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Evaluating the impact of Florida's "Stand Your Ground" self-defense law on homicide and homicide by firearm: an interrupted time series study

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ABSTRACT

Importance

In 2005 Florida amended its self-defense laws to provide legal immunity to individuals using lethal force in self-defense. The enactment of "Stand Your Ground" laws in the United States has been controversial and their effect on rates of homicide and homicide by firearm is uncertain.

Objective

To estimate the impact of Florida's Stand Your Ground law on rates of homicide and homicide by firearm.

Design, Setting and Participants

Using an interrupted time series design we analysed monthly rates of homicide and homicide by firearm in Florida between 1999 and 2014. Data were collected from the Wide-ranging Online Data for Epidemiologic Research (WONDER) web portal at the Centers for Disease Control and Prevention. We used seasonally adjusted segmented Poisson regression models to assess whether the onset of the law was associated with changes in the underlying trends for homicide and homicide by firearm in Florida. We also assessed the association using comparison states without Stand Your Ground laws (New York, New Jersey, Ohio, Virginia) and control outcomes (all suicides and suicides by firearm in Florida).

Intervention

October 1 2005, the effective date of the law, was used to define homicides "before' and "after" the change.

Main Outcome Measures

Monthly rates of homicide and firearm related homicide (ICD-10, X85 to Y09; X93-X95).

Results

Prior to the Stand Your Ground Law, the mean monthly homicide rate in Florida was 0.49 deaths per 100,000 with an underlying trend of 0.1% decrease per month. After the law took effect, there was an abrupt and sustained increase in monthly homicide rates of 24.4% (RR 1.24; 95% CI: 1.16–1.33, *P*=<0.001) and rates of homicide by firearm of 31.6% (RR 1.36; 95% CI: 1.21–1.44, *P*=<0.001). No evidence of change was found in the analyses of comparison states and of suicides and suicides by firearm in Florida.

Conclusions and Relevance

The removal of a "duty to retreat" under Florida's Stand Your Ground law was associated with a significant increase in homicides and homicides by firearm.

Throughout the United States the application of lethal force as a means of self-defense is governed by criminal law.[1] Since the colonial era, it has been an individual's "duty to retreat" from perceived threats before resorting to any use of force. When force is unavoidable for self-defense, one must demonstrate that steps were taken to retreat first. The "castle doctrine" is an exception, granting individuals who encounter threats within their own home (i.e. their "castle") immunity when using lethal force.[2] Since 2005, states across America have made changes to their self-defense laws, removing the "duty to retreat" and allowing the use of lethal force in situations (within and outside the home) where an individual perceives a threat of harm.[3]

Stand Your Ground laws have been implemented in 23 states to date, with considerable debate about their potential impact on public health (Table 1).[4–6] Advocates of the laws suggest that the increased threat of retaliatory violence deters would-be burglars, resulting in fewer intruder encounters.[4] Critics are concerned that weakening the punitive consequences of using force may serve to escalate aggressive encounters.[7] They also argue that these laws may exacerbate racial disparities in homicide where threats motivated by racial stereotypes produce unnecessary fatalities.[2,7]

Table 1

Few evaluations of the impact of Stand Your Ground laws on homicide have been conducted. Evaluations of Arizona's and Texas' Stand Your Ground law found no statistically significant impact on homicide.[8,9] Several observational studies have assessed whether homicide rates are higher in states with Stand Your Ground laws

compared to states without. Using Uniform Crime Reports from the Federal Bureau of Investigation, one study that used a difference in difference design to examine changes in 20 states that enacted Stand Your Ground laws between 2000 and 2010 compared with all non participating states found an associated 8% increase in homicide.[10] A study using U.S. vital statistics data for the same time period, using comparable methods for the same states, found that the enactment was associated, on average, with a 7.1% increase in homicides.[11] In 2016, a study by Gius using Uniform Crime Reports (FBI data) between 1995-2010 found no relationship between the enactment of Stand Your Ground laws and either homicide or firearm homicide. [12]

On April 26th 2005, Governor Jeb Bush signed Florida State Bill 436, enacting Florida's Stand Your Ground law.[3,13] The law increased the scope of self-defense claims by creating a "no duty to retreat" rule when individuals "reasonably believed" that force was necessary to prevent harm to themselves or others.[2] The Florida law extended the "no duty to retreat" clause of the castle doctrine to public places. In addition, the law created a series of conditions to strengthen the rights of individuals claiming self defense, including: extending "no duty to retreat" to situations where the defendant initiated a confrontation; extending the use of lethal force as a legitimate defense for the protection of private property (e.g. to deter vehicle theft); entitling defendants to pre-trial immunity hearings allowing judges to sanction immunity prior to jury trial; and providing defendants with immunity from any ensuing civil lawsuits.[1,7]

As the first state to implement a Stand Your Ground law, Florida is an important test case about the removal of the "duty to retreat" principle. We used the years that have

elapsed since the enactment of the Florida law as a natural experiment to assess its impact on rates of homicide and homicide by firearm.

METHODS

Study design

We used an interrupted time-series design to compare monthly rates of homicide in Florida before and after the Stand Your Ground law came into effect on October 1st 2005. Interrupted time series designs utilise data that are collected over time, usually recorded at regular intervals (e.g. months).[14–17] These data are used to identify an underlying trend and when an intervention (e.g. new law) occurs at a known time, post-intervention trends can be examined for distinct changes from pre-existing trends—thus serving as the counterfactual.[18] This study design can be valuable in situations where retrospective evaluations of population level interventions are required.[19,20]

A potential limitation of interrupted time series designs is the possibility that other factors that occur simultaneously may distort estimates of intervention effects. Such factors might include national changes in social or economic variables (e.g. a recession) or events that have a profound and lasting impact on society (e.g. natural disasters). Additional design elements can be added to interrupted time series designs to assess whether such factors are influencing statistical estimates.[14,15] We employed two such design features, these were: (a) analysis of homicide rates in four

comparison states (New York, New Jersey, Ohio and Virginia); and (b) analysis of control outcomes (suicide and suicide by firearm).

These analyses help to rule out the possibility of misattributing any changes to causal factors unrelated to the intervention in question. From the 27 states that had not implemented Stand Your Ground laws as of September 2016 only 4 had consistent monthly homicide data that could be used for analysis. The analyses of suicide and suicide by firearm tested for comparable intervention effects in variables that may be equally sensitive to social and economic trends, but that we did not hypothesise to be affected by the Stand Your Ground law. If patterns in these analyses showed changes similar to those found in our analyses of homicide and homicide by firearm, it may be reasonable to assume that any estimated intervention effect was not attributable to the Stand Your Ground law.[14,1514,15,20–22]

Data sources

We collected monthly totals of homicides and suicides (in total and for firearm-related cases) for Florida between January 1999 and December 2014. The data were accessed through the Centers for Disease Control and Prevention's (CDC) Wide-ranging Online Data for Epidemiologic Research (WONDER) web portal.[23] We classified cases by place of occurrence (within or outside the State of Florida), cause of death (homicide or suicide), mode of death (firearms or other means), and month of occurrence. We classified causes of death using the *International Classification of Diseases*, *10th Revision* (ICD-10).[24]

Outcome measures

We extracted 4 monthly time series: (a) All homicide (ICD-10, X85 to Y09); (b) All suicide (ICD-10, X60 to X84); (c) Homicide by firearm (X93-X95); Suicide by firearm (X72-X74). Additional analyses were disaggregated by racial and ethnic grouping (Caucasian or African American), age-group (0–19 yrs, 20–34 yrs and ≥35 yrs) and sex (male or female) for all outcomes. Population denominators were calculated separately for each series using annual population estimates from the U.S. Census Bureau.[25] In total, each of these time series spanned 192 months (82 pre- and 110 post-intervention).

Data analysis

We evaluated whether post-intervention trends in homicide and homicide by firearm in Florida differed significantly from pre-intervention trends. We used segmented quasi-Poisson regression analysis to analyse trends in both periods and estimate an effect size taking underlying trends into account. Recent technical tutorials provide a detailed explanation of these models.[18,26] Time series analyses may be confounded by seasonal effects that generate stable highs and lows in data trends. To account for this we applied seasonal models, using harmonic terms that control for seasonal influences.[18,19,27] Due to the time sequencing of data points used in time series analysis, residual autocorrelation can lead to the violation of regression assumptions. Where significant residual autocorrelation was detected ($p < 0.10$) and the assumptions of the general linear models became problematic, robust standard errors were

generated (using a sandwich estimator) to produce more conservative estimates of uncertainty.[28]

Due to the nature of the intervention — a legal change fixed at one point in time — we hypothesised the potential impact of Florida's Stand Your Ground law as an immediate and permanent change.[18] Analysis was repeated for comparison states without Stand Your Ground laws to test the validity of any effects observed for Florida. The comparison between Florida and other states was tested statistically by including an interaction term in a single model including intervention and comparison states. In addition, sensitivity analysis was performed using rates of suicide and firearm suicide as a control outcome for both Florida and comparison states. This was done to assess specific biases that may have resulted from the onset of the 2008 economic crisis in the United States, which could potentially effect homicide rates indirectly.[29] We chose suicide because recent research shows a significant association between suicide and the onset of the 2008 financial crises and subsequent austerity policies.[19,30,31]

Stratified analysis was conducted to investigate whether the Stand Your Ground law may have had a distributional impact on race and ethnicity, age group, and sex in Florida. Where large numbers of data points were missing or suppressed due to small cell counts (e.g. <10 cases per month), we could not analyse certain population groups separately. This included: Hispanic populations (all analyses); children and adolescents (≤19 years); African-American populations (suicide and suicide by firearm); and females (homicide). Thus, analyses for these groups are not reported.

All data analysis was conducted in R (version 3.1.2) using RStudio (version 0.99.486). Statistical significance was taken as $p<0.05$.

RESULTS

Between 1999 and October 2005 Florida had a homicide rate of 0.49 deaths per 100,000 population and a homicide by firearm rate of 0.29 deaths per 100,000 population, with 59.1% of all homicides resulting from firearm injuries. There was a slight decline in monthly rates of homicide and homicide over this period. In the 9 years following the implementation of the Stand Your Ground law both rates increased (Homicide=0.53 deaths per 100,000 population, Homicide by firearm=0.37 deaths per 100,000 population, 69.8% of homicides from firearms) (Table 1). After accounting for underlying trends, we estimated a 24.4% (RR 1.24; 95% CI: 1.16–1.33, *P*=<0.001) increase in the post-intervention monthly homicide rate when compared with pre-intervention trends. For homicide by firearm the findings were similar, with an estimated 31.6% (RR 1.31; 95% CI: 1.21–1.44, *P*=<0.001) increase in post-intervention monthly homicides by firearm when compared with pre-intervention trends. Figure 1 displays the magnitude of these effects for homicide (panel A) and homicide by firearm (Panel B) in relation to the comparison states.

Table 2

We compared these findings with comparison states to test whether such increases in patterns of homicide and homicide by firearm were present in states unexposed to

changes in self-defence laws. We found no significant changes in post-intervention homicide rates in the comparison states when compared with pre-intervention trends (RR 1.06; 95% CI: 0.98–1.13). Interaction models comparing Florida and the comparison states found a significant difference between intervention effects (RR 1.24 vs RR 1.06, *P*=<0.001).

For homicide by firearm rates, we found no significant changes in post-intervention firearm homicide when compared with pre-intervention trends in control states (RR 1.08, 95% CI: 0.99–1.17). A formal test of difference between Florida and comparison states found a significant difference in the patterns of homicide by firearm after the Florida law took effect (RR 1.32 vs RR 1.00, *P*=<0.001).

Analyses of suicide and suicide by firearms in Florida following the enactment of the law showed no evidence of effects comparable to those for homicide and homicide by firearm (Table 2). These findings help rule out the possibility that our estimates may have been confounded by other social or economic trends (e.g. the 2008 economic recession) that may have had an impact on the patterns of homicide.

Figure 1 (a, b,)

Stratified analyses for Florida found that the increases in homicide affected all demographic groups, but that the magnitude of effects was distributed unevenly across the population (Table 3). Comparing pre- and post-intervention trends, the onset of the Stand Your Ground law was associated with significant increases in homicide for: Caucasians (28.7%) (Figure 2a); African-Americans (20.4%); 20–34

year olds (31.7%) (Figure 2b); those aged 35 or over (13.8%); males (28.1%); and females (13.5%). Similar patterns were observed when comparing pre-and post-intervention trends for homicide by firearm in Florida (Table 3). These findings suggested a statistically significant increase in homicide by firearm for: Caucasians (45.1%) (Figure 2a); African Americans (22.9%); 20–34 year olds (35.8%) (Figure 2b); those aged 35 and over (21.5%); and males (31.8%). For suicide and suicide by firearm, we found no significant differences before and after the law took effect.

Table 2

Figure 2 (a,b)

DISCUSSION

Since Florida's Stand Your Ground law took effect in October 2005, rates of homicide and homicide by firearm in the state have significantly increased; through 2014 monthly rates of homicide increased by 24.4% and monthly rates of homicide by firearm by 31.6%. These increases appear to have occurred despite a general decline in homicide in the U.S. since the early nineties.[32] In contrast, rates of homicide and homicide by firearm did not increase in in states without a Stand Your Ground law (New York, New Jersey, Ohio and Virginia), and for either suicide or suicide by firearm. Our findings support the hypothesis that increases in the homicide and homicide by firearm rates in Florida are related to the Stand Your Ground law. We found increases in homicide and homicide by firearm in Florida in all the

demographic groupings we examined; the largest proportional increases were in the 20–34 age group and among Caucasians.

The increases in homicide and firearm homicide we report are greater than those reported elsewhere—where increases in homicide were estimated to be less than 10%.[10,11]. These differences may reflect differences in the Stand Your Ground laws between states (the other studies were not of Florida's law), and differences in socio-demographic and cultural factors as well as firearm and other laws.

Our study has limitations. Circumstances unique to Florida may have contributed to our findings, including those that we could not identify. We did not compare the impact of Stand your Ground laws across states; such analyses are susceptible to biases due to differences in regulatory contexts and events or other factors that influence homicide and firearm homicide rates but that are unique to a particular state. Finally, there has been considerable debate over the potential of the Florida law to deter crime and improve public safety. (30, 31). Our study examined the effect of the Florida law on homicide and homicide by firearm, not on crime and public safety. We also did not study the effects on firearm injuries other than homicide or suicide.

In conclusion, the enactment of Florida's Stand Your Ground law in 2005 has been associated with abrupt and sustained increases in homicide and firearm by homicide in the state.

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Author contributions

Drs Humphreys and Wiebe had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the analysis. Contributions were as follows: *Study concept and design:* Humphreys and Wiebe; *Acquisition, analysis, or interpretation of data:* All authors; *Drafting of the Manuscript:* All authors; *Critical revision of the manuscript for important intellectual content:* All authors; *Statistical analysis*: Humphreys & Wiebe; *Administrative, technical, or material support:* All authors.

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Figure Titles

Figures 1: Effect of Stand Your Ground law on Homicide and Homicide by Firearm

Figure 1a: Homicide Rates in Florida and Comparison States, 1999–2014

Figure 1b: Homicide by Firearm Rates in Florida and Comparison States, 1999–2014

Figure 2: Stratified analyses for Florida

Figure 2a: Changes in Caucasian Homicide and Homicide by Firearm 1999–2014

Figure 2b: Changes in Homicide and Homicide by Firearm in 20–34 yr olds

Figure Legends

Figure 1: Effect of Stand Your Ground law on Homicide and Homicide by Firearm

Data points represent monthly rates of homicide and homicide by firearm in Florida and Comparison States (New York, New Jersey, Ohio and Virginia) between 1999 and 2014. Florida is represented by red coloured data points and regression lines and the comparison states by blue data points and regression lines. Grey shaded areas depict the onset of Florida's Stand Your Ground law. Straight-hatched lines represent fitted estimates using a linear step change model. The curved lines represent fitted values for seasonally adjusted models.

Figure 2: Changes in Rates Homicide and Homicide by Firearm in Florida Stratified by Age, Race and Ethnicity

Data points represent monthly rates of homicide and homicide by firearm in Florida between 1999 and 2014. Red coloured data points represent monthly rates of homicide and blue coloured data points represent monthly rates of homicide by firearm. Grey shaded areas depict the onset of Florida's Stand Your Ground law. Straight-hatched line represents fitted estimates using a linear step change model. The curved lines represent fitted values for seasonally adjusted models.

Table 1: States with Stand Your Ground Laws (n=23)

	State Name (Year original law signed)
States with Stand Your Ground Laws (i.e. States with no duty to retreat in any place a person is legally allowed to be)	Alabama (2006), Alaska (2006), Arizona (2006), Florida (2005), Georgia (2006), Indiana (2006), Kansas (2006), Kentucky (2006), Louisiana (2006), Michigan (2006), Mississippi (2006), Montana (2009), Nevada (2011), New Hampshire (2011), North Carolina (2011), Oklahoma (2006), Pennsylvania (2011), South Carolina (2006), South Dakota (2006), Tennessee (2007), Texas (2007), Utah (1994)†, West Virginia (2008).

† Utah was the first state to pass a law that expanded a citizens right to use lethal force in public places. Florida was the first state to draft and pass a specific Stand Your Ground law.

Table 2: The Impact of Florida's Stand Your Ground' Self-Defense Laws on Homicide and Homicide by Firearm

	Mean monthly count		Mean monthly deaths per 100,000 population		Trend	95 % Confidence Interval		Step change	95 % Confidence Interval		Interaction Effect (Florida vs comparison states)
	Before	After	Before	After	Relative Risk	Lower limit	Upper limit	Relative Risk	Lower limit	Upper limit	*Exact P*-Value
Homicide											
Florida	81.93	99.22	0.49	0.53	0.99***	0.99	0.99	1.24***	1.16	1.33	0.00
Comparison States[a]	189.40	182.70	0.41	0.38	0.99***	0.99	0.99	1.06†	0.98	1.13	
Suicide											
Florida	188.30	232.50	1.13	1.23	1.00***	1.00	1.00	0.99†	0.94	1.05	0.97
Comparison States	314.20	382.20	0.68	0.80	1.00***	1.00	1.00	1.00†	0.96	1.04	
Homicide by firearm											
Florida	49.06	69.29	0.29	0.37	0.99	0.99	1.00	1.32***†	1.21	1.44	0.00
Comparison States	116.40	119.10	0.25	0.25	0.99**	0.99	1.00	1.08†	0.99	1.17	
Suicide by firearm											
Florida	99.32	119.50	0.60	0.63	1.00**	1.00	1.00	0.98†	0.91	1.06	0.54
Comparison States[b]	129.30	143.20	0.34	0.37	1.00***	1.00	1.02	0.95†	0.90	1.01	

* *P*=<.05, ** P=<.01, *** P=<.001; †Breusch–Godfrey (BG) and Seasonal Breusch–Godfrey tests reveal statistically significant serial autocorrelation, robust standard errors are reported.[a] N=1 month outlier (September, 2001) excluded in the control series; [b] Control states exclude New Jersey due to high number of suppressed cells.

Table 3: Florida Stratified Analysis

	Mean monthly count		Deaths per 100,00 population		Step change	95 % Confidence Interval	
	Before	After	Before	After	Relative Risk	Lower limit	Upper limit
Homicide							
Racial and ethnic groups							
Caucasian	44.52	49.83	0.34	0.34	1.29***	1.17	1.41
African American	36.53	48.23	1.50	1.75	1.20***	1.10	1.32
Age group							
20–34 yrs	31.80	41.94	1.01	1.18	1.32***	1.19	1.45
≥ 35 yrs	38.15	42.60	0.41	0.40	1.14**	1.04	1.25
Sex							
Male	60.75	77.04	0.75	0.83	1.28***	1.18	1.38
Female	21.17	22.18	0.25	0.23	1.13*	1.00	1.28
Suicide							
Racial and ethnic groups							
Caucasian	177.00	217.00	1.368	1.47	0.99†	0.93	1.05
African American	–	–	–	–	–	–	–
Age group							
20–34 yrs	34.53	40.86	1.10	1.15	0.99	0.91	1.08
≥ 35 yrs	146.80	184.20	1.58	1.75	1.01†	0.95	1.07
Sex							
Male	145.70	179.40	1.79	1.94	1.02†	0.95	1.09
Female	42.54	53.13	0.50	0.55	0.92*†	0.85	0.99
Firearm Homicide							
Racial and ethnic groups							
Caucasian	22.54	29.95	0.17	0.20	1.45***	1.29	1.63
African American	26.25	38.65	1.07	1.40	1.23***	1.10	1.38
Age group							
20–34 yrs	23.52	34.35	0.75	0.97	1.36***	1.21	1.52
≥ 35 yrs	19.38	25.45	0.21	0.24	1.21**†	1.05	1.40
Sex							
Male	39.67	57.05	0.48	0.62	1.32***†	1.19	1.46
Female	–	–	–	–	–	–	–
Firearm Suicide							
Racial and ethnic groups							
Caucasian	93.63	112.3	0.72	0.76	0.98	0.91	1.05
African American	–	–	–	–	–	–	–
Age group							
20–34 yrs	16.74	19.32	0.53	0.54	1.02	0.90	1.16
≥ 35 yrs	79.69	96.95	0.86	0.92	0.98†	0.91	1.05
Sex							
Male	84.53	101.5	1.04	1.09	0.99	0.93	1.07
Female	15.38	18.25	0.18	0.19	0.89	0.79	1.01

* *P*=<.05, ** *P*=<.01, *** *P*=<.001; †Breusch–Godfrey (BG) and Seasonal Breusch–Godfrey tests reveal statistically significant serial autocorrelation, robust standard errors are reported.