

Evaluating the Impact of Florida's "Stand Your Ground" Self-defense Law on Homicide and Suicide by Firearm

An Interrupted Time Series Study

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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 analyzed 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, and Virginia) and control outcomes (all suicides and suicides by firearm in Florida). October 1, 2005, the effective date of the law, was used to define homicides before and after the change.

MAIN OUTCOMES AND MEASURES Monthly rates of homicide, firearm-related homicide, suicide, and suicide by firearm in Florida and the 4 comparison states.

RESULTS Prior to the stand your ground law, the mean monthly homicide rate in Florida was 0.49 deaths per 100 000 (mean monthly count, 81.93), and the rate of homicide by firearm was 0.29 deaths per 100 000 (mean monthly count, 49.06). Both rates had an underlying trend of 0.1% decrease per month. After accounting for underlying trends, these results estimate that after the law took effect there was an abrupt and sustained increase in the monthly homicide rate of 24.4% (relative risk [RR], 1.24; 95%CI, 1.16-1.33) and in the rate of homicide by firearm of 31.6% (RR, 1.32; 95% CI, 1.21-1.44). No evidence of change was found in the analyses of comparison states for either homicide (RR, 1.06; 95% CI, 0.98-1.13) or homicide by firearm (RR, 1.08; 95% CI, 0.99-1.17). Furthermore, no changes were observed in control outcomes such as suicide (RR, 0.99; 95% CI, 0.94-1.05) and suicide by firearm (RR, 0.98; 95% CI, 0.91-1.06) in Florida between 2005 and 2014.

CONCLUSIONS AND RELEVANCE The implementation of Florida's stand your ground self-defense law was associated with a significant increase in homicides and homicides by firearm but no change in rates of suicide or suicide by firearm.

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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 in their own home (ie, their castle) immunity when using lethal force.² Since 2005, states across the United States have made changes to their self-defense laws, removing the duty to retreat and allowing the use of lethal force in situations (inside 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 (Box).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}

Few evaluations of the impact of stand your ground laws on homicide have been conducted. Evaluations of Arizona's and Texas' stand your ground laws 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 with states without. Using uniform crime reports from the Federal Bureau of Investigation (FBI), 1 study that used a difference in differences design to examine changes in 20 states that enacted stand your ground laws between 2000 and 2010 compared with all nonparticipating states found an associated 8% increase in homicide.¹⁰ A study using US 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,¹² using uniform crime reports (FBI data) between 1995 and 2010, found no relationship between the enactment of stand your ground laws and either homicide or firearm homicide.

On April 26, 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 (eg, to deter vehicle theft), entitling defendants to pretrial immunity hearings allowing judges to sanction immunity prior to jury trial, and providing defendants with immunity from any ensuing civil lawsuits.^{1,7}

Key Points

Question Did the implementation of Florida's "stand your ground" self-defense law have an impact on homicide and homicide by firearm between 2005 and 2014?

Findings This study used an interrupted time series design to analyze changes in rates of homicide and firearm-related homicide. We found that the implementation of Florida's stand your ground law was associated with a 24.4% increase in homicide and a 31.6% increase in firearm-related homicide.

Meaning The removal of restrictions on when and where individuals can use lethal force was associated with a significant increase in homicide and homicide by firearm in Florida.

Box. States That Have Enacted "Stand Your Ground" Laws^a

State Name (Year Original Law Signed)

Utah (1994)^b
 Florida (2005)
 Alabama (2006)
 Alaska (2006)
 Arizona (2006)
 Georgia (2006)
 Indiana (2006)
 Kansas (2006)
 Kentucky (2006)
 Louisiana (2006)
 Michigan (2006)
 Mississippi (2006)
 Oklahoma (2006)
 South Carolina (2006)
 South Dakota (2006)
 Tennessee (2007)
 Texas (2007)
 West Virginia (2008)
 Montana (2009)
 Nevada (2011)
 New Hampshire (2011)
 North Carolina (2011)
 Pennsylvania (2011)

^a Definitions of states that have enacted "stand your ground" laws were derived by cross-referencing several resources (eg, smartgunlaws.org and NRA.org) as well as recent publications.^{7,11,12}

^b Utah was the first state to pass a law that expanded a citizen's right to use lethal force in public places. Florida was the first state to draft and pass a specific stand your ground law. The conditions of each law vary.

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 1, 2005. Interrupted time series designs use data that are collected over time, usually recorded at regular intervals (eg, months).¹⁴⁻¹⁷ These data are used to identify an underlying trend and when an intervention (eg, new law) occurs at a known time, postintervention trends can be examined for distinct changes from preexisting 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 (eg, a recession) or events that have a profound and lasting impact on society (eg, 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 2 such design features: analysis of homicide rates in 4 comparison states (New York, New Jersey, Ohio, and Virginia), and 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 hypothesize 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.^{14,15,20-22}

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), mechanism (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) homi-

cide by firearm (*ICD-10*, X93-X95); and (d) suicide by firearm (*ICD-10*, X72-X74). Additional analyses were disaggregated by racial and ethnic grouping (white or African American), age group (0-19 years, 20-34 years, and ≥ 35 years), and sex (male or female) for all outcomes. Population denominators were calculated separately for each series using annual population estimates from the US Census Bureau.²⁵ In total, each of these time series spanned 192 months (82 preintervention and 110 postintervention).

Data Analysis

We evaluated whether postintervention trends in homicide and homicide by firearm in Florida differed significantly from preintervention trends. We used segmented quasi-Poisson regression analysis to analyze 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} Owing 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 ($P < .10$) 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

Owing to the nature of the intervention—a legal change fixed at 1 point in time—we hypothesized 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 owing to small cell counts (eg, <10 cases per month), we could not analyze 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 statistical software (version 3.1.2; RStudio, Inc) using RStudio (version 0.99.486; RStudio Inc). Statistical significance was taken as $P < .05$.

Table 1. The Impact of Florida's "Stand Your Ground" Self-defense Laws on Homicide and Homicide by Firearm

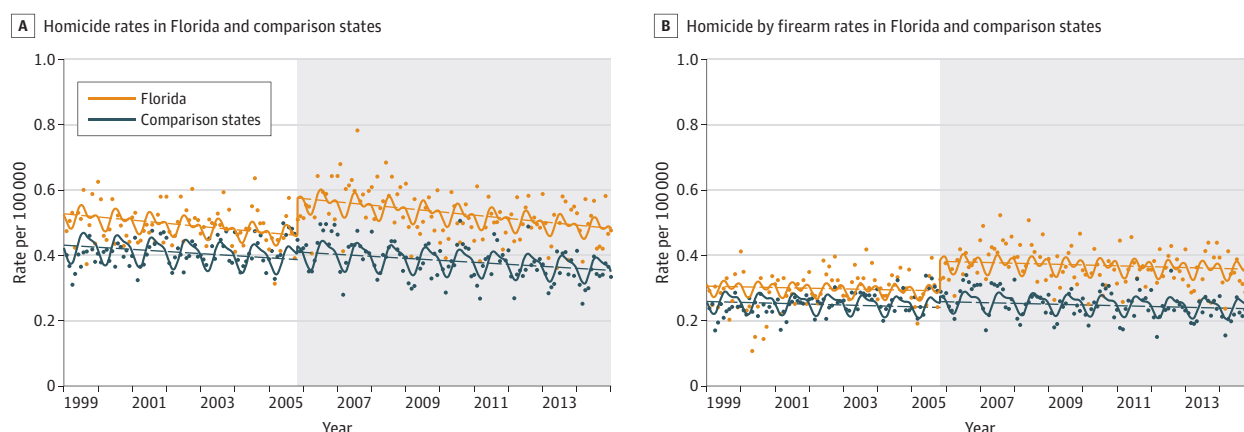
Characteristic	Mean Monthly Count		Mean Monthly Deaths per 100 000 Population		Relative Risk (95% CI)		P Value for Interaction Effect (Florida vs Comparison States)
	Before	After	Before	After	Trend	Step Change	
Homicide							
Florida	81.93	99.22	0.49	0.53	0.99 (0.99-0.99) ^a	1.24 (1.16-1.33) ^a	<.001
Comparison states ^b	189.40	182.70	0.41	0.38	0.99 (0.99-0.99) ^a	1.06 (0.98-1.13) ^c	
Suicide							
Florida	188.30	232.50	1.13	1.23	1.00 (1.00-1.00) ^a	0.99 (0.94-1.05) ^c	.97
Comparison states	314.20	382.20	0.68	0.80	1.00 (1.00-1.00) ^a	1.00 (0.96-1.04) ^c	
Homicide by firearm							
Florida	49.06	69.29	0.29	0.37	0.99 (0.99-1.00)	1.32 (1.21-1.44) ^{a,c}	<.001
Comparison states	116.40	119.10	0.25	0.25	0.99 (0.99-1.00) ^d	1.08 (0.99-1.17) ^c	
Suicide by firearm							
Florida	99.32	119.50	0.60	0.63	1.00 (1.00-1.00) ^d	0.98 (0.91-1.06) ^c	.54
Comparison states ^e	129.30	143.20	0.34	0.37	1.00 (1.00-1.02) ^a	0.95 (0.90-1.01) ^c	

^a $P < .001$.^b One month outlier (September 2001) excluded in the control series.^c Breusch-Godfrey and Seasonal Breusch-Godfrey tests reveal statistically

significant serial autocorrelation, robust standard errors are reported.

^d $P < .01$.^e Control states exclude New Jersey owing to high number of suppressed cells.

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 orange data points and regression lines and the comparison states by blue data points and regression lines. Gray-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.

Results

Between 1999 and October 2005, Florida had a mean monthly homicide count of 81.93, a homicide rate of 0.49 deaths per 100 000 population and a mean monthly homicide by firearm count of 49.06, 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 by firearm over this period. In the 9 years following the implementation of the stand your ground law, both rates increased with a mean monthly count of 99.22 and 69.29, respectively (homicide, 0.53 deaths per 100 000 population; homicide by firearm, 0.37 deaths per 100 000 population; 69.8% of homicides by firearm) (Table 1).

After accounting for underlying trends, we estimated a 24.4% (RR, 1.24; 95% CI, 1.16-1.33; $P < .001$) increase in the postintervention monthly homicide rate when compared with preintervention trends. For homicide by firearm the findings were similar, with an estimated 31.6% (RR, 1.32; 95% CI, 1.21-1.44; $P < .001$) increase in postintervention monthly homicides by firearm when compared with preintervention trends. Figure 1A displays the magnitude of these effects for homicide and Figure 1B shows homicide by firearm in relation to trends in the comparison states.

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-defense laws. We found no significant changes in postintervention homicide rates in the comparison states when

Table 2. Florida Stratified Analysis

Characteristic	Mean Monthly Count		Deaths per 100 000 Population		Step Change, Relative Risk (95% CI)
	Before Law	After Law	Before Law	After Law	
Homicide					
Racial and ethnic groups					
White	44.52	49.83	0.34	0.34	1.29 (1.17-1.41) ^a
African American	36.53	48.23	1.50	1.75	1.20 (1.10-1.32) ^a
Age group, y					
20-34	31.80	41.94	1.01	1.18	1.32 (1.19-1.45) ^a
≥35	38.15	42.60	0.41	0.40	1.14 (1.04-1.25) ^b
Sex					
Male	60.75	77.04	0.75	0.83	1.28 (1.18-1.38) ^a
Female	21.17	22.18	0.25	0.23	1.13 (1.00-1.28) ^c
Suicide					
Racial and ethnic groups					
White	177.00	217.00	1.368	1.47	0.99 (0.93-1.05) ^d
African American	...	...	...	...	...
Age group, y					
20-34	34.53	40.86	1.10	1.15	0.99 (0.91-1.08)
≥35	146.80	184.20	1.58	1.75	1.01 (0.95-1.07) ^d
Sex					
Male	145.70	179.40	1.79	1.94	1.02 (0.95-1.09) ^d
Female	42.54	53.13	0.50	0.55	0.92 (0.85-0.99) ^{c,d}
Firearm homicide					
Racial and ethnic groups					
White	22.54	29.95	0.17	0.20	1.45 (1.29-1.63) ^a
African American	26.25	38.65	1.07	1.40	1.23 (1.10-1.38) ^a
Age group, y					
20-34	23.52	34.35	0.75	0.97	1.36 (1.21-1.52) ^a
≥35	19.38	25.45	0.21	0.24	1.21 (1.05-1.40) ^{b,d}
Sex					
Male	39.67	57.05	0.48	0.62	1.32 (1.19-1.46) ^{a,d}
Female	...	...	...	...	...
Firearm suicide					
Racial and ethnic groups					
White	93.63	112.3	0.72	0.76	0.98 (0.91-1.05)
African American	...	...	...	...	...
Age group, y					
20-34	16.74	19.32	0.53	0.54	1.02 (0.90-1.16)
≥35	79.69	96.95	0.86	0.92	0.98 (0.91-1.05) ^d
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)

Ellipses indicate that analyses for these groups could not be conducted owing to a high proportion of suppressed cases (eg, small cell counts <10 cases per month).

^a $P < .001$.

^b $P < .01$.

^c $P < .05$.

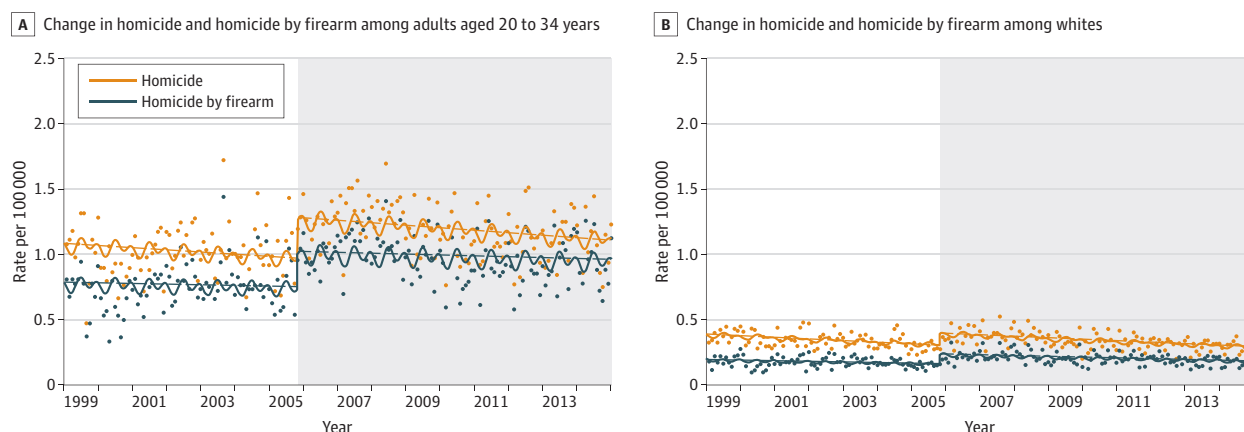
^d Breusch-Godfrey and seasonal Breusch-Godfrey tests revealed statistically significant serial autocorrelation; robust standard errors are reported.

compared with preintervention 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; $P < .001$).

For homicide by firearm rates, we found no significant changes in postintervention firearm homicide when compared with preintervention 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, 1.08; $P < .001$).

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. Prior to the implementation of the law, the mean monthly suicide rate in Florida was 1.13 per 100 000 (mean monthly count 188.30) vs after the law took effect, with 1.23 deaths per 100 000 and a mean monthly count of 232.50 (relative risk, 0.99; 95% CI, 0.94-1.05; $P = .97$). These findings help rule out the possibility that our estimates may have been confounded by other social or economic trends (eg, the 2008 economic recession) that may have had an impact on the patterns of homicide.

Figure 2. Stratified Analyses for Florida



Data points represent monthly rates of homicide and homicide by firearm in Florida between 1999 and 2014. Orange data points represent monthly rates of homicide and blue data points represent monthly rates of homicide by firearm. Gray-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.

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 2). Comparing preintervention and postintervention trends, the onset of the stand your ground law was associated with significant increases in homicide for whites (28.7%) (Figure 2B); African Americans (20.4%); those aged 20 to 34 years (31.7%) (Figure 2A); those 35 years or older (13.8%); males (28.1%); and females (13.5%). Similar patterns were observed when comparing preintervention and postintervention trends for homicide by firearm in Florida (Table 2). These findings suggested a statistically significant increase in homicide by firearm for whites (45.1%) (Figure 2B); African Americans (22.9%); those 20 to 34 years (35.8%) (Figure 2A); those 35 years and older (21.5%); and males (31.8%). For suicide and suicide by firearm, we found no significant differences before and after the law took effect.

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 United States since the early 1990s.³² In contrast, rates of homicide and homicide by firearm did not increase in states without a stand your ground law (New York, New Jersey, Ohio, and Virginia), or 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 those aged 20 to 34 years and among whites.

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 sociodemographic and cultural factors, as well as firearm and other laws.

Limitations

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 owing 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.

Conclusions

The enactment of Florida's stand your ground law in 2005 has been associated with abrupt and sustained increases in homicide and homicide by firearm in the state.

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Drafting of the manuscript: Humphreys, Wiebe.

Critical revision of the manuscript for important intellectual content: All authors.

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