

Rates of Household Firearm Ownership and Homicide Across US Regions and States, 1988–1997

Matthew Miller, MD, MPH, ScD, Deborah Azrael, MS, PhD, and David Hemenway, PhD

The United States has higher rates of firearm ownership than do other developed nations, and higher rates of homicide.^{1,2} Of the 233 251 people who were homicide victims in the United States between 1988 and 1997, 68% were killed with guns,³ of which the large majority were handguns.⁴

Case-control studies suggest that the presence of a gun in the home is a risk factor for homicide in the home,⁵ that the purchase of a handgun from a licensed dealer is associated with becoming a homicide victim,⁶ and that gun ownership may be a risk factor for committing homicide⁷ (although other studies found no association with homicide perpetration⁸). Most, but not all,^{9,10} cross-sectional studies have found a positive association between various measures of firearm availability and overall rates of homicide, a trend that holds across regions,¹¹ states,^{12–14} cities,^{15,16} and counties.¹⁷

Nationally representative studies of the effect of firearm prevalence on rates of homicide have been hampered by the lack of direct measures of firearm ownership within areas smaller than the 9 US Census regions and by uncertainty regarding the validity of firearm ownership proxies. Our study extends previous work by using recent data, looking across both regions and all 50 states, disaggregating victims by age, and adjusting for potential confounders, including poverty, urbanization, unemployment, alcohol consumption, aggravated assault, forcible rape, and robbery. In addition, we used the 2 best currently available measures of rates of household firearm ownership—direct survey-based measures for regional analyses¹⁸ and a rigorously validated proxy of household gun ownership¹⁹ for region- and state-level analyses.

METHODS

We used pooled cross-sectional time-series data for the 9 census regions and the 50

Objectives. In this study we explored the association between rates of household firearm ownership and homicide across the United States, by age groups.

Methods. We used cross-sectional time-series data (1988–1997) to estimate the association between rates of household firearm ownership and homicide.

Results. In region- and state-level analyses, a robust association between rates of household firearm ownership and homicide was found. Regionally, the association exists for victims aged 5 to 14 years and those 35 years and older. At the state level, the association exists for every age group over age 5, even after controlling for poverty, urbanization, unemployment, alcohol consumption, and nonlethal violent crime.

Conclusions. Although our study cannot determine causation, we found that in areas where household firearm ownership rates were higher, a disproportionately large number of people died from homicide. (*Am J Public Health.* 2002;92:1988–1993)

states for the period 1988 to 1997 to examine the association between rates of household firearm ownership and rates of overall homicide, gun-related homicide, and non-gun-related homicide. State-, age-, and year-specific mortality data came from the National Center for Health Statistics (NCHS) mortality files.²⁰ Gun-related deaths of undetermined intention constitute less than 3% of all gun-related deaths and were excluded from analyses. Region-specific population and mortality data were derived by aggregating state-level data.

At the regional level, survey-based measures of the percentage of households with guns and handguns came from the General Social Survey (GSS).¹⁸ The GSS, conducted by the National Opinion Research Center (Chicago, Ill) in most years from 1972 to 1993 and biennially since 1994, is the gold standard for national surveys of gun ownership. In its current form, the GSS is conducted by personal interview with a national area probability sample of 3000 noninstitutionalized adults. The sample is chosen to be representative of each of the 9 census regions and of the nation as a whole, but not of individual states. At the state level, published data on reported household gun ownership are available for only a nonrandom sample of 21 states.²¹ To analyze all 50 states, we used a proxy for household firearm ownership: the

fraction of all suicides in a state that involve a firearm, referred to hereafter as FS/S.

FS/S, which measures the distribution of firearm vs nonfirearm methods used in suicide rather than the rate of suicide, has been validated against survey-based measures of household gun ownership. A recent study determined that FS/S is the best proxy for household firearm ownership rates of the half-dozen or more proxies that have been used in the literature.¹⁹ FS/S is highly correlated with the percentage of households reporting firearm ownership in studies of 16 developed nations ($r=0.91$),²² the 9 US census regions ($r=0.93$),²³ 21 US states ($r=0.90$),²³ 170 US cities ($r=0.86$),²⁴ and 12 areas within a single state ($r=0.87$).¹⁹

Regressions allowed each region and state to assume a distinct firearm ownership rate for each of the 10 years in the study. Because an area's homicide rate in a given year is dependent on its rate in other years, standard errors were corrected by clustering observations by region or state. Distributions of death rates were skewed, and variances were greater than means. Consequently, negative binomial rather than Poisson models were used.

Primary analyses use incidence rate ratios (IRRs), obtained by exponentiating β coefficients in the negative binomial regressions, to express the association between firearm own-

TABLE 1—Crude Incidence Rate Ratios of Regional Homicide in the United States by Region-Level Proxies of Firearm Prevalence, 1988–1997

Victim Age	Homicide (95% CI)	Gun-Related Homicide (95% CI)	Non-gun-Related Homicide (95% CI)
0–4 years			
FS/S	1.11 (0.98, 1.24)*	1.22 (1.10, 1.35)†	1.09 (0.97, 1.24)
GSS ANY GUN	1.08 (0.98, 1.20)	1.24 (1.13, 1.36)†	1.06 (0.96, 1.18)
GSS HANDGUN	1.07 (0.97, 1.18)	1.20 (1.07, 1.34)***	1.06 (0.95, 1.17)
5–14 years			
FS/S	1.15 (1.02, 1.29)**	1.21 (1.03, 1.42)**	1.05 (0.98, 1.12)
GSS ANY GUN	1.11 (0.98, 1.26)	1.15 (0.94, 1.39)	1.05 (0.97, 1.11)
GSS HANDGUN	1.14 (1.02, 1.26)**	1.20 (1.02, 1.41)**	1.04 (0.98, 1.11)
15–24 years			
FS/S	1.10 (0.90, 1.34)	1.11 (0.89, 1.39)	1.07 (0.96, 1.20)
GSS ANY GUN	1.04 (0.87, 1.24)	1.04 (0.85, 1.27)	1.02 (0.93, 1.12)
GSS HANDGUN	1.10 (0.92, 1.31)	1.11 (0.91, 1.35)	1.07 (0.96, 1.20)
25–34 years			
FS/S	1.24 (1.00, 1.53)*	1.26 (0.99, 1.61)*	1.17 (1.01, 1.37)*
GSS ANY GUN	1.16 (0.96, 1.40)	1.18 (0.95, 1.46)	1.11 (0.98, 1.26)*
GSS HANDGUN	1.21 (1.01, 1.47)**	1.24 (1.00, 1.54)**	1.15 (1.01, 1.32)**
35–44 years			
FS/S	1.35 (1.09, 1.66)***	1.44 (1.13, 1.84)***	1.19 (1.02, 1.39)†
GSS ANY GUN	1.26 (1.05, 1.53)**	1.34 (1.07, 1.67)**	1.14 (0.99, 1.30)*
GSS HANDGUN	1.31 (1.09, 1.58)***	1.39 (1.13, 1.73)***	1.17 (1.02, 1.34)**
45–54 years			
FS/S	1.32 (1.10, 1.59)***	1.43 (1.18, 1.73)†	1.16 (0.97, 1.38)*
GSS ANY GUN	1.25 (1.05, 1.49)**	1.35 (1.12, 1.63)***	1.10 (0.95, 1.28)
GSS HANDGUN	1.30 (1.10, 1.54)***	1.40 (1.17, 1.67)†	1.14 (0.98, 1.33)*
55–64 years			
FS/S	1.35 (1.19, 1.53)†	1.48 (1.29, 1.70)†	1.21 (1.07, 1.36)***
GSS ANY GUN	1.27 (1.11, 1.45)***	1.39 (1.16, 1.63)†	1.14 (1.02, 1.27)**
GSS HANDGUN	1.32 (1.17, 1.50)†	1.44 (1.26, 1.65)†	1.19 (1.06, 1.33)***
≥ 65 years			
FS/S	1.38 (1.20, 1.59)†	1.63 (1.44, 1.85)†	1.26 (1.09, 1.45)***
GSS ANY GUN	1.31 (1.13, 1.51)†	1.51 (1.28, 1.80)†	1.21 (1.05, 1.38)**
GSS HANDGUN	1.35 (1.18, 1.56)†	1.60 (1.36, 1.88)†	1.23 (1.07, 1.40)***
All ages			
FS/S	1.23 (1.02, 1.49)**	1.27 (1.02, 1.58)**	1.16 (1.01, 1.33)**
GSS ANY GUN	1.16 (0.98, 1.38)*	1.19 (0.97, 1.45)*	1.11 (0.98, 1.25)*
GSS HANDGUN	1.21 (1.02, 1.44)**	1.25 (1.03, 1.52)**	1.14 (1.01, 1.29)**

Note. CI = confidence interval. Regional household firearm ownership prevalence was estimated using 3 measures: (1) a proxy representing the percentage of suicides that are firearm suicides (FS/S), (2) household gun ownership rates as reported in the General Social Survey (GSS ANY GUN), and (3) household handgun ownership rates as reported in the General Social Survey (GSS HANDGUN). All measures are standardized at the regional level so that their mean equals 0 and their standard deviation equals 1. Incidence rate ratios correspond to the standardized proxies. Over the 10-year study period, on average, our proxies vary across regions by 3.1, 3.4, and 3.4 standard deviations for FS/S, GSS ANY GUN, and GSS HANDGUN, respectively. Longitudinal variation is an order of magnitude smaller: over time, FS/S, GSS ANY GUN, and GSS HANDGUN measures fall within 0.35, 0.33, and 0.34 standard deviations of one another. Overall, when each region assumes a distinct prevalence estimate for each year, proxies span 3.6, 4.5, and 4.7 standard deviations for FS/S, GSS ANY GUN, and GSS HANDGUN, respectively.

* $P < 0.1$; ** $P < 0.05$; *** $P < 0.01$; † $P < 0.001$. All P values are two-tailed.

ership rates and rates of overall homicide, gun-related homicide, and non-gun-related homicide. To make our measures of firearm ownership easier to compare with one another, we standardized all measures to have a mean of 0 and a standard deviation of 1. Because the standard deviation of each firearm ownership measure was equal to 1, the reported IRRs represent the percentage change in the homicide rate for each standard deviation change in firearm ownership rate.

State-level analyses controlled for characteristics linked to homicide in the literature, including rates of violent crimes other than homicide (i.e., the Federal Bureau of Investigation “index crimes” of aggravated assault, forcible rape, and robbery), percentage of the adult population who are unemployed, percentage of the population who live in poverty (as defined by the poverty index developed by the Social Security Administration in 1961 and revised by the Federal Interagency Committees in 1980, with thresholds updated yearly to reflect changes in the Consumer Price Index), urbanization (percentage of the population living in metropolitan areas), and per capita alcohol consumption.^{25–29} Alcohol consumption data came from the National Institute on Alcohol Abuse and Alcoholism,³⁰ and data for other control variables came from the *Statistical Abstract of the United States*.³¹ Because of the small number of observations, regional analyses did not include control variables.

RESULTS

At the regional level, we found a positive and statistically significant relationship between rates of household gun ownership and homicide victimization for the entire population, for victims aged 5 to 14 years, and for victims 35 years and older (Table 1). These results were attributed primarily to higher gun-related homicide rates in regions with higher rates of firearm ownership; non-gun-related homicide rates were also elevated in regions where there were more guns, but to a lesser extent. Homicide victimization rates for those aged 0 to 4 years and aged 15 to 34 years were higher in regions with higher rates of gun ownership, but the association did not reach statistical significance. Results obtained

using survey (GSS) and proxy (FS/S) measures of firearm prevalence were nearly identical. Rates of household handgun ownership were somewhat more likely to be significantly associated with homicide rates than were measures of ownership of all household firearms.

At the state level, multivariate results showed a positive and significant relationship between rates of household gun ownership

and homicide victimization, for the entire population and for each age group aged 5 years and older (Table 2). As in the regional analyses, state-level results were attributed principally to substantially elevated gun-related homicide rates in states with higher rates of firearm ownership, although corresponding non-gun-related homicide rates were also somewhat elevated. The association between household gun ownership and

homicide victimization was strongest for victims 25 years and older.

Firearm ownership rates varied far more across states and regions (i.e., over time) than within states and regions. Not surprisingly, nearly identical results were obtained when firearm ownership rates were calculated using (1) distinct values for each state- (2) region-year or the average GSS or FS/S value for each geographic area over the 10-year study period, or (3) when 5-year rolling averages were used (not shown). Regressions across states in any given year yielded point estimates that were within 8% of the point estimate obtained when all 10 years of data were analyzed (not shown).

Table 3 compares the actual number of homicide victims between 1988 and 1997 in the states with the 4 lowest and 6 highest firearm ownership rates. These 10 states were chosen on the basis of their extreme firearm ownership rates, not on the basis of their homicide rates. The number of states in each group was selected so that the 2 groups' total person-years over the 10-year period were approximately the same (158 million vs 160 million).

In the "high gun states," 21 148 individuals were homicide victims, compared with 7266 in the "low gun states" (Table 3). For every age group of at least 5 years minimum age, people living in the high-gun states were more than 2.5 times more likely than those in the low-gun states to become homicide victims. These results were largely driven by higher rates of gun-related homicide, although rates of non-gun-related homicide were also somewhat higher in high-gun states. For all age groups, people living in high-gun states were 2.9 times more likely to die in a homicide; they were 4.2 times more likely to die in a gun-related homicide and 1.6 times more likely to die in a non-gun-related homicide.

State firearm ownership rates in Table 3 were determined using our proxy, FS/S, for all 50 states. Direct measures of firearm ownership rates are available from the Behavioral Risk Factor Surveillance System for 3 of the 6 high-gun states, in which an average of 53% of households contain firearms (range: 51%–55%). The system provides direct estimates of firearm ownership for 2 of the 4 low-gun

TABLE 2—Crude and Multivariate Adjusted Incidence Rate Ratios of State-Level Homicide by State-Level Measures of Firearm Prevalence, 1988–1997

Victim Age	Homicide (95% CI)	Gun-Related Homicide (95% CI)	Non-gun-Related Homicide (95% CI)
0–4 years			
FS/S (bivariate)	1.09 (1.02, 1.17)**	1.26 (1.13, 1.41)†	1.07 (1.00, 1.15)*
FS/S (multivariate)	1.07 (0.98, 1.17)	1.35 (1.18, 1.53)†	1.05 (0.96, 1.15)
5–14 years			
FS/S (bivariate)	1.13 (1.03, 1.24)***	1.20 (1.07, 1.36)***	1.04 (0.97, 1.11)
FS/S (multivariate)	1.15 (1.03, 1.28)**	1.23 (1.07, 1.41)***	1.05 (0.97, 1.13)
15–24 years			
FS/S (bivariate)	1.10 (0.94, 1.27)	1.12 (0.93, 1.34)	1.03 (0.94, 1.11)
FS/S (multivariate)	1.23 (1.12, 1.34)†	1.32 (1.18, 1.47)†	1.02 (0.95, 1.10)
25–34 years			
FS/S (bivariate)	1.23 (1.08, 1.41)**	1.28 (1.09, 1.52)**	1.13 (1.03, 1.25)**
FS/S (multivariate)	1.27 (1.10, 1.49)**	1.39 (1.23, 1.57)†	1.10 (1.02, 1.19)**
35–44 years			
FS/S (bivariate)	1.32 (1.17, 1.49)†	1.45 (1.24, 1.71)†	1.15 (1.04, 1.26)***
FS/S (multivariate)	1.35 (1.23, 1.48)†	1.52 (1.35, 1.77)†	1.15 (1.06, 1.24)†
45–54 years			
FS/S (bivariate)	1.32 (1.16, 1.49)†	1.45 (1.25, 1.68)†	1.14 (1.02, 1.27)**
FS/S (multivariate)	1.33 (1.19, 1.48)†	1.48 (1.30, 1.68)†	1.12 (1.02, 1.24)**
55–64 years			
FS/S (bivariate)	1.34 (1.21, 1.49)†	1.51 (1.32, 1.73)†	1.17 (1.06, 1.29)***
FS/S (multivariate)	1.36 (1.24, 1.50)†	1.54 (1.37, 1.72)†	1.18 (1.07, 1.38)***
≥ 65 years			
FS/S (bivariate)	1.36 (1.22, 1.52)†	1.64 (1.46, 1.84)†	1.24 (1.11, 1.38)†
FS/S (multivariate)	1.39 (1.27, 1.53)†	1.71 (1.53, 1.91)†	1.24 (1.13, 1.37)†
All ages			
FS/S (bivariate)	1.22 (1.08, 1.37)***	1.28 (1.10, 1.50)***	1.11 (1.03, 1.21)**
FS/S (multivariate)	1.27 (1.16, 1.39)†	1.41 (1.27, 1.57)†	1.10 (1.02, 1.19)**

Note. CI = confidence interval. Adjusted analyses control for rates of violent index crimes other than homicide (aggravated assault, forcible rape, and robbery), percentage unemployed of the adult population, percentage of the population living in poverty, percentage of the population living in metropolitan areas, and per capita alcohol consumption. Household firearm ownership prevalence was estimated for all 50 states using the percentage of suicides that are firearm suicides (FS/S) as a proxy. FS/S is standardized so that its mean equals 0 and its standard deviation equals 1. Incidence rate ratios correspond to standardized values for FS/S. Over the 10-year study period, on average, FS/S spans 4.1 standard deviations across the 50 states (FS/S ranges from 0.29 to 0.80); within-state variation is far smaller, ranging, on average, across 0.28 standard deviation (FS/S ranges from 0.58 to 0.61). Overall, when each state assumes a distinct value for each year, FS/S spans 5.1 standard deviations (FS/S ranges from 0.21 to 0.85).

* $P < 0.1$; ** $P < 0.05$; *** $P < 0.01$; † $P < 0.001$. All P values are two-tailed.

TABLE 3—Homicide Deaths in States With the Highest vs the Lowest Average Gun Ownership Prevalence Index, 1988–1997

Victim Age	High Gun States	Low Gun States	Mortality Rate Ratio (High Gun:Low Gun)
Total population, all ages	158 million	160 million	
0–4 years			
Gun-related homicide	67	17	4.0
Non-gun-related homicide	437	293	1.5
Total	504	310	1.6
5–14 years			
Gun-related homicide	302	80	3.8
Non-gun-related homicide	149	104	1.5
Total	451	184	2.5
15–24 years			
Gun-related homicide	5157	1539	3.4
Non-gun-related homicide	963	697	1.4
Total	6120	2236	2.8
25–34 years			
Gun-related homicide	4397	1078	4.1
Non-gun-related homicide	1445	920	1.6
Total	5842	1998	3.0
35–44 years			
Gun-related homicide	2825	495	5.8
Non-gun-related homicide	1168	684	1.7
Total	3993	1179	3.4
45–54 years			
Gun-related homicide	1316	264	5.0
Non-gun-related homicide	544	331	1.7
Total	1860	595	3.2
55–64 years			
Gun-related homicide	609	106	5.8
Non-gun-related homicide	402	216	1.9
Total	1011	322	3.2
≥ 65 years			
Gun-related homicide	602	80	7.6
Non-gun-related homicide	745	331	2.3
Total	1347	411	3.3
All ages			
Gun-related homicide	15 283	3668	4.2
Non-gun-related homicide	5865	3598	1.6
Total	21 148	7266	2.9

Note. For ease of comparison, similar populations were obtained by comparing the 4 states with the lowest gun ownership rates (“low gun states”) and the 6 states with the highest gun ownership rates (“high gun states”). The 6 states with the highest average gun ownership rates for 1988 to 1997 were Louisiana, Alabama, Mississippi, Wyoming, West Virginia, and Arkansas. The 4 states with the lowest average gun ownership rates for 1988 to 1997 were Hawaii, Massachusetts, Rhode Island, and New Jersey. Overall mortality rate ratios and ratios for each age stratum use strata-specific populations as denominators.

Introducing a lagged firearm ownership measure in regressions did not alter our findings. Homicide rates for the period 1988 to 1997 were associated with firearm ownership rates regardless of whether ownership data came from contemporaneous years or from the preceding decade (i.e., the average firearm ownership rates between 1979 and 1987).

Overall homicide rates were significantly higher in states with higher rates of nonlethal violent crime, poverty, and urbanization. Per capita alcohol consumption and unemployment were not significantly associated with homicide rates in multivariate regressions.

DISCUSSION

In the United States, regions and states with higher rates of firearm ownership have significantly higher homicide victimization rates. This result is driven primarily by gun-related homicide victimization rates, although non-gun-related victimization rates were also higher in states with higher rates of firearm ownership. The close correspondence between our proxy (FS/S) and survey-based (GSS) measures of household firearm ownership is readily apparent in Table 1, in which results obtained with survey and proxy measures are nearly identical.

The association between higher household gun ownership rates and higher overall homicide rates is robust. Regressions were driven neither by either the most populous states nor by the states with the most extreme rates of gun ownership. Overall, the results obtained when we analyzed all 50 states and the 40 least and 40 most populous states were equivalent to those obtained when analyses excluded the 10 states most extreme in FS/S (i.e., the 5 states with the highest FS/S and the 5 states with the lowest FS/S). The firearm–homicide association remained significant even when state-level analyses controlled for rates of poverty, urbanization, unemployment, per capita alcohol consumption, and violent crimes other than homicide (i.e., aggravated assault, forcible rape, and robbery). In fact, the cross-sectional association between rates of firearm ownership and homicide victimization was so stable over time that regressions across states in any

states, in which 13% of households contain firearms (range: 12%–14%). The corresponding FS/S measures for the 6 high-gun states

and the 4 low-gun states are 76% (range: 75%–80%) and 33% (range: 30%–36%), respectively.

given year produced point estimates that were within 8% of the point estimate obtained when all 10 years of data were analyzed.

The association between household firearm ownership rates and homicide rates held for virtually all age groups and was particularly strong for adults aged 25 years and older. An example is the category of homicide victims aged 35 to 44 years. Table 2 indicates that in a comparison of states that differed by 1 standard deviation in our firearm proxy (FS/S), the homicide rate was on average 35% higher in the states with the higher FS/S (i.e., multivariate IRR=1.35). Given that FS/S was 4-fold higher in states with the lowest relative to those with the highest gun ownership rates, our multivariate model suggested that the homicide rate in the high-gun states would be 3.3 times that in the low-gun states (35% compounded 4-fold), and our bivariate model suggested a 3-fold difference (32% compounded 4-fold). Table 3 presents the corresponding bivariate comparison of the actual number of homicide victims in the states with the 4 lowest and the 6 highest gun ownership rates: for victims aged 35 to 44 years, homicide rates were 3.4 times higher in the high-gun states.

One reason that FS/S may be such a good proxy for household firearm ownership is that guns used for suicide appear typically to be household guns. However, guns used in homicide, especially homicides committed by adolescents and young adults, may often be obtained on the street. If, as has been reported,^{32–34} it is relatively easy for adolescents and young adults to acquire illegal guns on the street, the association between household gun ownership incidence and rates of homicide committed by this age group might be diluted by this alternative source of firearms. Because individuals murdered by 15- to 24-year-olds tend to be other 15- to 24-year-olds,³⁵ this may explain, in part, our finding that the association between household firearm ownership and the rate of homicide was stronger among adults 25 years and older than it was among younger adults and adolescents. Consistent with this possibility, others have found that in areas with few guns and strict gun control laws, criminal adolescents and young adults appear to obtain their firearms via gun runners who pur-

chase the weapons in states with more permissive gun laws.³²

Neither survey estimates of household firearm ownership nor our proxy is an ideal measure of firearm availability. Surveys typically underrepresent poor people, and women living in 2-adult households with guns do not always have accurate information about whether a gun is present in their home.^{36,37} In addition, household firearm ownership rates indicate nothing about the number of guns per household, storage practices, or the ease with which high-risk individuals can obtain firearms in secondary market transfers. Given that household firearm ownership rates are likely to be only a crude measure of firearm availability, the robust association we report between measures of firearm prevalence and rates of homicide is striking.

Our study included only a limited number of potential confounders—poverty, urbanization, unemployment, alcohol consumption, and violent crimes (aggravated assault, forcible rape, and robbery)—and then only in state-level analyses. We found, consistent with previous work, that homicide rates were higher in areas with higher rates of urbanization, poverty, and nonlethal violent crime (not shown),^{25–28} but many other factors may affect homicide rates. It is not clear, however, whether accounting for these or other area-wide characteristics would increase or reduce the magnitude or significance of the association between rates of household firearm ownership and homicide.

Our study did not provide information about causation. One approach to evaluating causal direction is to use a lagged measure of the key independent variable. Our finding that a lagged measure of firearm ownership yielded results similar to results obtained with contemporaneous ownership and homicide measures is consistent with higher gun ownership rates leading to higher homicide rates. However, this result does not rule out the possibility that reverse causation or a non-causal explanation accounts for the association between rates of firearm ownership and homicide. It is possible, for example, that locally elevated homicide rates may have led to increased local gun acquisition. Unfortunately, we were unable to resolve this issue, in part because cross-sectional patterns of gun own-

ership rates across the United States are so stable over time.¹⁹

The current study adds to previous work by using recent data, looking across both regions and all 50 states, disaggregating victims by age, and adjusting for several potential confounders not previously accounted for in nationally representative studies. We found that across US regions and states, and for virtually every age group, higher rates of household firearm ownership were associated with higher rates of homicide. Our findings held regardless of the following: whether firearm ownership rates were survey-based or derived from a validated proxy, whether states most extreme in ownership rates were excluded from analyses, whether the most and the least populous states were excluded, and whether regressions controlled for rates of poverty, urbanization, unemployment, alcohol consumption, and violent crimes other than homicide. In areas with more firearms, people of all ages were more likely to be murdered, especially with handguns. ■

About the Authors

Matthew Miller, Deborah Azrael, and David Hemenway are all from the Harvard School of Public Health, Boston, Mass.

Requests for reprints should be sent to Matthew Miller, MD, MPH, ScD, Harvard School of Public Health, 677 Huntington Ave, Boston, MA 02115 (e-mail: mmiller@hsph.harvard.edu).

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Contributors

Each author contributed substantially to the conceptualization, design, and interpretation of the study. M. Miller wrote the article and analyzed the data. D. Azrael and D. Hemenway contributed to the writing of the article and the analysis of the data, and made critical revisions to various iterations of the article.

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Human Participant Protection

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