

# Handgun Acquisitions in California After Two Mass Shootings

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**Background:** Mass shootings are common in the United States. They are the most visible form of firearm violence. Their effect on personal decisions to purchase firearms is not well-understood.

**Objective:** To determine changes in handgun acquisition patterns after the mass shootings in Newtown, Connecticut, in 2012 and San Bernardino, California, in 2015.

**Design:** Time-series analysis using seasonal autoregressive integrated moving-average (SARIMA) models.

**Setting:** California.

**Population:** Adults who acquired handguns between 2007 and 2016.

**Measurements:** Excess handgun acquisitions (defined as the difference between actual and expected acquisitions) in the 6-week and 12-week periods after each shooting, overall and within subgroups of acquirers.

**Results:** In the 6 weeks after the Newtown and San Bernardino shootings, there were 25 705 (95% prediction interval, 17 411 to 32 788) and 27 413 (prediction interval, 15 188 to 37 734) excess

acquisitions, respectively, representing increases of 53% (95% CI, 30% to 80%) and 41% (CI, 19% to 68%) over expected volume. Large increases in acquisitions occurred among white and Hispanic persons, but not among black persons, and among persons with no record of having previously acquired a handgun. After the San Bernardino shootings, acquisition rates increased by 85% among residents of that city and adjacent neighborhoods, compared with 35% elsewhere in California.

**Limitations:** The data relate to handguns in 1 state. The statistical analysis cannot establish causality.

**Conclusion:** Large increases in handgun acquisitions occurred after these 2 mass shootings. The spikes were short-lived and accounted for less than 10% of annual handgun acquisitions statewide. Further research should examine whether repeated shocks of this kind lead to substantial increases in the prevalence of firearm ownership.

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Each year in the United States, more than 32 000 people die of gunshot wounds (1). Mass shootings account for less than 1% of those deaths (2-5), but to the general public, they are the most visible form of firearm violence. (Definitions of "mass shooting" vary; most versions refer to a single continuous event, carried out in public, with at least 3 or 4 indiscriminate victims [4-8]). These attacks are covered extensively by the media (9, 10), and large proportions of the public follow the coverage closely (11, 12). Reactions include dismay, shock, sadness, anger, anxiety, and fear (13, 14).

For some, a gruesome mass shooting may induce repulsion at the idea of owning a weapon. For others, it may motivate acquisition. Mass shootings are likely to boost sales if they heighten concerns over personal security, because self-protection is the most commonly cited reason for owning a firearm (15). Another predictable reason for purchasing firearms in response to a mass shooting is apprehension that government will react with gun control measures that make it more difficult to obtain them in the future (16-18). Interest groups stoke these concerns. Gun control advocates

use the media attention that mass shootings create to redouble calls for stronger firearm safety laws. Gun rights advocates use the spotlight to reassert the perceived safety benefits of firearm ownership—a view encapsulated in a much-quoted statement from a leader of the National Rifle Association after the 2012 mass shooting at Newtown, Connecticut: "The only thing that stops a bad guy with a gun is a good guy with a gun" (19).

Evidence regarding the effects of mass shootings on firearm purchasing behavior is limited. A lack of centralized information about firearm transactions is a key obstacle. News stories (17, 18, 20, 21) and 2 studies (16, 22) have reported sharp increases in sales after several mass shootings, but the size and nature of these increases have not been well-described. Moreover, the reports to date rely on statistics from the National Instant Criminal Background Check System (NICS); federal background checks are crude proxies for firearm sales, and NICS does not retain purchase-level information (23).

Using detailed individual-level information on firearm transactions in California, we analyzed statewide acquisition patterns after 2 of the highest-profile mass shootings in U.S. history: those in Newtown, Connecticut, in 2012 and San Bernardino, California, in 2015. Our analysis focused on handguns, which have particular importance for public health and crime: They are used in approximately three quarters of all firearm-related suicides and homicides in which the type of firearm is known (24-26). We expected to find substantial

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Editorial comment . . . . . 749

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increases in handgun acquisitions after both mass shootings. Anticipating that personal security concerns would be a key motivator, we hypothesized that acquisition responses would be especially large among persons who had not previously acquired handguns and, after the San Bernardino attack, among Californians living near the scene.

## METHODS

### The Newtown and San Bernardino Shootings

Before data analysis began, we selected the Newtown and San Bernardino attacks for study because, in the period for which we had acquisition data, these were distinctive mass shootings in terms of both the number of fatalities and the intensity of media coverage. Details are provided in **Supplement 1** (available at [Annals.org](http://Annals.org)).

On 14 December 2012, Adam Lanza shot and killed his mother at their home in Newtown, Connecticut. Armed with 2 semiautomatic handguns, a rifle, and a shotgun, he then drove to nearby Sandy Hook Elementary School, where he shot and killed 20 children and 6 adults. On 2 December 2015, Syed Rizwan Farook and Tashfeen Malik opened fire on a staff gathering at a social services center in San Bernardino, California. Using semiautomatic pistols and 2 rifles, they shot and killed 14 people and wounded 22.

### Process for Acquiring Firearms in California

Under California law, virtually all transfers of firearms in the state must be done through a licensed firearms retailer (a dealer or pawnbroker), who takes possession of the firearm during the transfer process (27). The mandate is broad and covers sales, transfers between private parties, gun show sales, gifts, loans, and redemption of pawned or consigned weapons. (Hereafter, we use the term "acquisition" to refer to the various types of transfers, and "acquirer" to refer to the recipient of a transfer.)

The retailer and prospective acquirer together complete an application form requesting approval for the acquisition, which is submitted electronically to the California Department of Justice (CalDOJ). The acquirer must present proof of identity and California residency, typically in the form of a California driver's license. The retailer swipes the driver's license or other identity card through a card reader, electronically transferring the information to the CalDOJ, which then uses this information to perform a background check.

If the background check confirms eligibility to obtain a firearm, the retailer may release the firearm to the acquirer after a mandatory 10-day waiting period has elapsed (28). California law prohibits a person from acquiring more than 1 handgun within any 30-day period (29).

### Data and Variables

The CalDOJ retains a permanent record of every firearm acquisition. Collectively, this Web-based electronic reporting system is known as the Dealer Record

of Sale (DROS). The DROS system is operated by the Bureau of Firearms, a division of the CalDOJ.

We obtained an extract of DROS data covering all handgun acquisitions in California between 1 January 2007 and 25 February 2016. There were no substantial changes to the content or structure of the DROS database over this period, nor to the accuracy or completeness of reporting, except that it became mandatory to record long gun acquisitions from 1 January 2014. The records included variables indicating details of the transaction, the weapon, and the acquirer (age, sex, race/ethnicity, and ZIP code of residence).

The CalDOJ assigns each acquirer a unique identification number, which permits linkage of multiple acquisitions over time by the same person. For each acquisition, we determined whether it was a first acquisition, defined as the first recorded handgun acquisition by that person since 1 January 1995 (18 years before the Newtown shootings and 21 years before the San Bernardino shootings). To test for geographic variation in acquisition responses, we identified 163 ZIP codes whose centroids are located in the Metropolitan Statistical Area in which San Bernardino lies. We then created a variable distinguishing acquisitions by residents of these areas from acquisitions in all other parts of California.

The institutional review board at Stanford University approved the study.

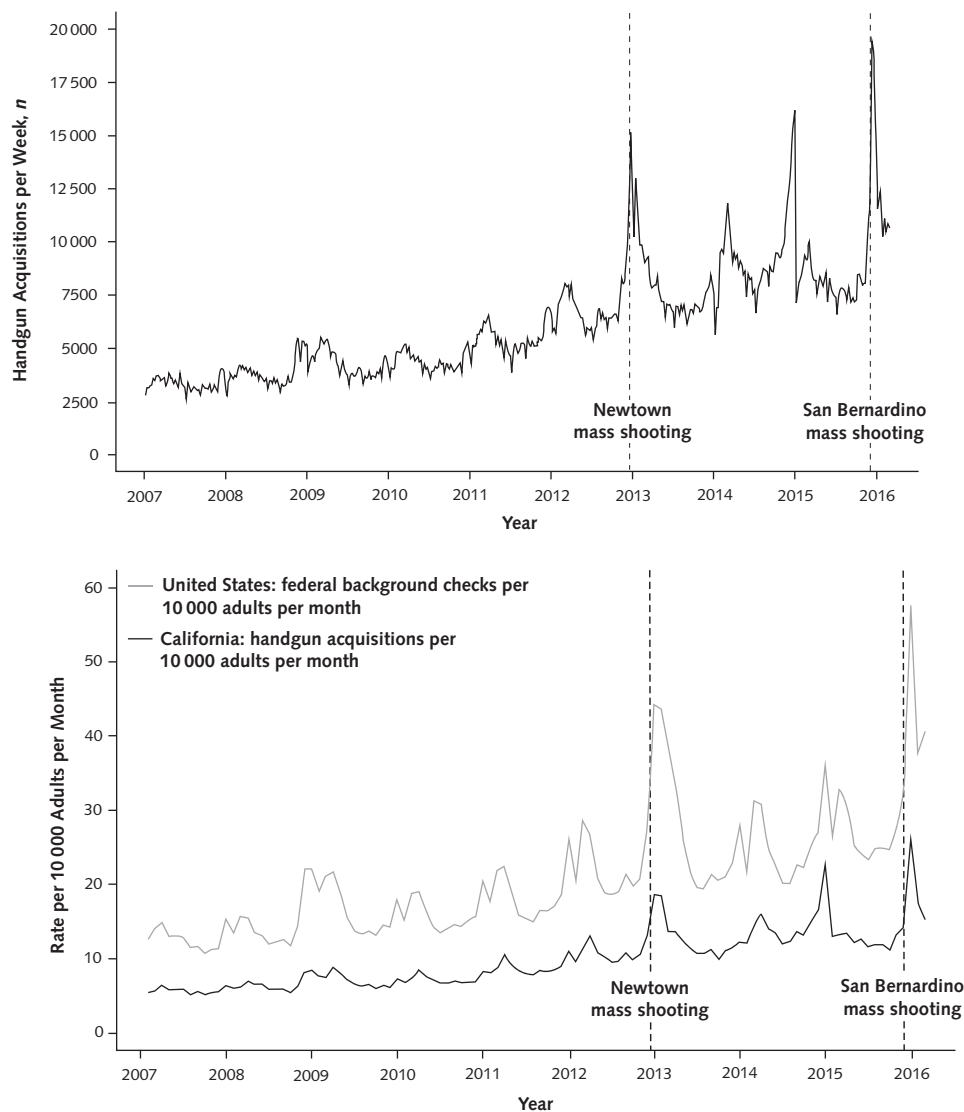
### Statistical Analysis

The analysis was conducted at the week level. We used counts and percentages to describe characteristics of acquisitions and acquirers. We also calculated weekly rates of acquisitions, overall and by acquirers' sex, age, race/ethnicity, and residential area. Denominators for the rates came from U.S. census data (30).

The main goal of the analysis was to estimate the number of "excess" handgun acquisitions made in the period immediately after each mass shooting. Excess acquisitions were calculated as the difference between the actual number of acquisitions in the postshooting period and the expected number. Estimating the expected number of acquisitions (that is, the counterfactual) on the basis of prior patterns was not straightforward because the time series exhibited trends, seasonality, and changes in variance over time.

To address these issues, we fit a seasonal autoregressive integrated moving-average (SARIMA) model. Whereas conventional multiple regression models estimate the outcome variable as a function of independent variables, autoregressive models estimate the outcome variable as a function of past values of that same variable. The SARIMA model takes the form  $ARIMA(p,d,q) \times (P,D,Q)_s$ , where  $p$  and  $q$  denote the number of nonseasonal autoregressive (AR) and moving average (MA) terms, respectively, and  $d$  refers to the order of nonseasonal differencing.  $P$ ,  $D$ , and  $Q$  denote analogues in the seasonal part of the model, and  $S$  denotes the length of the seasonal cycle.

Construction of the SARIMA model followed the Box-Jenkins modeling process (31); the steps in this

**Figure 1.** Handgun acquisitions in California, 1 January 2007 to 25 February 2016.

**Top.** Number of handgun acquisitions per week in California. **Bottom.** Monthly rate of handgun acquisitions in California and of federal background checks for handgun acquisitions nationwide.

process are described in **Supplement 2** (available at [Annals.org](http://Annals.org)). We tested the fit of several different model specifications. The best-performing model took the form  $ARIMA(2,1,0) \times (0,1,1)_{52}$  and was fit to a training set beginning in the first week of 2007 and ending in the 13th week before each shooting. The seasonal cycle ( $S$ ) was set at 52 weeks, corresponding to the number of weeks in a year. Further details of the time series model, its performance in standard diagnostic checks, and methods used to estimate 95% prediction intervals are provided in **Supplement 2**.

We used the model to estimate the expected number of handgun acquisitions in each of the 25 weeks surrounding the Newtown and San Bernardino shootings (12 preshooting weeks, 1 shooting week, and 12 postshooting weeks). We fit the same model within

subgroups of acquirers to test for heterogeneous acquisition responses.

All statistical analyses were conducted in R, version 3.2.4, (R Foundation, Vienna, Austria).

### Role of the Funding Source

No external funding was received for this study. Each investigator was supported by general internal funds at their home institutions.

## RESULTS

### General Time Trends

A total of 2 918 747 handguns were acquired in California between 1 January 2007 and 25 February 2016, at an average of 6132 per week (**Figure 1, top**). Volume tripled over this decade, from an average of

3315 acquisitions per week in the first year of the period to an average of 9268 per week in the last year. The rate of handgun acquisitions in California over this period was lower than the national rate of background checks for handguns, but many of the peaks and dips in the 2 curves seem to have occurred at similar times (Figure 1, bottom).

Weekly and seasonal cyclicity in acquisitions are evident throughout the decade. In a typical week, daily acquisitions build from Monday through Friday, reaching a peak on Saturdays and a nadir on Sundays. In a typical calendar year, daily peaks occurred on the day after Thanksgiving and on days leading up to Christmas, and monthly peaks occurred in March and December.

Beginning in late 2012, the variability of acquisitions in California increased substantially (Figure 1, top). Three spikes are particularly prominent, occurring in late 2012, late 2014, and late 2015. The first and last of these spikes are also apparent in federal background-check data; they coincide with the weeks immediately following the mass shootings in Newtown and San Bernardino. The spike in late 2014 seems to be specific to California and attributable to a new state law (32) restricting the sale of certain types of handguns that went into effect on 1 January 2015 (details provided in Supplement 3, available at [Annals.org](http://Annals.org)).

### Baseline Characteristics

A total of 356 418 handgun acquisitions occurred in the year before the Newtown shootings, and 450 091 acquisitions occurred in the year before the San Bernardino shootings. Table 1 shows the characteristics of the acquisitions and the acquirers.

Acquisition characteristics were very similar across the 2 periods. Approximately two thirds of transactions were dealer sales, and 18% were transfers between private parties. Seventy-eight percent of the handguns were semiautomatic. Three quarters of the handguns were new weapons.

Acquirer characteristics were also similar across the 2 periods. Ninety percent were male, and approximately 70% were white. First acquisitions accounted for 40% of all acquisitions in the year before the Newtown shootings and 32% in the year before the San Bernardino shootings.

The rate of acquisition was nearly 10 times higher among men than among women. White persons acquired handguns at 3 to 4 times the rate of Hispanic persons and 2 to 3 times the rate of black persons. California residents aged 65 years or older acquired handguns at approximately one half the rate of residents younger than 50 years.

### Overall Changes in Frequency of Acquisitions

Handgun acquisitions increased sharply immediately after the mass shootings in Newtown and San Bernardino and then reverted to expected levels at 7 to 8 weeks after the shootings (Figure 2). In the 6 weeks after the Newtown and San Bernardino shootings, there were 25 705 (95% prediction interval, 17 411 to 32 788) and 27 413 (prediction interval, 15 188 to 37 734) ex-

cess acquisitions, respectively; these represented increases of 53% and 41% over expected volume.

Expected acquisitions closely approximated actual acquisitions in most of the 12 weeks before the mass shootings, suggesting good model fit, except for the 5 weeks preceding the Newtown attacks and 2 weeks preceding the San Bernardino attacks. The reelection of Barack Obama as U.S. president on 6 November 2012 and the terrorist attacks in Paris on 13 November 2015 are probable explanations for these exceptions; daily plots of acquisition volume point to these events as coincident with the beginning of the periods of higher-than-expected acquisition rates in the preshoot- ing periods (Supplement 3).

### Changes in Acquisition Rate by Sex and Race/Ethnicity

The acquisition response seemed to be disproportionately large among women. Acquisition rates were 75% higher (3 excess acquisitions per 10 000 residents per week) than expected among women and 48% higher (16 excess acquisitions per 10 000 residents per week) among men in the 6 weeks after the Newtown shootings, and they were 50% higher (3 excess acquisitions per 10 000 residents per week) than expected among women and 38% higher (16 excess acquisitions per 10 000 residents per week) among men in the 6 weeks after San Bernardino shootings (Table 2). Nonetheless, men continued to acquire handguns at a much higher rate than women throughout the observation periods.

Acquisition rates among white persons were 62% higher than expected after the Newtown shootings and 47% higher after the San Bernardino shootings (18 excess acquisitions per 10 000 residents per week for both). Acquisition rates among Hispanic persons were 43% higher (3 excess acquisitions per 10 000 residents per week) than expected after the Newtown shootings and 50% higher after the San Bernardino shootings (5 excess acquisitions per 10 000 residents per week). Acquisition increases among black persons after both mass shootings were relatively small and not statistically significant.

### Changes by Geography

After the Newtown shootings, acquisition rates were 50% higher than expected (7 excess acquisitions per 10 000 residents per week) among residents in and around San Bernardino, which was very close to the increase in acquisitions among residents of other parts of California (Table 2). After the San Bernardino shootings, acquisition rates were 85% higher in and around that city, compared with 35% higher elsewhere in the state.

### Changes in First Acquisitions

In the 6 weeks after the Newtown shootings, the number of acquisitions by first acquirers was 72% higher than expected (14 560 excess acquisitions), compared with 35% higher than expected (10 269 excess acquisitions) among repeat acquirers. In the 6 weeks after the San Bernardino shootings, acquisitions

**Table 1.** Characteristics of Handgun Acquisitions and Acquirers in California in the 12 Months Before the Mass Shootings in Newtown and San Bernardino\*

Characteristic	Before the Newtown Shootings†		Before the San Bernardino Shootings‡	
	Data, n (%)	Rate per 10 000 Adult Residents	Data, n (%)	Rate per 10 000 Adult Residents
<b>Acquisition</b>				
Total	356 418		450 091	
Type of transaction				
Dealer sale	244 987 (69)	-	285 799 (63)	-
Private party transfer	62 418 (18)	-	81 236 (18)	-
Curio/relic	25 695 (7)	-	62 325 (14)	-
Loan	3 (<1)	-	1 (<1)	-
Pawn redemption	5087 (1)	-	6128 (1)	-
Nonroster peace officer	18 228 (5)	-	14 602 (3)	-
Gun show sale	6703 (2)	-	6199 (1)	-
Type of handgun				
Revolver	66 253 (19)	-	69 983 (16)	-
Semiautomatic	278 400 (78)	-	352 865 (78)	-
Single shot	10 326 (3)	-	24 791 (6)	-
Derringer	1371 (<1)	-	2034 (<1)	-
Other	67 (<1)	-	418 (<1)	-
New handgun	267 196 (75)	-	341 830 (76)	-
<b>Acquirer</b>				
Race/ethnicity				
White	249 930 (70)	209	300 235 (67)	250
Hispanic	48 913 (14)	55	72 093 (16)	74
Black	12 750 (4)	80	15 824 (4)	96
Other	44 516 (13)	99	61 253 (14)	129
Sex				
Male	322 013 (90)	242	405 560 (90)	293
Female	34 405 (10)	25	44 531 (10)	31
Age				
<34 y	111 784 (31)	146	133 729 (30)	170
35–49 y	115 189 (32)	148	150 107 (33)	193
50–64 y	94 962 (27)	137	118 962 (26)	163
≥65 y	34 483 (10)	75	47 293 (11)	91
Novelty of acquisition				
First§	141 122 (40)	-	142 348 (32)	-
Repeat	215 296 (60)	-	307 743 (68)	-
Residential location				
San Bernardino and surrounding area	46 126 (13)	103	61 263 (14)	136
Rest of California	310 235 (87)	92	388 823 (86)	116

\* Dashes indicate rates that are not applicable or are incalculable.

† The Newtown shootings took place on 14 December 2012. Type of handgun was missing for 1 acquisition, race/ethnicity was missing for 309 (0.09%) acquirers, and residential location was missing for 57 (0.02%) acquirers.

‡ The San Bernardino shootings took place on 2 December 2015. Race/ethnicity was missing for 686 acquirers (0.15%), and residential location was missing for 5 acquirers (0.001%).

§ No prior handgun acquisitions recorded from 1 January 1995.

|| Acquirers whose residential ZIP codes have centroids located within the metropolitan statistical area of Riverside-San Bernardino-Ontario.

by first acquirers were 52% higher than expected (13 950 excess acquisitions) compared with 29% higher (11 816 excess acquisitions) among repeat acquirers. Details of these acquisition responses are provided in Table S3 in Supplement 5 (available at Annals.org).

## DISCUSSION

The number of handguns acquired in California increased sharply after the mass shootings in Newtown and San Bernardino, although the response varied widely within the population. Large and significant spikes in acquisition occurred among white and Hispanic persons, but not among black persons. Increases in acquisitions were larger among those who had not purchased another handgun in the previous 18 to 21

years than among those who had. In addition, after the San Bernardino mass shooting, a much larger increase in acquisitions occurred in neighborhoods in and around that city than elsewhere in California.

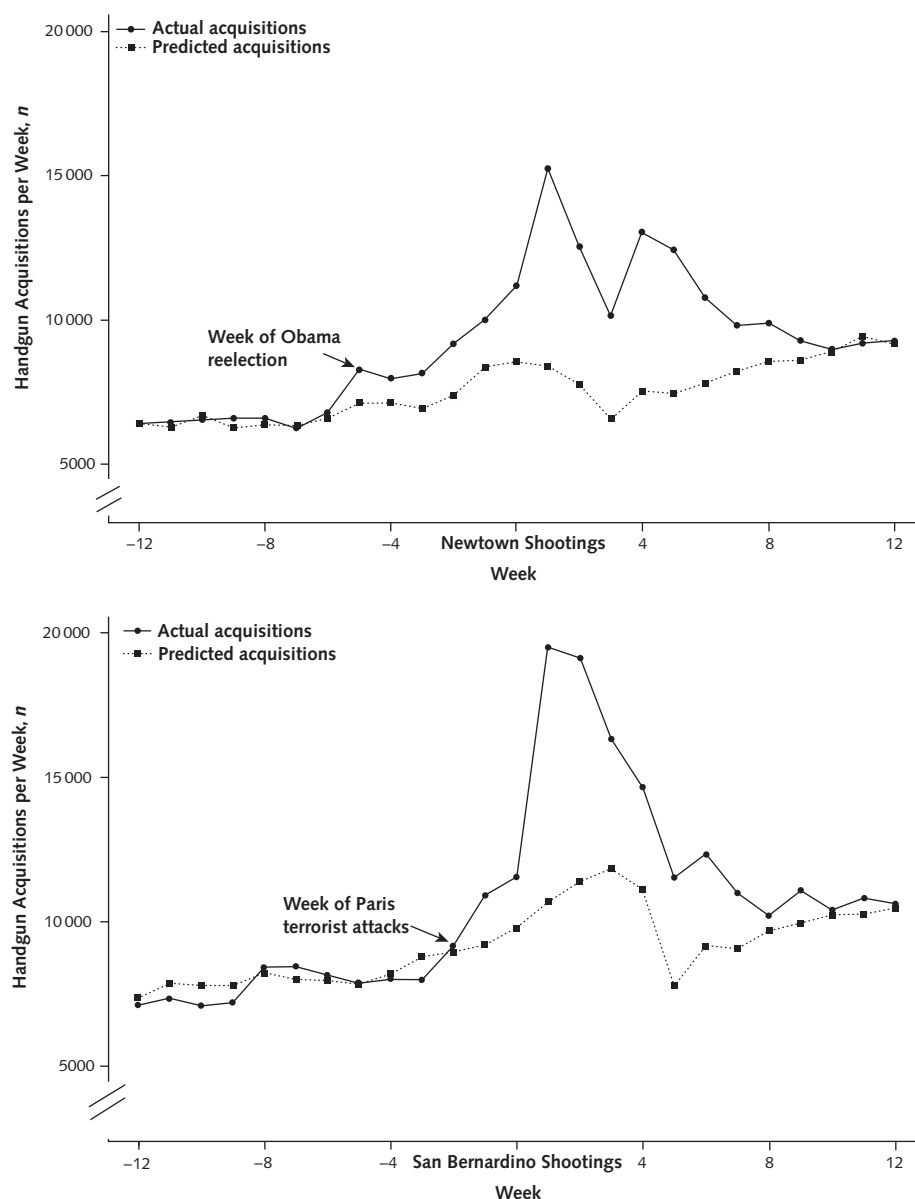
We provide the first detailed picture of firearm purchasing behavior in the immediate aftermath of mass shootings. Previous examinations (16–18, 20–22) of this relationship have used NICS data, which have the advantage of providing a national perspective. However, several factors disrupt a 1-to-1 relationship between federal background checks and firearm acquisitions. First, a large proportion of firearm acquisitions—estimates range up to 40% (33, 34)—occur without a federal background check. Second, a single check may be used to buy multiple firearms (23). Third, NICS sta-



tistics for some states include background checks performed routinely to determine the eligibility of existing firearm owners (23) and checks done for purposes of issuing concealed carry permits. Finally, NICS data are reported as aggregate statistics at the monthly level, which is too coarse to detect some aspects of acquisition responses. The Federal Bureau of Investigation does not publish NICS data at the level of persons or transactions and is required by federal law to destroy such information on approved transactions within 90 days (35).

Our study avoided these problems but also had limitations. First, isolating the effect of particular mass shootings on acquisitions is challenging: Acquisition patterns change over time and seem to be sensitive to a variety of events that occur regularly. Our modeling approach helped to address these issues, although it could not account for factors unrelated to the mass shootings of interest that affected acquisitions during the forecast periods (12 weeks before and after the shootings for the overall analysis and 6 weeks before and after for the subgroup analyses). The excess acqui-

**Figure 2.** Actual and predicted weekly handgun acquisitions from 12 weeks before to 12 weeks after the mass shootings in Newtown (top) and San Bernardino (bottom).



Predicted acquisitions closely approximate actual acquisitions in most of the 12 weeks before the mass shootings, suggesting good model fit, except for the 5 weeks preceding the Newtown attack and the week preceding the San Bernardino attack. President Obama's reelection on 6 November 2012 and the Paris terrorist attacks on 13 November 2015 are probable explanations for these higher-than-expected acquisition rates in the preshooting periods (see Figures S8 and S9 in Supplement 4, available at [Annals.org](https://annals.org)).

**Table 2.** Changes in Handgun Acquisitions in California in the 6 Weeks After the Mass Shootings in Newtown and San Bernardino, by Characteristics of Acquirers

Acquirer Characteristic	Handgun Acquisitions*							
	After the Newtown Shootings				After the San Bernardino Shootings			
	Actual Rate, <i>n</i>	Predicted Rate (95% PI), <i>n</i>	Absolute Change in Rate (95% PI), <i>n</i>	Relative Change in Rate (95% PI), %	Actual Rate, <i>n</i>	Predicted Rate (95% PI), <i>n</i>	Absolute Change in Rate (95% PI), <i>n</i>	Relative Change in Rate (95% PI), %
<b>Race/ethnicity</b>								
White	47	29 (25 to 35)	18 (12 to 22)	62 (34 to 88)	56	38 (32 to 46)	18 (10 to 24)	47 (22 to 75)
Hispanic	10	7 (6 to 8)	3 (2 to 4)	43 (25 to 67)	15	10 (9 to 12)	5 (3 to 6)	50 (25 to 67)
Black	11	10 (8 to 12)	1 (-1 to 3)	10 (-8 to 38)	15	13 (10 to 16)	2 (-1 to 5)	15 (-6 to 50)
Other	17	12 (11 to 14)	5 (3 to 6)	42 (21 to 55)	20	16 (13 to 19)	4 (1 to 7)	25 (5 to 54)
<b>Sex</b>								
Male	49	33 (28 to 39)	16 (10 to 21)	48 (26 to 75)	58	42 (36 to 50)	16 (8 to 22)	38 (16 to 61)
Female	7	4 (3 to 5)	3 (2 to 4)	75 (40 to 133)	9	6 (4 to 7)	3 (2 to 5)	50 (29 to 125)
<b>Age</b>								
<34 y	27	20 (17 to 24)	7 (3 to 10)	35 (12 to 59)	32	25 (21 to 30)	7 (2 to 11)	28 (7 to 52)
35-49 y	31	21 (17 to 25)	10 (6 to 14)	48 (24 to 82)	40	28 (24 to 34)	12 (6 to 16)	43 (18 to 67)
50-64 y	31	19 (16 to 22)	12 (9 to 15)	63 (41 to 94)	37	25 (21 to 29)	12 (8 to 16)	48 (28 to 76)
≥65 y	16	10 (8 to 12)	6 (4 to 8)	60 (33 to 100)	21	13 (11 to 15)	8 (6 to 10)	62 (40 to 91)
<b>Residential location</b>								
San Bernardino and surrounding area	21	14 (12 to 17)	7 (4 to 9)	50 (24 to 75)	37	20 (17 to 24)	17 (13 to 20)	85 (54 to 118)
Rest of California	19	13 (11 to 15)	6 (4 to 8)	46 (27 to 73)	23	17 (15 to 20)	6 (3 to 8)	35 (15 to 53)

PI = prediction interval.

\* All rates are per 10 000 adults per week.

sitions we estimated are associated with the mass shootings, not necessarily caused by them.

Second, our analysis does not consider long guns, which accounted for 45% of all firearm acquisitions in California in 2014 and 2015. Although retailers frequently logged long gun acquisitions into DROS before 2014, it was not mandatory to do so. Count data before and after San Bernardino show a spike in long gun acquisitions of similar magnitude to that observed in handgun sales, suggesting that handguns may represent only about one half of the total firearm acquisition response in California to that mass shooting. However, it was not possible to formally estimate the increase in long gun sales after San Bernardino because the method we used required several years of preevent data.

Finally, the generalizability of our findings outside California is unknown. The NICS data suggest similar national spikes in handgun acquisitions after the Newtown and San Bernardino shootings, but responses in other states may differ. California has stricter firearm laws than most other states (36). It is also worth noting that the attacks in Newtown and San Bernardino resulted in more deaths and attracted more publicity than most mass shootings do—indeed, we selected them for analysis on this basis. Consequently, the acquisition responses to the 2 mass shootings we analyzed are likely to be atypically large.

Our findings have implications for public health. Firearm ownership is a risk factor for firearm-related suicide and homicide (37-41). The increase in firearm

acquisitions that follows mass shootings may therefore have negative health effects over time, especially among individuals and households that previously had no firearms.

However, it is important to place our findings in a wider context. The spikes after the Newtown and San Bernardino shootings were large but did not last long. Consequently, the excess acquisitions that we estimated account for a relatively small proportion (<10%) of total annual handgun acquisitions in California in the relevant years (Supplement 6, available at [Annals.org](http://Annals.org)). Broadening the frame even further, the stock of firearms in California dwarfs the number of excess handgun acquisitions that we estimated. The size of this stock is unknown but is likely to be more than 30 million weapons (42). In sum, the incremental risk introduced by the spikes in handgun acquisitions after the Newtown and San Bernardino shootings is likely to be modest. Concerns about firearm violence and the public health risks of firearm ownership should stay focused on the much larger volume of weapons that routinely changes hands, and the immense stock that already sits in households.

On the other hand, the cumulative effect of such “shocks” as the Newtown and San Bernardino shootings on firearm prevalence may be substantial. Mass shootings occur regularly: Counts for the past 15 years range from several dozen to several hundred, depending on the restrictiveness of the definition used (3-7, 43, 44). Moreover, firearm acquisitions seem to be sensitive to a range of other events that are also common,

such as federal elections, new firearm safety laws, and terrorist attacks. Taken as a whole, these events may drive nontrivial increases in overall firearm prevalence, which may in turn increase the risk for firearm-related morbidity and mortality in the long run.

Substantial increases in firearm prevalence are particularly likely if the repeated shocks fundamentally alter baseline acquisition levels. A broader view of trends (Figure 1) indicates a marked change in handgun acquisition patterns in California beginning in late 2012; in the years after the Newtown shootings, a “new normal” has emerged. However, our study was not designed to measure aggregate or “ratcheting” effects of mass shootings on firearm acquisitions: We focused on short periods after 2 particularly high-profile shootings, and the model we used continuously incorporated upward shifts into expectations about future volume. Further research is needed to explore both cumulative effects and nontransient shifts in acquisition patterns; their causes; and their implications for public health, crime, and social cohesion.

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**Reproducible Research Statement:** *Study protocol:* Not applicable. *Statistical code:* The R code used to conduct the analyses is provided in **Supplement 7** (available at [Annals.org](http://Annals.org)). *Data set:* Not available.

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