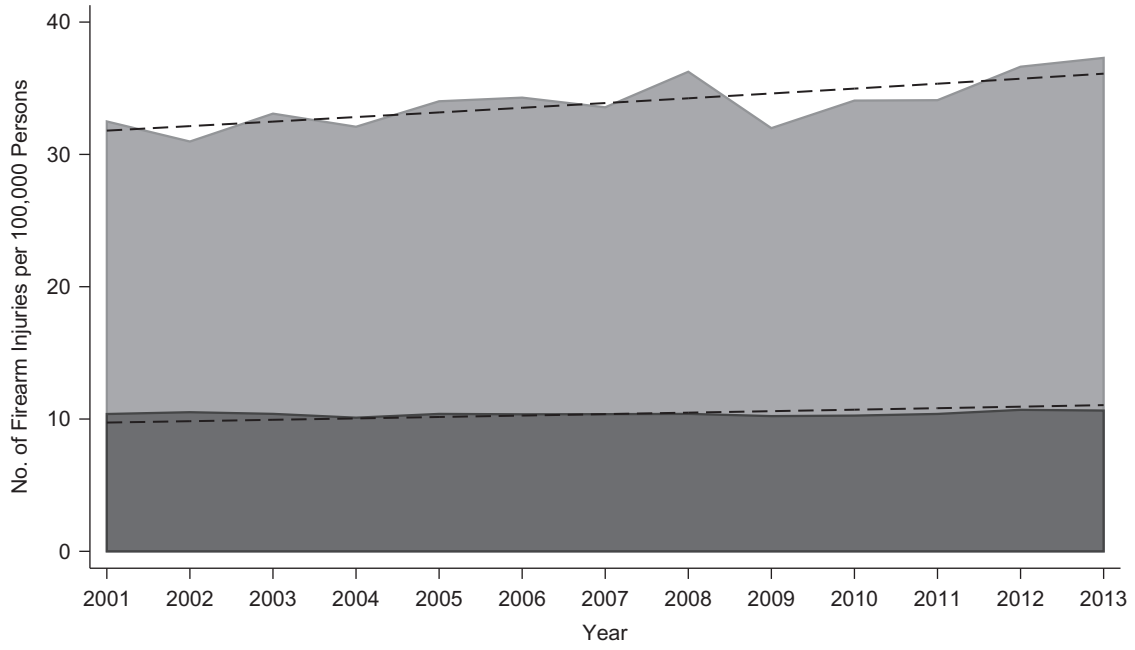

Figure 1. Temporal trends of fatal and nonfatal firearm injuries in the United States, 2001–2013. Rates of fatal firearm injuries (dark gray) and nonfatal firearm injuries (light gray) are presented cumulatively and stacked (nonfatal over fatal). The solid lines on top of the shaded segments connect the crude annual rates per 100,000 persons, and the dotted lines connect the predicted annual rates per 100,000 persons. Fatal firearm injuries: annual change = 0.015 per 100,000; $P = 0.22$. Nonfatal firearm injuries: annual change = 0.345 per 100,000; $P < 0.0001$. All fatal and nonfatal firearm injuries: annual change = 0.360 per 100,000; $P < 0.0001$.

Table 1. Temporal Trends of Fatal and Nonfatal Firearm Injuries by Race/Ethnicity, United States, 2001–2013

Race/Ethnicity and Injury Type	Rate per 100,000 Persons[a]			IRR	95% CI	Annual Change	P_{trend}	$P_{interaction}$[b]
	2001	2006	2013					
Race/ethnicity[c]								0.001[d]
White	16.9	18.0	20.4	1.02	1.01, 1.02	0.28	<0.0001	0.92
Fatal	9.44	9.19	11.0	1.02	1.01, 1.02	0.15	<0.0001	
Nonfatal	7.47	8.81	9.33	1.02	1.01, 1.02	0.13	<0.0001	
Black	92.6	98.3	86.8	0.99	0.99, 1.00	−0.48	0.059	0.14
Fatal	19.1	21.0	17.8	0.99	0.98, 0.99	−0.20	<0.0001	
Nonfatal	73.4	77.3	68.9	0.99	0.99, 1.00	−0.28	0.279	
Hispanic	31.6	35.7	30.3	1.01	0.99, 1.02	0.27	0.23	<0.0001
Fatal	8.54	7.98	5.60	0.96	0.95, 0.97	−0.28	<0.0001	
Nonfatal	23.1	27.8	24.7	1.02	1.00, 1.04	0.55	0.014	
Other	17.9	15.4	12.7	0.96	0.94, 0.99	−0.46	0.006	0.20
Fatal	4.20	4.29	3.68	0.98	0.97, 0.99	−0.08	<0.0001	
Nonfatal	13.7	11.2	9.03	0.96	0.92, 0.99	−0.38	0.024	

Abbreviations: CI, confidence interval; IRR, incidence rate ratio.

[a] The sum of fatal and nonfatal injuries within each racial/ethnic subgroup may not always add up to the total due to missing information in racial/ethnic subgroups for nonfatal firearm injuries.

[b] $P_{interaction}$ values are from 2-way interactions testing whether temporal trends vary between fatal and nonfatal firearm injury within each racial/ethnic group.

[c] Racial/ethnic categories were non-Hispanic white, black (including Hispanic and non-Hispanic), Hispanic (for all races other than black), and other non-Hispanic.

[d] $P_{interaction}$ value is for 3-way interactions, testing whether the difference in fatal and nonfatal injury temporal trends within each racial/ethnic group vary between the 4 racial/ethnic groups.

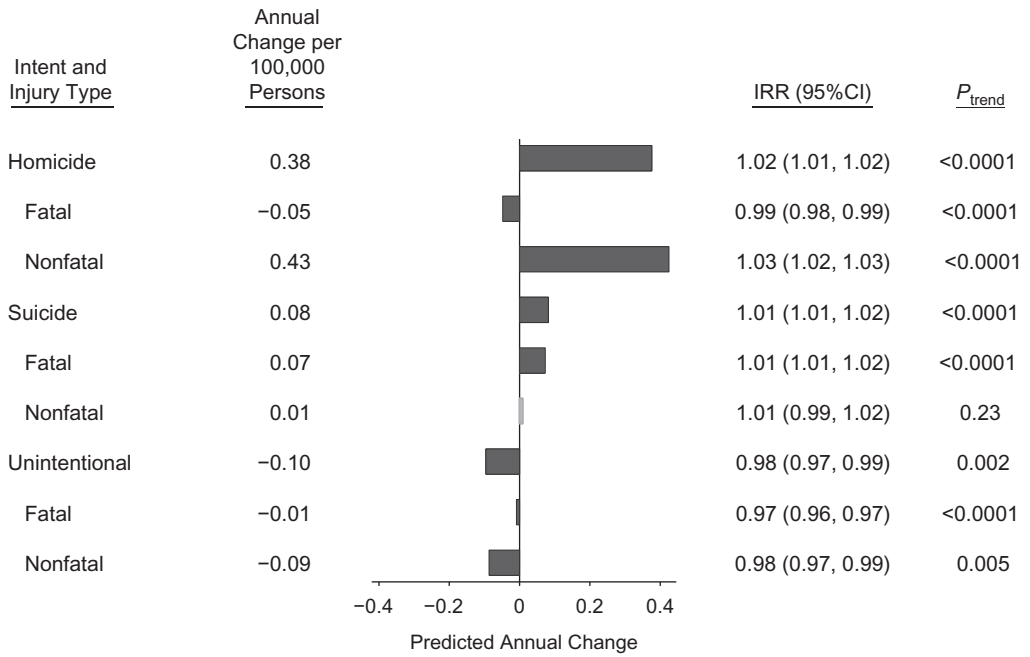

Figure 2. Temporal trends of different intents of fatal and nonfatal firearm injuries in the United States, 2001–2013. The horizontal bars represent the predicted annual change in rate per 100,000 persons. The *x*-axis is predicted annual change in rate per 100,000 persons. The black bars represent the statistically significant annual change, and the light gray bar represents annual change, which was not found to be significant. Unintentional injuries include undetermined injuries. $P_{interaction} < 0.0001$. CI, confidence interval; IRR, incidence rate ratio.

blacks, and Hispanics but declined among others (non-Hispanic) (annual change = −0.25; P_{trend} = 0.044). There was a decline in homicide FFI, no change in homicide NFI in all racial/ethnic groups, and an increase in NFI among whites (annual change = 0.08; P_{trend} = 0.049) and Hispanics (annual change = 0.66; P_{trend} = 0.002). The difference in temporal trends by type of injury was significant among whites ($P_{interaction}$ = 0.016), blacks ($P_{interaction}$ = 0.002), and Hispanics ($P_{interaction}$ < 0.0001). Homicide injury temporal trends of each injury type were significantly different across race/ethnicity ($P_{interaction}$ < 0.0001). Suicide firearm injuries were unchanged among blacks, Hispanics, and others (non-Hispanic) but increased among whites (annual change = 0.16; P_{trend} < 0.0001). Suicide FFI increased among whites (annual change = 0.16; P_{trend} < 0.0001) and declined among blacks (annual change = −0.02; P_{trend} = 0.014) and Hispanics (annual change = −0.02; P_{trend} < 0.0001). The rates of suicide NFI remained unchanged in all racial/ethnic groups. Suicide injury temporal trends of each injury type were significantly different across race/ethnicity ($P_{interaction}$ < 0.0001). Unintentional/undetermined firearm injury rates plateaued among whites and declined among Hispanics (annual change = −0.12; P_{trend} = 0.007), blacks (annual change = −0.46; P_{trend} < 0.0001), and others (non-Hispanic) (annual change = −0.21; P_{trend} = 0.017). Unintentional/undetermined FFI rates declined among all racial/ethnic groups, while NFI rates declined among blacks (annual change = −0.44; P_{trend} < 0.0001), Hispanics (annual change = −0.11; P_{trend} = 0.020), and others (non-Hispanic) (annual change = −0.20; P_{trend} = 0.024) without changing among whites (annual change = 0.06; P_{trend} = 0.11). Unintentional/undetermined injury temporal trends of each injury type were significantly different across race/ethnicity ($P_{interaction}$ < 0.0001). Additional information on temporal trends of FFI and NFI by age and sex are presented in Web Table 3.

DISCUSSION

Using the most comprehensive national data from 2001–2013 on FFI and NFI, we observed, as expected, that of all firearm injuries, two thirds were nonfatal and only a third were fatal. We present 4 novel findings. First, we showed that an increase in overall firearm injury rate across 13 years was driven by an increase in NFI with no change in FFI. Second, overall firearm injury trends were characterized by opposing intent-specific trends of increasing homicide and suicide injuries and declining unintentional/undetermined firearm injuries. The increase in homicide firearm injuries was characterized by a moderate decline in FFI and an 11-fold greater increase (0.43 vs. −0.05 annual change per 100,000 persons) in NFI, while the increase in suicide injuries and decline in unintentional/undetermined injuries was driven by FFI in their respective directions. Third, although blacks had overall firearm injury rates 4-fold greater than whites, there was a decline in FFI among blacks, while FFI and NFI increased among whites. Fourth, while the decline in homicide FFI occurred across all racial/ethnic groups, the increasing trend in suicide FFI was characterized by a substantial increase among whites and an opposing but moderate decline among blacks and Hispanics.

Our demonstration of an increase in overall firearm injuries adds to the finding of a steadily increasing trend of all violence involving firearms reported by the Department of Justice, where the rates of firearm injury among all injuries related to violence increased from 7.3% in 2000 to 8.2% in 2011 (14). This recent increase shown in our study suggests a reverse in the decline in firearm injury rates that occurred during 1993–2002 (7, 14). The unchanging FFI rate after 2000 was similar and a continuation of the lack of an upward or downward trend that we reported in our work using firearm deaths from 2000–2010 (15). More important, to our knowledge, there have been no studies that assessed the temporal trends of NFI that included both ED and hospitalizations. To date, the evidence regarding NFI was an incomplete representation of either ED or hospitalizations, amounting to 30% and 40% of the overall firearm injuries (1, 3). We demonstrate in this study that a large increasing temporal trend in NFI drove the increasing overall firearm injury rates, which in turn was largely due to mounting homicide NFI rates, despite a minor reduction in homicide FFI.

The rising rates of homicide and suicide and declining rate of unintentional/undetermined firearm injury in our study were consistent with similar findings from several sources that used smaller samples (14, 16–18). The opposing but large increase in homicide NFI that we report was similar to the increasing trend described in the National Hospital Discharge Survey (3). When the intent was suicide, self-inflicted firearm-related injuries usually resulted in death (10, 16, 17). The increasing suicide FFI rates in our study mirror the overall suicide rates in the United States, which are currently at an all-time high and have increased by more than 11% during the 1990s (19). The decline of unintentional/undetermined FFI and NFI among all races/ethnicities in our study is consistent with the steady decrease reported over the past 2 decades (20, 21). While the findings in our study are concordant with piecemeal evidence from different studies, our results provide direct comparisons between the temporal trends of homicide, suicide, and unintentional/undetermined overall firearm injuries, establishing that the increase in homicide firearm injury is primarily due to homicide NFI increase, whereas the increasing suicide and decrease in unintentional/undetermined firearm injuries are driven by the respective intent of nonfatal injuries.

Among all racial/ethnic groups, we found the highest rates of firearm injuries—86.8 per 100,000 person in 2013—among blacks, and it was 4-fold higher than that among white population and was similar to previous studies (3, 15). However, between 2001 and 2013, this racial gap between blacks and whites began narrowing from a ratio of 5.5 to 4.25 for total firearm injuries and from 2.0 in 1.6 for FFI. This trend is consistent with 2 CDC reports: Gotsch et al. (1), before 2000, addressed both FFIs and NFIs, and Athar et al. (22) included a disparities report between 2003 and 2006. Our data suggest that the reason behind this narrowing gap was a confluence of consistently increasing firearm injury rates among whites driven by FFI and NFI and an overall decline in firearm injury rates among blacks, predominantly FFI. FFI rates among

Table 2. Temporal Trends of Fatal and Nonfatal Firearm Injuries by Intent and Race/Ethnicity, United States, 2001–2013

Intent, Race/Ethnicity, and Injury Type[a]	Rate per 100,000 Persons[b]			IRR	95% CI	Annual Change	P_{trend}	$P_{interaction}$[c]
	2001	2006	2013					
Homicide								<0.0001[d]
White	4.09	5.73	4.93	1.01	0.99, 1.03	0.07	0.059	0.016
Fatal	1.65	1.52	1.51	0.99	0.99,0.99	−0.01	0.006	
Nonfatal	2.43	4.21	3.42	1.02	1.00, 1.05	0.08	0.049	
Black	75.7	84.8	76.3	1.00	0.99, 1.01	−0.01	0.97	0.002
Fatal	16.0	18.1	15.0	0.99	0.98, 0.99	−0.18	0.001	
Nonfatal	59.7	66.7	61.2	1.00	0.99, 1.01	0.19	0.38	
Hispanic	23.7	30.0	24.8	1.02	0.99, 1.03	0.41	0.064	<0.0001
Fatal	6.03	5.87	3.45	0.95	0.94, 0.96	−0.24	<0.0001	
Nonfatal	17.7	24.2	21.3	1.03	1.01, 1.05	0.66	0.002	
Other	8.96	13.1	7.19	0.97	0.93, 0.99	−0.25	0.044	0.72
Fatal	1.91	2.34	1.37	0.96	0.94, 0.97	−0.07	<0.0001	
Nonfatal	7.05	10.8	5.82	0.97	0.92, 1.01	−0.18	0.16	
Suicide								<0.0001[d]
White	8.57	8.50	10.3	1.02	1.01, 1.02	0.16	<0.0001	0.001
Fatal	7.40	7.39	9.24	1.02	1.01, 1.03	0.16	<0.0001	
Nonfatal	1.17	1.11	1.10	0.98	0.98, 1.01	−0.004	0.59	
Black	4.12	3.10	2.96	0.99	0.97, 1.01	−0.03	0.29	0.76
Fatal	2.93	2.55	2.49	0.99	0.98, 0.99	−0.02	0.014	
Nonfatal	1.19	0.55	0.47	0.98	0.90, 1.07	−0.01	0.63	
Hispanic	2.76	2.58	2.62	0.99	0.98, 1.01	−0.02	0.42	0.58
Fatal	2.21	1.89	2.00	0.99	0.98, 0.99	−0.02	<0.0001	
Nonfatal	0.55	0.69	0.62	1.01	0.95, 1.07	0.005	0.82	
Other	2.11	1.83	2.79	1.01	0.99, 1.03	−0.01	0.52	0.85
Fatal	2.11	1.83	2.23	1.00	0.99, 1.02	0.01	0.46	
Nonfatal	<0	<0	0.56	1.02	0.90, 1.15	0.01	0.80	
Unintentional								<0.0001[d]
White	4.26	3.78	5.08	1.01	0.99, 1.03	0.05	0.16	<0.0001
Fatal	0.38	0.28	0.27	0.98	0.97, 0.99	−0.01	<0.0001	
Nonfatal	3.87	3.49	4.80	1.01	0.99, 1.03	0.06	0.11	
Black	12.9	10.4	7.54	0.95	0.94, 0.97	−0.46	<0.0001	0.30
Fatal	0.39	0.47	0.31	0.96	0.95, 0.98	−0.01	<0.0001	
Nonfatal	12.5	9.96	7.23	0.95	0.93, 0.97	−0.44	<0.0001	
Hispanic	5.15	3.13	2.86	0.97	0.95, 0.99	−0.12	0.007	0.016
Fatal	0.30	0.22	0.15	0.93	0.92, 0.95	−0.01	<0.0001	
Nonfatal	4.85	2.91	2.70	0.97	0.95, 0.99	−0.11	0.020	
Other[e]	6.87	0.51	2.74	0.93	0.87, 0.99	−0.21	0.017	0.67
Fatal	0.17	0.11	0.08	0.94	0.92, 0.96	−0.01	<0.0001	
Nonfatal	6.69	0.39	2.66	0.92	0.86, 0.99	−0.20	0.024	

Abbreviations: CI, confidence interval; IRR, incidence rate ratio.

[a] Racial/ethnic categories were non-Hispanic white; black (including Hispanic and non-Hispanic); Hispanic (for all races other than black), and other non-Hispanic.

[b] The sum of fatal and nonfatal injuries within each racial/ethnic subgroup may not always add up to the total due to missing information in racial/ethnic subgroups for nonfatal firearm injuries.

[c] $P_{interaction}$ values are from 2-way interactions, testing whether temporal trends vary between fatal and nonfatal firearm injury within each racial/ethnic group by intent of injury.

[d] $P_{interaction}$ values are 3-way interactions, testing whether the difference in fatal and nonfatal injury temporal trends within each racial/ethnic group vary between the 4 racial/ethnic groups within each intent.

[e] Incidence rates and estimates for others (non-Hispanic) in the unintentional nonfatal firearm injuries may be unreliable due to the small number of events.

whites and blacks in our study were an extension of the analysis performed using WISQARS data from 2000–2010 that was indicative of such an opposing trend (15). The increasing NFI, indicative of greater severity of injury among whites in our study, is in opposition to the lower rates among whites in the 1990s (23), suggesting a possible reversal in trends among whites after 2000. The increase in NFI among whites was comparable to that seen in data from a more recent cohort study from a health maintenance organization in northern California that showed whites were more likely to be hospitalized for suicide firearm injuries than were other race groups (24).

We found an overall decline in firearm homicide that occurred among all racial/ethnic groups. While our results were consistent with earlier studies using the same data over a shorter period (15) and similar to those of another study of homicide trends exclusive to young adults, our results span a longer and more recent time period and are applicable to all age groups (18). Our results demonstrating the decline in homicide FFI being driven mainly by blacks and Hispanics build on a similar study that showed a decline among these racial/ethnic groups using data from a shorter time period, indicating the sustained decline among these racial/ethnic groups beyond 2010 (15). The increasing trend in suicide FFI rates in our study that was predominantly among whites, while blacks and Hispanics showed a moderate decline, was comparable to findings in a report by the Pennsylvania Department of Health using death certificates and hospital discharges, in which whites showed higher rates of firearm suicide than did other racial/ethnic groups (25). The decline among Hispanics was also similar to that in an analysis using a shorter time period where the decline was moderate (15). The decline in unintentional/undetermined FFI and NFI in all racial/ethnic groups observed in this study was also previously reported in 2 trend-analysis studies of fatal and hospitalized firearm injuries, without the inclusion of ED-treated NFI (3, 15).

Our study has to be interpreted in the light of certain limitations. The absence of individual patient data and the weighted estimates of nonfatal injuries are the most obvious limitations. While the lack of individual data renders it impossible to validate categorization of firearm injury, the rigorous nature of the data-collection procedures using multiple data sources may reduce the possible misclassification bias. On the other hand, the weighted estimates of counts of nonfatal injury data, especially the lack of follow-up after hospitalization, may have overestimated the counts of NFI-hospitalizations, which we have attempted to correct by excluding the deaths known to have occurred during hospitalization, hospice, or nursing home care. The results from the sensitivity analysis were robust. However, in the event of such overestimation, our results for temporal trends in NFI may be slightly exaggerated. We were also unable to assess the obvious state-specific differences in injury type trends due to the lack of state-specific aggregate data on nonfatal injuries. Not being able to account for state-specific associations may bias the results in either direction, which is not estimable. In previous studies, the profile of undetermined injuries did not compare to that of any other intent of injury (3, 7). However, the nonfatal injury data in WISQARS are reported in a cumulative undetermined/unintentional category that forced us to combine the 2 categories among fatal injuries to be comparable. This might weaken or amplify the results depending on the actual difference between the 2 categories, which unfortunately cannot be quantified.

The epidemic of firearm violence, driven largely by nonfatal injuries, is an important public health problem that is characterized by an increased health-care burden, reduced quality of life, and increasing costs. Considering that the majority of FFI are due to suicides, the continuous and sizeable increase in suicide FFI observed in our study indicates a systemic national problem, which has several underlying social and individual factors that have been neglected for a long time and continue to be unaddressed. In conclusion, the public health consequences and the enormous costs associated with firearm injuries are of increasing concern, considering the epidemic of NFI. Our data show that this public health emergency is driven primarily by nonfatal injuries.

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