Repeal of the concealed weapons law and its impact on gun-related injuries and deaths

Rashna Ginwalla, MD, Peter Rhee, MD, MPH, Randall Friese, MD, Donald J. Green, MD, Lynn Gries, MD, Bellal Joseph, MD, Narong Kulvatunyou, MD, Dafney Lubin, MD, Terence O'Keeffe, MBChB, Gary Vercruysse, MD, Julie Wynne, MD, *and* **Andrew Tang, MD,** *Charlottesville, Virginia*

BACKGROUND: Senate Bill 1108 (SB-1108) allows adult citizens to carry concealed weapons without a permit and without completion of a training course. It is unclear whether the law creates a "deterrent factor" to criminals or whether it escalates gun-related violence. We hypothesized that the enactment of SB-1108 resulted in an increase in gun-related injuries and deaths (GRIDs) in southern Arizona.

METHODS: We performed a retrospective cohort study spanning 24 months before (prelaw) and after (postlaw) SB-1108. We collected injury and death data and overall crime and accident trends. Injured patients were dichotomized based on whether their injuries were intentional (iGRIDs) or accidental (aGRIDs). The primary outcome was any GRID. To determine proportional differences in GRIDs between the two periods, we performed χ^2 analyses. For each subgroup, we calculated relative risk (RR).

RESULTS: The number of national and state background checks for firearms purchases increased in the postlaw period (national and state $p < 0.001$); that increase was proportionately reflected in a relative increase in state firearm purchase in the postlaw period (1.50% prelaw vs. 1.59% postlaw, $p < 0.001$). Overall, victims of events potentially involving guns had an 11% increased risk of being injured or killed by a firearm ($p = 0.036$) The proportion of iGRIDs to overall city violent crime remained the same during the two periods (9.74% prelaw vs. 10.36% postlaw; RR, 1.06; 95% confidence interval, 0.96–1.17). However, in the postlaw period, the proportion of gun-related homicides increased by 27% after SB-1108 (RR, 1.27; 95% confidence interval, 1.02–1.58).

CONCLUSION: Both nationally and statewide, firearm purchases increased after the passage of SB-1108. Although the proportion of iGRIDs to overall city violent crime remained the same, the proportion of gun-related homicides increased. Liberalization of gun access is associated with an increase in fatalities from guns. (*J Trauma Acute Care Surg*. 2014;76: 569–575. Copyright © 2014 by Lippincott Williams & Wilkins)

LEVEL OF EVIDENCE: Epidemiologic study, level III.

KEY WORDS: Concealed carry; gun violence; SB-1108; firearms; background checks.

The United States leads the world in private, civilian ownership of firearms. At a rate of 88.8 firearms per 100 people, gun ownership in the United States far surpasses that in Yemen, the country with the next highest rate at 54.8 firearms per 100 people.[1] In 2010, in the United States, the use of firearms resulted in the death of 31,672 people, representing a crude mortality rate of 10.26 per 100,000 people. Of those deaths, 19,392 (61.2%) were suicides, 11,078 (35%) were homicides, and 606 (1.9%) were accidental gun-related deaths.[2]

Submitted: August 31, 2013, Revised: November 18, 2013, Accepted: November 21, 2013.

From the Division of Trauma and Emergency General Surgery (R.G.), University of Virginia School of Medicine, Charlottesville, Virginia; Division of Trauma, Surgical Critical Care and Emergency General Surgery (P.R., R.F., D.J.G., L.G., B.J., N.K., T.O., G.V., J.W., A.T.), University of Arizona College of Medicine, Tucson, Arizona; Division of Trauma (D.L.), Memorial Regional Hospital, Hollywood, Florida.

This study was presented at the 72nd annual meeting of the American Association for the Surgery of Trauma, September 18–21, 2013, in San Francisco, California.

Address for reprints: Rashna Ginwalla, MD, Rwanda Human Resources for Health, Program, Division of Trauma and Emergency General Surgery, University of Virginia School of Medicine, Charlottesville, VA 22908; email: rashnafg@gmail.com.

DOI: 10.1097/TA.0000000000000141

The degree to which the US Constitution's Second Amendment guarantees the right to possess firearms in public places is controversial.[3–5] Recently, US courts have increasingly broadened their interpretation of the Second Amendment with their rulings on gun regulations for personal use.[6–8] However, US Courts have ruled inconsistently on the extension of the Second Amendment rights in public.[9,10] Many state legislatures have begun to address this issue by passing increasingly permissive regulations on personal possession of firearms in public places, with variable effects on homicide and suicide rates.[11–17]

Arizona, a state with some of the least restrictive gun laws in the nation, has a gun homicide rate greater than the national average (4.24 vs. 3.59 per 100,000 people).[2] Arizona does not regulate the quantity or type of firearms an individual may purchase and has traditionally granted permits to applicants not convicted of previous felonies or crimes, who are not a danger to themselves or others owing to mental illness. With these precedents, Senate Bill 1108 (SB-1108), or Arizona Revised Statute (A.R.S.) 13-3112, was drafted in early 2010; it modified the existing Arizona statutes and removed requirements for permits to carry concealed weapons, while maintaining that individuals were still required to follow posted signs in facilities

that banned weapons and to cooperate with law enforcement when questioned.[18] Signed by the Governor on April 16, 2010, SB-1108 went into effect on July 29, 2010. This new law removed the previous restrictions on carrying concealed weapons as well as the previously mandatory 8-hour training session required to obtain a concealed carry permit. The effect of this legislation on the frequency of gun-related morbidity and mortality in state of Arizona is unknown.

The purpose of this study was to describe the effect of SB-1108 on the rate of gun-related injuries and deaths (GRIDs) in southern Arizona. We hypothesized that the enactment of SB-1108 has resulted in an increase in GRIDs in southern Arizona.

PATIENTS AND METHODS

This study is a retrospective, observational, before-and-after cohort analysis exploring the effect of legislation relaxing restrictions on the concealed carry of firearms in public places on rates of GRID in southern Arizona. The overall study period spanned 48 months, from August 1, 2008, through July 31, 2012. We divided those 48 months into two periods, each spanning 24-month prelaw period (from August 1, 2008, through July 31, 2010) and postlaw period (from August 1, 2010, through July 31, 2012).

Population at Risk

Data on background checks related to firearm purchases for both Arizona and the United States were obtained from the National Instant Criminal Background Check System (http://www.fbi.gov/about-us/cjis/nics). For our analysis, we aggregated monthly totals into the prelaw and postlaw periods.

We collated overall intentional and accidental event data from the Web-based Crime Statistics database of the Tucson Police Department (TPD) (http://tpdinternet.tucsonaz.gov/stats/statistics.aspx). These events were further classified into the categories "violent crime;" "other intentional violence;" based, in part, on the Uniform Crime Reporting Program of the Federal Bureau of Investigation; and "accidents" that could possibly involve firearms. The federal definition of violent crime includes criminal homicide, aggravated assault, sexual assault, and robbery; to that list, we added suicide. Other intentional violence includes among many other crimes that could involve firearms, property crime, and arson (see Table 1 for definitions).

TABLE 1. Definitions (per TPD database)

	TPD Definition
Accidents	Firearm accident, personal injury accident, death of unknown causes
Violent crime	Federal definition (criminal homicide, sexual assault, robbery, aggravated assault) + suicide
Other intentional violence	Burglary, larceny, motor vehicle theft, arson, other assaults, stolen property, criminal damage, sex offenses, narcotic drug laws, gambling, offenses against family and children, driving under the influence/nonaccident, liquor laws, intoxication, disorderly conduct, other offenses, arrest for other jurisdiction, juvenile violations
Population at risk	Population that might be killed or injured with a gun = other intentional violence + violent crime + accidents

These were categories selected from the TPD Crime Statistics Database online to define our populations at risk.

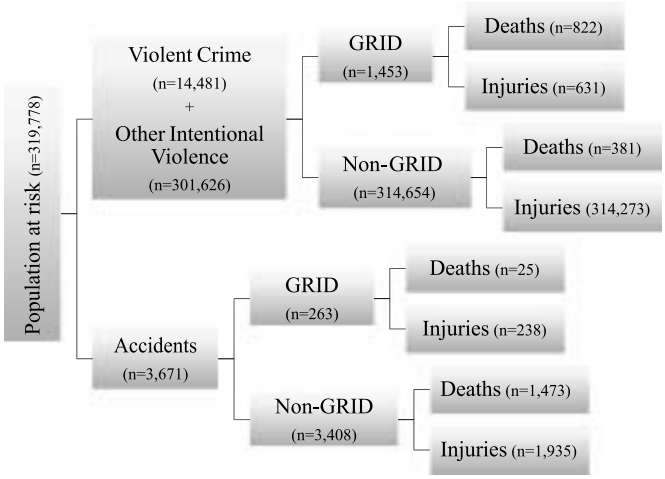

Figure 1. Study design.

Frequency of GRID

Hospital data on injury mechanism were obtained from the University of Arizona Medical Center's prospectively maintained trauma registry. The data were then used to identify injury and death occurring secondary to firearm use. To capture prehospital firearm deaths and avoid double-counting those who died on admission to the hospital, we obtained mortality data only from the Pima County Medical Examiner's (ME's) Office. As a matter of legal reporting, all hospital deaths that occur as a result of firearms are reported to the ME's office. We only included patient records that included the date of injury, mechanism of injury, and documentation of mortality. Records for which these data were not available were excluded. In the trauma registry, homicides are defined as those deaths occurring as a direct result of an intentional crime by another person; we classified "undetermined" or "other" causes as accidental, where applicable. The term *gun-related* was defined as the use of all types of firearms, including shotguns and military weapons. Patients were divided into two subgroups based on whether their GRIDs were intentional (iGRIDs) or accidental (aGRIDs). These two subgroups were analyzed separately (Fig. 1).

Outcomes and Statistical Analysis

The primary outcome of this study was the frequency of GRID in each period. Gun-related deaths alone were analyzed as a secondary outcome. To determine proportional differences in GRIDs between the two periods, we performed χ^2 analyses. For each subgroup, we calculated relative risk (RR) and the 95% confidence interval. We considered a $p < 0.05$ to be statistically significant.

Microsoft Excel (Microsoft Corporation, Redmond, WA) software was used for data storage and management. Statistical analyses were performed using STATA-IC version 12 software (StataCorp LC, College Station, TX).

RESULTS

Background Checks

In the postlaw period, the rate of background checks for gun purchases in Arizona increased by 5.5% ($p = 0.001$) and was higher than the national average ($p < 0.001$) (Table 2). On the whole, proportionally more firearms were purchased in Arizona in the postlaw period than in the rest of the nation, although there was an overall national increase in such purchases ($p < 0.001$) (Table 3).

Study Populations

Other intentional violence including property crimes, arson, and violent incidents that could involve firearms constituted 94% of the study population, while violent crimes constituted 4% to 5% of the study populations (Table 2). The rate of at-risk accidents was twice as high (4.3%) as the rate of at-risk violent crimes (2.19%). Figure 2 shows that while violent crime trends mirrored trends in the overall at-risk population, rates of at-risk accidents remained fairly stable over time.

GRIDs

In the postlaw period, Arizonans at risk of being involved in firearm-related events (see Table 1 for definitions) were 11% more likely to be either injured or killed with a gun (Table 3). Individuals were at no higher risk of being only injured (but not killed) by a gun after SB-1108 (RR, 1.07; $p = 0.290$); however, there was a trend toward being killed with a gun, whether by suicide or homicide (RR, 1.14; $p = 0.055$). If they were involved in an at-risk altercation, they were 27% more likely to be deliberately killed by someone with a gun (RR, 1.27; $p = 0.035$).

Those involved in violent crimes were at a 24% increased risk of being fatally shot by someone else with a gun after SB-1108 (RR, 1.24; $p = 0.05$) (Table 3). Gun-related suicide rates increased, overall, by 7%; among Arizonans involved in violent crimes, gun-related suicide rates increased by 5%.

TABLE 2. GRIDs, by Period (All Sources)

	Prelaw	Postlaw	Rate of Change*	
	n	n	%	*p*
Entire population at risk	167,216	152,562	Reference	0.001
Violent crimes	7,494	6,987	2.19	
Accidents	1,881	1,790	4.30	
All GRIDs	854	862	10.6	
iGRIDs	730	723	8.55	
aGRIDs	124	139	22.9	
GR deaths	415	432	14.1	
GR homicides	148	171	26.6	
GR suicides	254	249	7.45	
Background checks				
National	28,166,646	32,945,233	Reference	<0.001
Arizona	423,633	522,821	5.51	

*Based on entire population at risk, for example, rate of violent crimes = [6,987 / 152,562 − 7,494 / 167,216] / [7,494 / 167,216] = 2.19%.

TABLE 3. Proportional GRIDs of Entire Population at Risk, by Period

	Prelaw, n (%)	Postlaw, n (%)	RR	95% Confidence Interval
Entire population at risk	167,216	152,562	Reference	Reference
GRID	854 (0.51)	862 (0.57)	*1.11*	*1.01–1.22*
GR deaths	415 (0.25)	432 (0.28)	1.14	0.997–1.31
GR homicide	148 (0.09)	171 (0.11)	*1.27*	*1.02–1.58*
GR suicide	254 (0.15)	249 (0.16)	1.07	0.902–1.28
Violent crime	7,494	6,987	Reference	Reference
iGRID	730 (9.74)	723 (10.4)	1.06	0.964–1.17
iGR deaths	402 (5.36)	420 (6.01)	1.12	0.981–1.28
GR homicide	148 (1.97)	171 (2.45)	1.24	0.997–1.54
GR suicide	254 (3.39)	249 (3.56)	1.05	0.886–1.25
Accidents	1,881	1,790	Reference	Reference
aGRID	124 (6.59)	139 (7.77)	1.18	0.933–1.49
aGR deaths	13 (0.69)	12 (0.67)	0.970	0.444–2.12
Background checks				
National	28,166,646	32,945,233	Reference	Reference
Arizona	423,633 (1.50)	522,821 (1.59)	*1.06*	*1.05–1.06*

Italics indicate statistical significance.

DISCUSSION

Our retrospective cohort study demonstrates that, after enactment of SB-1108, GRIDs increased in southern Arizona, mostly owing to an increase in gun-related homicides. We also found that Arizonans purchased more guns during the postlaw period.

Although the number of firearm purchases that we noted is probably a gross underestimate of the actual number, we still found an increase in GRIDs. One reason for this underestimation is that data on background checks related to purchases of firearms and explosives, as required by the Brady Handgun Violence Prevention Act of 1993,[19–21] are limited to legitimate gun dealerships only; private sales and those at gun shows are exempt from checks and reporting. In addition, in many states—including Arizona—sales are not limited to merely one weapon per background check—buyers are free to purchase as many firearms with ammunition as they wish during the same transaction. Gun sales not subject to background checks have been estimated to account for almost 40% of all sales nationwide.[22–24] We recognize that the increased availability of guns after the concealed carry law was repealed could act as a confounder whereby the increase in GRIDs could be related to the overall increase in guns rather than the enhanced ability to carry concealed weapons, but we did show an increase in GRIDs; this could be caused by an

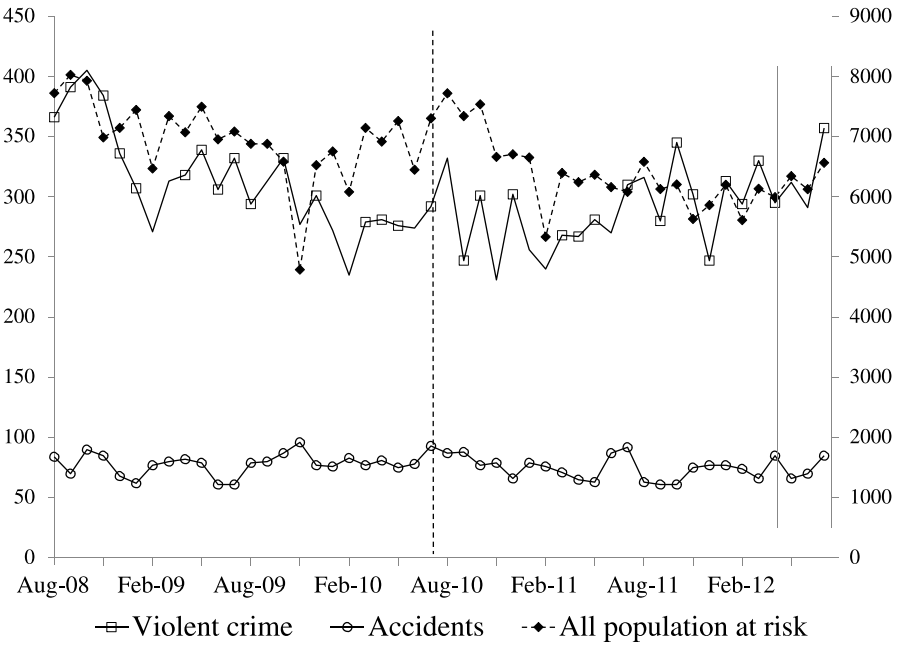

Figure 2. Populations at risk for being injured or killed with guns, Tucson metropolitan area, August 2008 to July 2012 (*vertical line*, July 2010; cohort to left, prelaw; cohort to right, postlaw; see text and Table 1 for definitions of ''at risk'').

increased availability of guns, the increased ability to carry these guns in a concealed fashion, or both.

Despite the inherent limitations of the data on firearm purchases, we showed that the rate of increase of gun purchases in Arizona was 5% greater than the national increase and that Americans in general have been buying more guns.

It would seem intuitive that gun-related accidents might have increased after SB-1108's removal of mandatory training on appropriate gun use. However, in the postlaw period in our study, we found that gun-related accidents were rare (at least according to the number of accidentally injured patients at our trauma center or accidental deaths reported to the medical examiner). We also found that the rate of gun-related accidental deaths was exceedingly small. The reasons for this are unknown; experience suggests that seeking medical attention for a self-inflicted accidental injury with one's own gun is associated with some level of social stigma, so perhaps such individuals fail to come to a trauma center such as ours for minor wounds.

In the postlaw period in our study, the rate of homicides as a whole increased by only 3% (data not shown). However, the rate of gun-related homicides increased by 27% among the entire at-risk population and by 24% if individuals were involved in a violent crime (Table 3). Gun-related homicides among patient of violent crimes approached significance, and we believe that this loss of significance when we focused on a subgroup rather than the entire population at risk is likely a result of the differential decline in the two denominators. Southern Arizonans did not become significantly more homicidal, but rather, they were more likely to use a gun to commit murder than before the enactment of SB-1108. Whether this was because more guns were available on the streets that individuals could conceal or because more people were carrying guns is unexplainable by our data.

Suicide rates did not seem to be affected by the enactment of SB-1108. Previous studies have shown that creating a waiting period between the initiation of a background check and the granting of firearm ownership reduces suicide risk.[25] Implementation of a suicide plan is very often an impulsive act, particularly among younger individuals, making it harder for them to obtain a weapon at this vulnerable time improves their chances of survival.[20]

The findings of our study must be interpreted within the context of its limitations. As the only Level I trauma center in southern Arizona, in conjunction with the Pima County ME's Office, our group at the University of Arizona Medical Center in Tucson, Arizona, captures data on all of the gun-related deaths occurring in this large jurisdiction. At our trauma center, we also see most of the patients in southern Arizona who need treatment for gun-related injuries. Thus, our group is particularly well suited to obtain comprehensive data.

Demographic information such as comorbidities and injury severity was available only from the trauma registry. As such, we were unable to control for any possible confounders. This speaks to the quality of the data on firearm-related violence currently being collected by public agencies and ought to strengthen the call for increased financial and institutional support for such research and data collection and analyses. These types of weaknesses in epidemiologic studies such as ours could be eliminated by collecting good-quality data on this issue, unfettered by political special interests.

We did exclude those records outside our timeline of interest as well as those with data missing on trauma type, mechanism of injury, date of injury or hospital admission, and

mortality, which theoretically could have introduced a selection bias. However, these excluded data amounted to approximately less than 1% of the 19,945 records included in the trauma registry or of the 2,700 records included in the ME database, minimizing the effects of any selection bias.

We were also not able to obtain information about those gun-related incidents that did not involve the police, the ME's office, or our hospital. Since our Level I trauma center also services populations from some of the surrounding counties, we may have missed some patients by relying solely on the TPD's database. Our populations were therefore not entirely concordant. Moreover, US Census Bureau data were not available for our entire study period, limiting the population-based conclusions that we were able to draw. In addition, since our catchment area included the border region with Mexico, we examined those firearm-related injuries that occurred in Mexico yet were treated at our hospital. These amounted to only 1.6% (313 cases) of the sample from our trauma registry. We do not therefore believe that international events and cross-border firearm violence had a significant impact on the results of our study.

Although our data were therefore not fully inclusive, neither the referral patterns to our trauma center nor the inclusion criteria for our trauma registry changed over the study period. Similarly, the data collection methods did not change, whether in our trauma center, the ME's office, or TPD. Thus, the likelihood of misclassification bias seems low. Until data registries across government agencies become more coherent and cohesive,[26] our study's data—from multiple sources—provided the best estimates available for our analysis.

By 2015, mortality and morbidity caused by firearms are expected to surpass those caused by motor vehicle injuries,[27] yet federal spending on gun-related research has been shackled by strong special interest groups.[28] As a result, the need for accurate, reproducible, and well-designed epidemiologic, outcomes, and prevention studies has never been more urgent. However, existing data are simply too fragmented among various state and federal agencies to produce clean results.

Repeatedly, homicides have increased in states with less restrictive gun regulations.[17] Critics may cite that "open-carry" states such as Vermont have some of the most permissive gun laws in the country yet also have low crime rates, while others with more restrictive gun laws such as Washington, District of Columbia, have high crime rates.[29] However, it is also true that most of Vermont's crime-related guns do not stay in the state but are exported elsewhere such as to Washington, District of Columbia, where the numbers of crime guns that are imported from other locations are among the highest in the nation, yet the data are limited.[30] This would suggest that perhaps state-based gun laws have no impact on gun-related crime, since the availability of guns is fluid across borders. If so, perhaps national, rather than statewide, gun regulations can have a greater impact on gun-related violence. Further analyses are required to tease out the possibility of causality between increased homicide rates and increased gun availability; nonetheless, the association exists, as we found. Of utmost importance, our study underscores the need to develop robust, unbiased, unfettered, reproducible databases for performing accurate and unfragmented analyses.

CONCLUSION

After the enactment of SB-1108, GRIDs increased by 11%. Homicide by firearms increased by 24% among those individuals involved in violent crimes and by 27% among the entire at-risk population. Legislation such as Arizona SB-1108, which allows an increased prevalence of concealed firearms in public places, does not act as a deterrent to homicide. However, it may in fact contribute to an increase in gun-related injury.

AUTHORSHIP

R.G. R.F., and A.T. conceived of and designed this study R.G. collected the data. R.G., P.R., R.F., L.G., and A.T. contributed to data analysis. R.G., R.F., and A.T. prepared the manuscript.

ACKNOWLEDGMENT

Many thanks to Veena Singh from the Pima County ME's Office for providing us with data.

DISCLOSURE

The authors declare no conflicts of interest.

REFERENCES

1. Small Arms Survey. (2007). Small Arms Survey Report 2007. Graduate Institute of International and Development Studies. Geneva, Switzerland. Available at: http://www.smallarmssurvey.org/fileadmin/docs/A-Yearbook/2007/en/Small-Arms-Survey-2007-Chapter-02-annexe-4-EN.pdf. Accessed June 15, 2013.
2. Centers for Disease Control and Prevention (CDC). 2013. Web-based Injury Statistics Query and Reporting Systems: Fatal Injury Data. Available at: http://www.cdc.gov/injury/wisqars/fatal_injury_reports.html. Accessed June 16, 2013.
3. Hemenway D, Azrael D, Miller M. National attitudes concerning gun carrying in the United States. *Inj Prev*. 2001;7:282–285.
4. Tushnet M. Interpreting the right to bear arms—gun regulation and constitutional law. *N Engl J Med*. 2008;358(14):1424–1426.
5. Wintemute GJ. Guns, fear, the constitution and the public's health. *N Engl J Med*. 2008;358(14):1421–1424.
6. District of Columbia vs Heller. No. 07-290. 128 S. Ct. 2783 (2008).
7. McDonald vs City of Chicago. No. 08-1521. 130 S. Ct. 3020. (2010).
8. United States vs. Black. No. 11-5084. 707 F.3d 531. (4th Cir. Feb 25, 2013).
9. Peterson vs Martinez. No. 11-1149. 707 F.3d 1197. (10th Cir. Feb 22, 2013).
10. Woollard vs Gallagher. No. 12-1437. 712 F.3d 865. (4th Cir. March 21, 2013).
11. Loftin C, McDowall D, Wiersema B, Cottey TJ. Effects of restrictive licensing of handguns on homicide and suicide in the District of Columbia. *N Engl J Med*. 1991;325(23):1615–1620.
12. Cummings P, Koepsell TD. Does owning a firearm increase or decrease the risk of death? *JAMA*. 1998;280(5):471–473.
13. Wintemute GJ, Parham CA, Beaumont JJ, Wright M, Drake C. Mortality among recent purchasers of handguns. *N Engl J Med*. 1999;341(21):1583–1589.
14. Miller M, Azrael D, Hemenway D. Rates of household firearm ownership and homicide across US regions and states, 1988–1997. *Am J Public Health*. 2002;92:1988–1993.
15. Rosengart M, Cummings P, Nathens A, Heagerty P, Maier R, Rivara F. An evaluation of state firearm regulations and homicide and suicide death rates. *Inj Prev*. 2005;11:77–83.
16. Miller M, Hemenway D, Azrael D. State-level homicide victimization rates in the US in relation to survey measures of household firearm ownership, 2001–2003. *Soc Sci Med*. 2007;64:656–664.

17. Fleegler EW, Lee LK, Monuteaux MC, Hemenway D, Mannix R. Firearm legislation and firearm-related fatalities in the United States. *JAMA Intern. Med*. 2013;173(9):732–740.
18. SB-1108. (2010). Arizona State Legislature. Forty-Ninth Legislature. Second Regular Session. Available at: http://www.azleg.gov/DocumentsForBill.asp?Bill_Number=SB1108&Session_ID=93. Accessed September 28, 2011.
19. Brady Handgun Violence Prevention Act. (1993). Pub L No. 103-159. 107 Stat. 1536. Available at: http://www.gpo.gov/fdsys/pkg/BILLS-103hr1025enr/pdf/BILLS-103hr1025enr.pdf. Accessed June 18, 2013.
20. Ludwig J, Cook PJ. Homicide and suicide rates associated with implementation of the Brady Handgun Violence Prevention Act. *JAMA*. 2000;284(5):585–591.
21. Wintemute GJ, Braga AA, Kennedy DM. Private-party gun sales, regulation, and public safety. *N Engl J Med*. 2010;363(6):508–511.
22. Cook PJ, Ludwig J. *Guns in America: Results of a Comprehensive Survey of Gun Ownership and Use*. Washington, DC: Police Foundation; 1996.
23. Wintemute GJ. Gun shows across a multistate American gun market: observational evidence of the effects of regulatory policies. *Inj Prev*. 2007;13:150–155.
24. Cole TB. Firearms sales via "gun show loophole" thwart efforts to reduce gun violence. *JAMA*. 2008;300(6):640–641.
25. Rosenberg ML, Mercy JA, Potter LB. Editorial. Firearms and suicide. *N Engl J Med*. 1999;341(21):1609–1610.
26. Weiner J, Wiebe DJ, Richmond TS, Beam K, Berman AL, Branas CC, Cheney RA, Coyne-Beasley T, Firman J, Fishbein M, et al. Reducing firearm violence: a research agenda. *Inj Prev*. 2007;13:80–84.
27. Christoff C, Kolet I. (December 19, 2012). American gun deaths to exceed traffic fatalities by 2015. *Bloomberg.com News*. Available at: http://www.bloomberg.com/news/2012-12-19/american-gun-deaths-to-exceed-traffic-fatalities-by-2015.html. Accessed June 16, 2013.
28. Kellerman AL, Rivara FP. Silencing the science on gun research. *JAMA*. 2013;309(6):549–550.
29. Law Center to Prevent Gun Violence. (2013). Available at: www.smartgunlaws.org. Accessed September 1, 2013.
30. Mayors Against Illegal Guns (MAIG). (2013). Access Denied: How the gun lobby is depriving police, policy makers and the public of the data we need to prevent gun violence. Available at: http://www.mayorsagainstillegalguns.org. Accessed June 16, 2013.

DISCUSSION

Dr. Glen Tinkoff (Newark, Delaware): Since the late '90s when economist John Lott published More Guns, Less Crime, which purported concealed weapons were a deterrent to violent crime, the issue of concealed carry laws and their impact on violent crime has been a controversial political and public health issue.

Currently there are four types of concealed weapons laws in the United States: "Unrestricted," like this one, anyone can carry a concealed weapon without state issued license. The law in five states, including Arizona. "Shall issue," as long as the applicant meets certain preset requirements they can receive a permit. The law Arizona had this, as does 38 states. "May issue," which allows authorities to deny an applicant if a reasonable need to carry a concealed weapon is not met, the law in 8 states. And, finally, "no issue," which is only the law in D.C.

Proponents on both sides of this issue of gun control have used concealed carry laws as a platform to espouse their viewpoints. However, to date the general consensus of the public health community is that concealed weapon laws have minimal, if any, impact on violent crime in our nation relative to other legal, political and societal factors.

Dr. Ginwalla and her colleagues in their presentation and manuscript sought to assess the impact of the State of Arizona's repeal of its concealed carry laws on gun-related injuries and deaths within the Southern Arizona region served by their Level I trauma center.

They analyzed data accrued from three administrative data sets supplemented by the ME reports and sources 24-months pre- and post-repeal and concluded that after the repeal gun-related homicides associated with violent crime increased significantly, presumably due to the increased prevalence of concealed weapons.

Although it seems intuitively reasonable that increased access to concealed weapons would be related to an increase in gun-related fatalities associated with violent crime, I have concerns regarding the study's methodology and conclusions and several questions for the authors.

Was the crime statistics database of the Tucson Police Department linked to your hospital trauma registry? It sounds like it wasn't. If not, how were these crime statistics correlated with the hospital trauma registry accrued gun-related injury and death data?

Were there any excluded records? And if so, what were they?

The region your trauma center serves includes the international border with Mexico. How were gun-related injuries and deaths in this population handled in your analysis?

Gun-related was defined as all types of firearms, including shotguns and military weapons, which are not generally subjected to concealment. How many incidents were actually associated with a concealed weapon?

Twenty-three more homicides post-repeal are cited as evidence of the impact of the repeal, despite the fact that total gun-related injuries throughout the population studied and deaths remained virtually unchanged.

Did you consider controlling for age, injury severity and comorbidities within these deaths and injuries?

Could you provide insight on how you conclude this finding was due to the repeal as opposed to other legal, political and societal factors?

The entire at-risk and violent crime population decreased post-repeal. And couldn't we conclude that since there was less criminal activity after the repeal concealed weapons were, in fact, a deterrent?

Finally, Vermont, which also does not have a concealed weapon law, has one of the lowest crime rates in the nation while the District of Columbia, which has the strict "no issue" law is one of the highest. Please comment.

I would like to, again, acknowledge and thank these authors for addressing a controversial and relevant public health issue. And I would like to, again, thank the AAST for the privilege of the podium.

Dr. Juan Carlos Puyana (Pittsburgh, Pennsylvania): I want to congratulate you for presenting these data and echo your comment about the society's ability to present more of these papers in this meeting which is different from meetings in the past. I think the time has come for this society to do so. I have a brief comment and a short question.

The brief comment is that having grown up in Columbia, a country that has been suffering of violence for 40 years, this is

very, very interesting to see. And I wonder what the effect of drug and trafficking and illicit drug with the legalization of marijuana is anything that you can actually look into your data to feed a little bit more the information.

The comment is brief. When you look at the development of biomedical informatics in the world, you see that the advancement in understanding the genome of the pathogen is what has caused an incredible difference in our knowledge.

The pathogen in trauma is the gun. And we've got to figure out a way to do research to understand the genome of the guns. And I think you and some of the people yesterday, like Dr. Livingston, have begun to do so. Thank you.

Dr. Sheldon Teperman (Bronx, New York): Dr. Ginwalla, I'd like to compliment you and your group for the wonderful work that you have done here.

A brief comment. I don't agree with Dr. Tinkoff that the public health officials in the United States think that concealed carry laws are not useful.

The question: There is an act going through Congress called "The Concealed Carry Reciprocity Act," which is picking up steam which will essentially neuter all municipalities' concealed carry laws throughout the United States if this was to be passed.

What do you think the effect of this would be on GRID in general?

Dr. David P. Blake (Norfolk, Virginia): That was an interesting paper, especially in the light of events of the past week and over the past couple of years.

I want to refocus the question back on whether you have any information regarding the perpetrators of some of these firearm incidents? You alluded to the fact that the background checks only serve as a surrogate but I'm curious whether or not you have any data regarding the association with either mental health issues, prior gun-related law-enforcement interactions, and the like. I think that is going to be a key to whether or not these concealment and restricted-issue laws will make any effect if we're not going to address the real problems with some of these folks that are perpetrating the crimes.

Dr. Rashna F. Ginwalla (Tucson, Arizona): Dr. Tinkoff and others, thank you very much for your questions. Let me try to broadly answer some of these questions, many of which have common themes.

One of the biggest things that we discovered as we did this study was the lack of existing quality data and how poor data collection is on this topic.

So a lot of the questions, Dr. Tinkoff, that you have were related to the data that is publicly available. To answer your first question, for example, the TPD crime statistics database was not linked to our trauma registry.

The TPD database is an online database where all the demographics are de-identified. So there is no way for me to look at our trauma registry and say this patient came in under this crime report on the TPD database.

However, that being said, the ME's office and our trauma registry can be linked because we could we could see which of the ME patients were brought to our hospital and declared over there. And so we do not double-count those patients for mortality purposes.

So we're fairly certain that our numerator numbers are accurate and we're only counting patients once. The denominator, as I talked about earlier, is not linked. And that is a limitation of the data that we have available to us.

As far as excluded records are concerned, yes, there were some excluded records. But most of them were excluded because of missing data: missing mortality data, missing type of injury data. There weren't that many.

I think your question about our geographic proximity to the international border with Mexico probably relates to those spillover patients who were shot in Mexico and then came over the border to receive care in Arizona.

I will say that (mostly anecdotally, I don't have accurate numbers) most of the patients that come over the border to seek care in Arizona are border jumpers and border crossers that cross the desert so it's mostly blunt trauma and/or patients requiring medical care for dehydration and acidosis.

There are really very few that we've seen. I think there have probably only been about two or three in the last two or three years that are actually shot in Mexico and come over the border. If they were shot in Arizona (and therefore are relevant to our study) and killed, they get logged into the Medical Examiner's Office data; if they are injured and/or caught by the Border Patrol they get entered into our trauma registry since we are the only Level I trauma center in the region.

As far as your question about controlling for comorbidities and injury severity, again, unfortunately we don't have that demographic data. If we did, we definitely agree that this would be a much more robust study. We would also be able to then begin to decipher the links between gun violence, mental health, and substance abuse.

What we're trying to show with this study is that:
A. the data quality that's out there and available for studies like this is not very good and we as a community need to work on that; and
B. given the limitations of these data we can still show an association between increased homicides and the increased availability of guns.

We cannot, again, say that this was causal; all we can say is that there is an association between an increased availability of guns and gun- related homicides, as with all epidemiological studies. A randomized controlled trial on this will not likely be possible. And so once we have accurate data, we have to then think about other methods to demonstrate causality or the lack of it.

Finally, I do want to talk about the situations in Vermont and Washington, D.C. You are absolutely correct, Vermont does have extremely permissive laws. Washington, D.C., has extremely restrictive laws.

What is missed in that description is that Vermont is also one of the top exporters of guns that are related to crime. It's very easy to buy guns in Vermont. But these guns don't stay there and injureVermonters. They are used shoot everybody else.

Conversely, Washington, D.C., is one of the top locations where guns are imported for crime. And so I think that's where a lot of the crime statistics come from.

I cannot emphasize enough that data, and unrestricted, quality data is necessary to effectively analyze this issue. The AAST really should be commended on bringing this to the forefront so that perhaps as a scientific community we can actually begin to collect such data. Once we have that then we can come up with better answers.

Thank you.