J Urban Health
https://doi.org/10.1007/s11524-023-00759-2

ORIGINAL ARTICLE

The Relationship between Concealed Carry Licenses and Firearm Homicide in the US: A Reciprocal County-Level Analysis

Richard Stansfield · Daniel Semenza · Ian Silver

Accepted: 12 June 2023

Abstract This study investigates the reciprocal county-level relationship between the number of concealed carry weapon (CCW) licenses issued and homicides between 2010 and 2019 in a sample of eleven states. We utilize a random intercept cross-lagged panel model (RI-CLPM) approach accounting for reciprocal effects over time between homicide and concealed carry licenses, providing a robust methodological approach to the study of concealed carry and homicide. The results of the RI-CLPM found that increases in the number of CCWs in 2010–2017 were statistically associated with increases in total gun homicide in 2011–2018. Reciprocally, we found some limited evidence that increases in gun homicide were associated with changes in the number of CCWs issued in subsequent years during the early part of our study period. Far from concealed carry making people safer, our model finds acute safety risks associated with expansion of legal firearm carrying. As the right to carry firearms expands in many states, we emphasize the importance of responsible gun ownership practices, and draw attention to the need to implement preventive laws that keep guns out of the hands of people with prior violent histories and from places where violence risk is amplified.

Keywords Concealed carry licenses · Gun availability · Gun homicide

R. Stansfield (✉) · D. Semenza
Rutgers University Camden, 405-407 Cooper Street, Camden, NJ 08102, USA
e-mail: Richard.stansfield@rutgers.edu

D. Semenza
New Jersey Gun Violence Research Center, Piscataway, USA

I. Silver
RTI International, Raleigh, USA

Introduction

The enduring debate around firearm safety in the United States (US) often focuses on how laws that enable people to carry guns in public impact levels of gun violence. This issue has received renewed attention considering a recent Supreme Court ruling in New York State (New York State Rifle & Pistol Association v. Bruen), which deemed that requiring a proper-cause reason to obtain an unrestricted license to carry a concealed firearm outside the home violates both the Fourteenth and Second amendments. The decision makes it highly likely that other states with proper-cause licensing requirements, such as New Jersey, California, and Massachusetts, will be challenged in court. This could have the effect of requiring several "may-issue" states to adopt less restrictive "shall-issue" policies. As such, policymakers and researchers alike are actively considering how broader concealed carry across more states might influence rates of gun violence during a time where

Published online: 31 July 2023

shootings have risen throughout many parts of the country.

All states in the US allow persons to carry concealed handguns under varying conditions, with three broad categories of permitting in use [1]. As of the start of 2023, there are 26 "permitless carry" states, where no permit is necessary to carry a concealed handgun outside the home (although other state and federal regulations governing legal ownership still apply). There are currently eight states that allow a resident to apply for a permit for a concealed carry weapon (CCW), but license approval is not guaranteed. Law enforcement "may" issue the permit depending on if a resident meets all requirements and can justify need for a CCW. The remaining 18 states are considered "shall-issue" states, whereby residents that complete all local requirements can receive a concealed carry permit without the need for additional justification or approval. In the past 7 years, the number of permitless carry states has tripled, pulling into focus a need to examine the implications of rising gun carrying in public.

Many researchers argue laws that enable more people to carry guns in public will increase shootings [1–4] and crimes committed with a firearm [5, 6]. In opposition, others claim concealed carry laws enable citizens to defend themselves or other citizens against potential attacks [7–9]. Despite substantial scholarly attention to the issue of how concealed carry influences firearm violence, there are several limitations to past research. First, most studies that examine how concealed carry impacts rates of firearm violence rely on measurements that codify the presence of particular state policies related to concealed carry [2–6] or self-report surveys of carrying behaviors [10]. Although these studies are informative, there is a need for research that leverages objective data about both concealed carrying behaviors (e.g., permit applications, licenses issued) and firearm violence (e.g., standardized homicide data). For example, different state provisions in their permitting policy may alter the specific number of licenses issued, such that no two shall-issue states, or may-issue states, may be alike [5]. Second, few studies have incorporated longitudinal data to analyze the *reciprocal* relationship between concealed carry and rates of firearm violence. Firearm violence may influence the number of concealed carry licenses if people are concerned about high crime rates and want to protect themselves [3]. We leverage a series of longitudinal, reciprocal models to assess the association between concealed carry permitting and total firearm homicide rates.

Concealed Carry and Crime Research

After several states enacted laws expanding the right to carry concealed weapons in public, academic literature emerged to suggest that violent crime, especially homicide, may be reduced due to the deterrent effect of more bystanders being armed [7, 10]. In general, these researchers reasoned that more people with access to a gun in public would be able to defend themselves from an attack or step in to stop a violent crime from taking place between others. Several studies reported significant decreases in violent crime because of shall-issue concealed carry laws [7, 11], although much of this work has been questioned due to the use of improper methods and statistically improbable estimates of defensive use prevalence [12]. Additionally, self-defensive firearm use appears to be remarkably rare and is often not socially beneficial such that it protects most members of society [13, 14]. Furthermore, incidents of self-defensive firearm use can result in collateral injuries or deaths to parties not involved in the dispute at all [15].

Reviving this line of thinking, Lott and colleagues recently detailed exponential growth in the number of permit holders in the US, alongside general linear declines in murder and violent crime rates over the past two decades [8, 9]. Critical of recent studies of right-to-carry laws, Moody and Lott point out that many studies erroneously assume that less restrictive laws instantly cause more people to apply for licenses and carry concealed handguns [8]. They also note that states who have adopted shall-issue or permitless carry laws recently tend to still have higher restrictions in the form of fees or training requirements. In distinguishing between early- and late-adopting right-to-carry law states, they conducted a state-level analysis between 1970 and 2014 to document that right-to-carry states experienced lower murder rates than states that did not adopt. They suggest that because early-adopting states issue more permits than late-adopting states, this creates more of a risk for would-be criminals, and therefore, murder has declined further.

Most recent public health literature supports the notion that more firearms in public result in more shootings and deaths given the higher mortality associated with intentional firearm use in contrast to other weapons [1–5]. For example, a recent study found that moving from a may-issue to a shall-issue law over time was associated with an additional 5.3 gun assaults per 100,000 people on average above forecasted counterfactuals [5]. In the study, violence-generating effects were particularly noticeable when states allowed people with prior misdemeanor violent convictions to obtain CCW permits [5]. These findings are supported by criminological literature demonstrating that more guns make situations inherently more lethal [16]. These findings suggest that any increase in the number of firearms legally obtained or carried by people should increase the overall homicide rate, even if levels of other violent crimes remain unchanged [17].

The impacts of firearm carrying in public extend beyond the individual carrier to criminal behavior and policing more broadly. In one of the few city-level studies of right-to-carry policies, Donahue and colleagues analyzed a sample of 47 large US cities to document approximately 30% increases in violent crime and robbery associated with the introduction of right-to-carry laws [3]. Extending prior research, the authors found support for two potential mechanisms driving this relationship. First, they found that expansion of right-to-carry laws were associated with a 35% increase in the stolen gun rate, thereby also increasing illegal firearm availability at large. The researchers also found that crime increased via diminished police effectiveness. The authors suggest that police effectiveness is likely diminished broadly by right-to-carry laws for numerous reasons including diverting police time to activities related to checking firearm permits, responding to gun thefts, and responding to accidental discharges. Law enforcement organizations similarly raise concerns about weakening concealed carry requirements [18]. The authors' main conclusion is stark, suggesting that any crime-inhibiting benefits from increased firearm carrying are swamped by crime-stimulating impacts.

Current Study

The review of the literature described above reveals ample theoretical and empirical reason to expect that recent expansions in right-to-carry laws may have profound implications for public safety. We seek to assess the impact of change in the number of licenses issued (as a different proxy for expanded public firearm carrying [9]) on firearm homicide, while simultaneously accounting for potential reciprocity between homicide and local firearm carrying. Additionally, we control for other potential indicators of gun availability, including the number of gun stores in local areas and the percentage of suicides commited with a firearm, in addition to commonly used macro-level correlates of homicide [19, 20].

Most of the research described herein focused on state-level laws related to conceal carry rather than the actual number of licenses issued at the local level. This involves using a treatment variable, where a 0 indicates times and places where concealed carrying is prohibited (or a may-issue law is in place) and a 1 is used for the times and places where a shall-issue law goes into effect [3, 5, 7]. A limited number of studies have alternatively assessed the impact of concealed carry permitting on crime using a measure of the number of licenses issued. Using a county-level analysis for four states, namely Florida, Michigan, Pennsylvania, and Texas, Phillips and colleagues found no relationship between lagged licensing rates and crime rates [21]. In another study of Florida counties, Carter and Binder examined the association between firearm violence and concealed gun applications and permits [22]. In their diagnostic testing, they found that concealed carry applications in the previous year had no effect on armed violent crime. Notably, however, these studies are limited in time frame and geographic coverage. We utilize a unique longitudinal dataset with annual counts of the licenses issued for each county in a sample of eleven states.

The issue of reciprocal relationships was one of the major methodological problems highlighted by the National Research Council in its review of studies examining the effects of gun laws and firearm availability on firearm violence [23]. The potential for changes in violent crime to be reciprocally related to the passing of shall-issue laws and license applications has been discussed in many of the studies mentioned above [24]. Scholars have suggested that protective gun ownership and carrying may be driven by a fear of crime in a person's community [22]. Recent Pew Research data suggest that protection tops the reasons for people owning a gun in the US, where over two-thirds cite protection as the primary reason [25]. Failure to account for reciprocal causation could result in inconsistent and biased estimates of firearm licensing or legislation on crime [23, 26].

While some studies have attempted to address these concerns in studies of licensing and violent crime [27, 28], they have largely documented effects from a policy change in a single state or over short periods of time, whereas many other state or local factors may explain crime changes in states with a concealed carry law change. We hope to overcome some methodological concerns of prior studies on this topic by using a cross-lagged panel modeling approach that accounts for the reciprocal effects over time between firearm homicide and the number of concealed carry licenses issued over a 10-year time period. We specifically test the following two hypotheses:

H1. Increased change in the number of concealed carry licenses issued will be associated with increased changes in firearm homicide.

H2. Increased change in the number of firearm homicides will be associated with increases in the number of concealed carry licenses issued.

Data and Methods

Data for our dependent variable, the count of firearm homicides per county-year, come from the Center for Disease Control and Prevention (CDC) Multiple Cause of Death data. These county-level mortality data are based on death certificates for US residents and provided to the National Center for Health Statistics (NCHS). We defined gun homicide using ICD-10 codes X93 (assault by handgun discharge), X94 (assault by rifle, shotgun, and larger firearm discharge), and X95 (assault by other and unspecified firearm discharges). All deaths caused by a homicide with a firearm were counted per the county-year of the victim's place of death. These data were advantageous given that the NCHS combines detailed information from death certificate data with information from autopsy reports and police records, providing a more complete picture of the incident, including distinguishing between firearm and non-firearm homicides. These data are also advantageous because they are more complete and more accurate than other official data sources, such as the Uniform Crime Reports (UCR) or NIBRS, concerns about which have been extensively documented [29].

The current study only utilizes data from the eleven states for which the numbers of concealed carry licenses issued were also available for all counties during the time period of our study, 2010–2019 (Colorado, Iowa, Kansas, Michigan, Minnesota, New Mexico, North Carolina, Ohio, Oklahoma, Pennsylvania, and Utah). States including Iowa, Ohio, Oklahoma, and Utah have since passed laws allowing residents to carry concealed weapons without a permit, although these laws were not in effect during the time period of this study. As such, changes in licensing between 2010 and 2019 should reflect changes in the ability of people to publicly carry in these states. Kansas did allow permitless carry beginning in 2015. Observations for Kansas counties after 2015 were excluded as a result. These eleven states combine for 832 counties available for analysis. Table 1 reveals that the average number of firearm homicides per county in our sample ranged from 2.27 per year in 2010 to 3.53 in 2019. Homicide is a rare outcome to study at the county level per year, especially for smaller, more rural counties. In part, this is why many prior studies of firearm availability and homicide either conduct research at the state level or pool county homicides over several years. We discuss this further in the analytical strategy, below.

Licenses Issued

We obtained the number of concealed carry licenses issued for each county from Trent Steidley's concealed carry weapons licenses database, a longitudinal collection of county-level data on weapons licenses [30]. Data on license applications and issuances were collected from a series of freedom of information requests sent to state governments, with funding support from the Center on American Politics at the University of Denver. Not all states provide information on the number of licenses issued at the county level, and there is some variation in measurement across states. Data for the eleven states used in our analysis were standardized so that we measure the annual number of new licenses issued per county for the years 2010–2019.

Table 1 Descriptive statistics of concealed carry licenses issued (CCWs) and homicides, 2010–2019

Variable	Mean	SD
No. of CCWs issued		
2010	524.28	1.02
2011	737.55	1.23
2012	800.20	1.55
2013	1311.62	2.12
2014	988.57	1.77
2015	1002.91	1.80
2016	1465.17	2.36
2017	1247.58	2.17
2018	1336.27	2.12
2019	1258.36	1.97
Total firearm homicides		
2010	2.27	5.61
2011	3.18	8.92
2012	3.23	9.15
2013	3.17	9.37
2014	3.36	14.59
2015	2.66	12.55
2016	3.47	15.91
2017	3.50	15.37
2018	3.37	16.09
2019	3.53	16.40
Time invariant covariates		
Total population (2010–2019)	83992.27	177542.95
Percent male in college (2010–2019)	20.74	9.22
Percent divorce (2010–2019)	10.74	2.27
Percent black (2010–2019)	5.25	9.00
Percent in poverty (2010–2019)	10.05	3.97
Female male income ratio (2010–2019)	0.61	0.08
Percent firearm suicides (2010–2019)	58.44	10.41
Number of gun stores (2010–2019)	21.18	24.14
Non-gun homicides (2010–2019)	0.96	2.68

N = 832 counties. *SD*, standard deviation

Analytic Strategy

A four-part analytic plan was developed for the current study. First, descriptive statistics were produced (Table 1). Second, the reciprocal association between firearm homicide (2010–2019) and number of CCWs (2010–2019) was evaluated through the employment of a random intercept cross-lagged panel model (RI-CLPM) [31, 32]. A RI-CLPM is a longitudinal path model that permits the estimation of the reciprocal association between two or more constructs while adjusting for the mean trend of a construct across all observations. The reciprocal association can be simultaneously estimated by predicting variation in the lagged observations with prior observations of both constructs.

In the context of the current study, the reciprocal effects were examined by (1) regressing the number of CCWs at a subsequent time period (e.g., 2011) on the number of CCWs at the preceding time period (e.g., 2010) and total firearm homicide during the preceding time period (e.g., 2010), while simultaneously (2) regressing firearm homicide at a subsequent time period (e.g., 2011) on the number of CCWs at the preceding time period (e.g., 2010) and firearm homicide during the preceding time period (e.g., 2010). Latent random intercepts for firearm homicide (2011–2019) and the number of CCWs issued (2011–2019) were estimated by fixing the factor loadings across all observations to 1 and specifying a residual covariance between the latent intercepts [32].

Similar to a random intercept model, RI-CLPM permits the estimation of the effects of one construct on another construct independent of the variation associated with prior observations [31, 32. Nevertheless, distinct from traditional random intercept model, a cross-lagged panel model can simultaneously evaluate the effects of the number of CCWs on firearm homicide and the effects of firearm homicide on the number of CCWs while adjusting for the continuity within a construct over time [32]. The ability to simultaneously examine these reciprocal processes addresses a notable limitation in the extant literature [26].

Two iterations of the RI-CLPM were estimated, where the first model adjusted for several basic demographic and economic characteristics of the counties: the average population from 2010 to 2019, average percent males in college from 2010 to 2019, average percent divorce from 2010 to 2019, the average female to male income ratio from 2010 to 2019, the average percent black from 2010 to 2019, and average percent in poverty from 2010 to 2019 within all the estimated regression equations. The second model adjusted for these same demographic measures, but also accounted for other proxies of gun ownership and availability in the county, including the average percent of suicides committed with a firearm from 2010 to 2019, the average number of licensed gun stores from 2010 to 2019, and average number of homicides perpetrated without a gun from 2010 to 2019, within all of the estimated regression equations. This second modeling allowed us to assess the association between licensing and firearm homicide, net of gun availability, and violence more broadly.

Given the existence of missing license issuing data in some counties, we employed the full information maximum likelihood estimator in the *Lavaan* package in R to estimate the main models [33]. Importantly, due to the large variance of the number of CCWs issued between counties, the construct was transformed by multiplying the number of CCWs issued by .0001. This transformation maintains the interpretability of the unstandardized estimates, where a 1 unit change in no. of CCWs issued represents 1000 concealed carry licenses issued within a county. Finally, we note that the global fit statistics of the model could potentially become biased due to the rarity of homicide estimated in the model. We evaluated the fit of the data using R^2 values for each endogenous variable and plotted trajectories to confirm appropriate model fit [34].

Results

Figure 1 illustrates the RI-CLPM examining the reciprocal effects of firearm homicide on the number of CCWs issued with limited control variables. The estimates presented in Fig. 1 represent the unstandardized regression coefficients (single-headed arrows) and the unstandardized residual covariances (double-headed arrows). Focusing on the between-construct regression coefficients, increases in the number of CCWs issued in 2010–2015 and 2017 were statistically associated with increases in firearm homicide in 2011–2016 and 2018, respectively. Specifically, a one thousand license increase in the number of CCWs issued was associated with between a .266 and a 1.898 increase in total firearm homicide. Alternatively, increases in firearm homicide in 2010 and 2018 were associated with increases in the number of CCWs issued in 2011 and 2019, but increases in firearm homicide in 2012, 2015, 2016, and 2017 were associated with decreases in the number of CCWs issued in 2013, 2016, 2017, and 2018.

Figure 2 provides the RI-CLPM examining the reciprocal effects of total gun homicide on the number of CCWs issued with all of the control variables. The results of the second RI-CLPM support the findings of the first RI-CLPM. In particular, increases in the number of CCWs in 2010–2017 were statistically associated with increases in firearm homicide in 2011–2018. The estimates suggest that a one thousand license increase in the number of CCWs issued was associated with between a .385 and 2.128 increase in total firearm homicide. Regarding the reciprocal pathway, it appeared that increases in firearm homicide in 2010, 2011, and 2013 were associated with increases in the number of CCWs issued in 2011, 2012, and 2014. Taken together, the models suggest that the number of CCWs issued the previous year was associated with increases in total firearm homicide the subsequent year. On the other hand, firearm homicide the previous year had limited little impact on the number of CCWs the subsequent year.

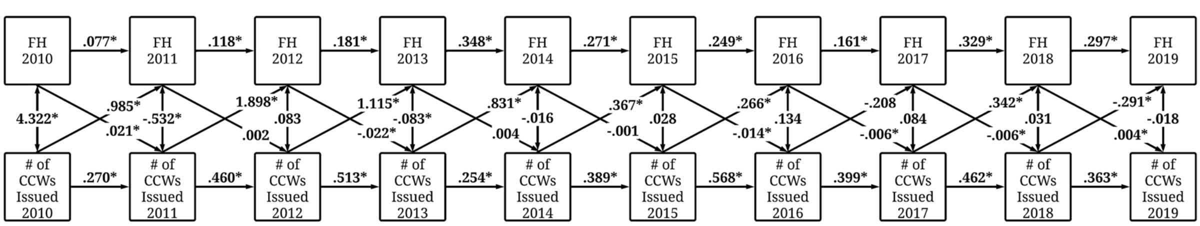

Fig. 1 Random intercept cross-lagged panel model examining the reciprocal association between total firearm homicide (2010–2019) and conceal carry licenses issued (limited controls). *Notes*: FH, firearm homicide; # of CCWs issued, number of concealed carry licenses issued. The cross-lagged panel model was estimated using the full information maximum likelihood (FIML) estimator in Lavaan. All estimates on single-headed arrows represent the unstandardized regression coefficients, while all estimates on double-headed arrows represent the unstandardized covariance. The estimates adjust for the influence of the average population from 2010 to 2019, average percent males in college from 2010 to 2019, average percent divorce from 2010 to 2019, average percent black from 2010 to 2019, and average percent in poverty from 2010 to 2019. A 1 unit change in no. of CCWs issued represents 1000 concealed carry licenses issued. *$p < .05$

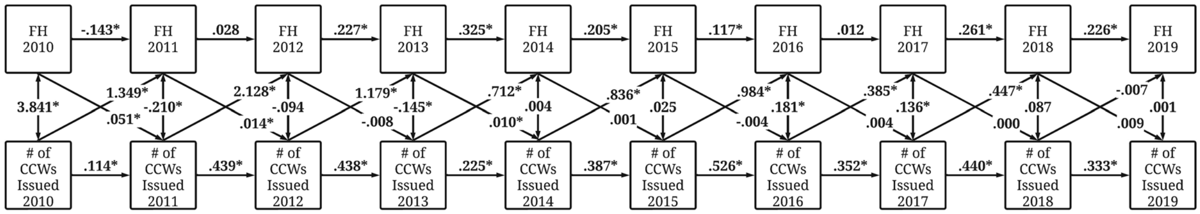

Fig. 2 Random intercept cross-lagged panel model examining the reciprocal association between firearm homicide (2010–2019) and conceal carry licenses issued (full controls). *Notes*: FH, firearm homicide; # of CCWs issued, number of concealed carry licenses issued. The cross-lagged panel model was estimated using the full information maximum likelihood (FIML) estimator in Lavaan. All estimates on single-headed arrows represent the unstandardized regression coefficients, while all estimates on double-headed arrows represent the unstandardized covariance. The estimates adjust for the influence of the average population from 2010 to 2019, average percent males in college from 2010 to 2019, average percent divorce from 2010 to 2019, average percent black from 2010 to 2019, and average percent in poverty from 2010 to 2019, average percent of firearm suicides from 2010 to 2019, average number of gun stores from 2010 to 2019, average number of homicides without a gun from 2010 to 2019, and average female to male income ratio from 2010 to 2019. A 1 unit change in # of CCWs issued represents 1000 concealed carry licenses issued. $*p < .05$

Discussion

The current study revisited the relationship between concealed carry and firearm homicide, an often studied and debated topic with significant implications for public safety and gun violence prevention. One primary conclusion emerged. Increases in the number of licenses issued generally increased firearm homicides in subsequent years. Conversely, our models did not offer evidence that firearm homicide decreased because of CCW licenses issued. The findings are diametrically opposed to suggestions that more legal carrying would broadly reduce gun violence via self- or bystander-facilitated defense. Additionally, we found some limited evidence to suggest that increases in CCWs issued follow increases in firearm homicide. This relationship waned over time, however.

With nuanced evidence of an association between CCW licenses and homicide, it is imperative that discourse on the topic of gun violence avoids simplified notions such as “good guy with a gun” or “bad guy with a gun.” Such depictions obscure the everyday interactions and disputes between ordinary people that can boil over into violence and the lethal potential of access to a firearm in such a context. Instead of considering good guys and bad guys with guns, it is far more productive to focus on a broader harm reduction framework that does not rely on an oppositional “us versus them” framework. More guns in public can create significant harm in everyday interactions, whether through accidental shootings, road rage incidents, or domestic incidents between people that are estranged. And a move towards shall-issue and permitless carry policies may increase the likelihood of prohibited buyers and persons with prior violent history obtaining guns [35]. The adoption of shall-issue laws is particularly risky for future violence when states allowed people with prior misdemeanor violent convictions to obtain a CCW [5]. These findings together speak to the instrumentality effect of firearms, with mounting evidence that increases in guns contribute to fatalities that would otherwise have been non-fatal assaults [16].

Therefore, the first major policy implication is to ensure guns do not end up in the wrong hands. In response to the Bruen decision, some States including New Jersey submitted legislation to strengthen background checks and ensuring permits could only be obtained after extensive review and gun safety training. This is not a policy to limit the right to gun ownership, but part of a broad standard that gun owners and non-owners alike support [36]. Data suggest that an increasing majority of gun owners and people identifying as either Democrat or Republican support universal background checks, stronger regulations of gun dealers, and requiring tests of safe handling practices prior to carrying a concealed weapon [36]. This public sentiment is echoed in recent iterations of the National Survey of Gun Policy [37], revealing high support among gun owners for conceal carry applicants to demonstrate competence in safe and lawful gun use. While public support exists, however, ordinary citizens may need to be more activated to discuss these policies with their elected representatives.

In addition to strengthening standards at the point of purchase and demonstrating responsible gun ownership, concealed carry also needs some guard rails controlling the carrying of handguns in public places, such as schools, alcohol serving outlets, sports arenas, and other highly populated public spaces. The National Survey on Gun Policy in 2019 and 2021 also revealed broad declining support for expanding the locations for civilian gun carrying [37]. Yet recent reports have detailed upticks in the number of guns carried into airports in the US [38]. And several recent studies reveal double digit increases in homicide as a result of weakening carry laws and expanding carrying in public [1, 3–5], including a 29% increase in firearm workplace homicides [4]. Thus, restricting customer and employee firearm access in the workplace and allowing private business and public buildings to enforce these restrictions may help to reduce lethal escalation. Colleges and universities have had some success in prohibiting legal gun owners from carrying weapons on to campus. But policies allowing gun carrying on campus have increased the risk of assault, self-harm, and lethality [39].

There are several limitations to the present study that provide opportunity for additional research. First, our analysis is limited to fatal firearm violence (homicides) and does not include non-fatal shootings. Non-fatal shootings make up the vast majority of interpersonal firearm assaults in the US, occurring roughly four times as frequently as homicides. Although there remains no official, national-level data repository that tracks non-fatal shootings, it is imperative that subsequent studies test the reciprocal relationships explored in this study using non-fatal data where feasible. Second, our study is limited to the timeframe where data from all sources were available (2010–2019). This time period includes years of relatively low homicide rates compared to other decades, although homicide rates did begin to slowly increase during this period starting in 2014. Additionally, we were unable to examine the impact of conceal carry on discrete homicide types. Our findings could be more muted if assessing the relationship between CCW and gun violence related to gang-related activity, drug markets, robbery, or other incidents less likely to rely on legal firearms acquisition. Stolen guns, straw purchases, and guns trafficked from states with softer gun regulations often facilitate gun violence in many of America's largest cities with a higher prevalence of gang and drug market activity [16].

Finally, we are mindful of the generalizability of our findings. Concealed carry licenses are not required in permitless carry states, making it more difficult to ascertain numbers of people carrying firearms in public in those states. But by using data on licenses prior to the rapid expansion in permitless carry policies, we highlight the need for research to consider the role that increased numbers of guns in public can play in creating additional harm. It is clear that study of the dynamics between legal firearm availability, right to carry legislation, and the extent of gun violence is far from over. Instead, researchers moving forward must consider how increases in carrying of firearms can impact certain types of gun violence, for certain groups, and in certain contexts. These inquiries will likely lead to more consistent conclusions around the harm generated by increases in firearms in public.

Acknowledgments The authors received no specific funding for this work. The authors would like to thank Trent Steidley for allowing use of his data on CCW licenses and his feedback on an earlier draft of the paper.

Data Availability All data are publicly available.

References

1. Siegel M, Xuan Z, Ross CS, Galea S, Kalesan B, Fleegler E, Goss KA. Easiness of legal access to concealed firearm permits and homicide rates in the United States. Am J Public Health. 2017;107(12):1923–9.
2. Crifasi CK, Merrill-Francis M, McCourt A, Vernick JS, Wintemute GJ, Webster DW. Association between firearm laws and homicide in urban counties. J Urban Health. 2018;95:383–90.
3. Donohue JJ, Aneja A, Weber KD. Right-to-carry laws and violent crime: a comprehensive assessment using panel data and a state-level synthetic control analysis. J Empirical Legal Stud. 2019;16(2):198–247.
4. Donohue JJ, Cai SV, Bondy MV, Cook PJ. More guns, more unintended consequences: the effects of right-to-carry on criminal behavior and policing in US cities: National Bureau of Economic Research; 2022. https://www.nber.org/papers/w30190
5. Doucette ML, McCourt AD, Crifasi CK, Webster DW. Impact of changes to concealed-carry weapons laws on fatal and nonfatal violent crime, 1980–2019. Am J Epidemiol. 2023;192(3):342–55.
6. Hepburn L, Miller M, Azrael D, Hemenway D. The effect of nondiscretionary concealed weapon carrying laws on homicide. J Trauma Acute Care Surg. 2004;56(3):676–81.
7. Lott JR. More guns, less crime: understanding crime and gun control laws. Chicago, University of Chicago Press; 2013.
8. Moody CE, Lott JR. Do right-to-carry concealed weapons laws still reduce crime? Academia Letters. Article 4888. 2022
9. Lott JR, Wang R. Concealed carry permit holders across the United States. 2021. Available at SSRN: https://ssrn.com/abstract=3937627.

10. Kleck G, Gertz M. Carrying guns for protection: results from the National Self-Defense Survey. J Res Crime Delinq. 1998;35(2):193–224.
11. Bartley WA, Cohen MA. The effect of concealed weapons laws: an extreme bound analysis. Econ Inq. 1998;36(2):258–65.
12. Cook PJ, Ludwig J, Hemenway D. The gun debate's new mythical number: how many defensive uses per year? J Policy Anal Manage. 1997;16(3):463–9.
13. Hemenway D, Solnick SJ. The epidemiology of self-defense gun use: evidence from the National Crime Victimization Surveys 2007–2011. Prev Med. 2015;1(79):22–7.
14. Hemenway D, Shawah C, Lites E. Defensive gun use: what can we learn from news reports?. Inj Epidemiol 2022 9(1):1-0.
15. Cook PJ, Ludwig J. Gun violence: the real costs. New York, Oxford University Press; 2000.
16. Braga AA, Griffiths E, Sheppard K, Douglas S. Firearm instrumentality: do guns make violent situations more lethal? Annu Rev Criminol. 2021 4:147–64.
17. Cook PJ, Braga AA, Moore MH. Gun control. Crime and Public Policy. 2011;25:257–92.
18. Kruesi K. Tennessee GOP pushes gun bill over law enforcement concerns: Associated Press; 2021. https://apnews.com/article/joe-biden-violence-legislation-racial-injustice-tennessee-74925fdeb101c8e78cc311e6fd85b7f2. Accessed 20 May 2023.
19. Haviland MJ, Gause E, Rivara FP, Bowen AG, Hanron A, Rowhani-Rahbar A. Assessment of county-level proxy variables for household firearm ownership. Prev Med. 2021;148:106571.
20. Siegel M, Ross CS, King C. A new proxy measure for state-level gun ownership in studies of firearm injury prevention. Inj Prev. 2014;20(3):204–7.
21. Phillips CD, Nwaiwu O, Lin SH, Edwards R, Imanpour S, Ohsfeldt R. Concealed handgun licensing and crime in four states. J Criminol. 2015;803742.
22. Carter JG, Binder M. Firearm violence and effects on concealed gun carrying: large debate and small effects. J Interpers Violence. 2018;33(19):3025–52.
23. National Research Council. Firearms and violence: a critical review. Washington, D.C.: National Academies Press; 2004.
24. Aneja A, Donohue JJ, Zhang A. The impact of right to carry laws and the NRC report: the latest lessons for the empirical evaluation of law and policy. American Law and Economics Review. 2011;13(2):565–631.
25. Igielnik R, Brown A. Key takeaways on American's views of guns and gun ownership. Pew Research Center. https://www.pewresearch.org/fact-tank/2017/06/22/key-takeaways-on-americans-views-of-guns-and-gun-ownership/. Accessed 1 Dec 2022.
26. Leshner AI, Altevogt BM, Lee AF, McCoy MA, Kelley PW. Committee on Priorities for a Public Health Research Agenda to Reduce the Threat of Firearm-Related Violence: Executive Office, Institute of Medicine (EO); Institute of Medicine (IOM); Committee on Law and Justice; Division of Behavioral and Social Sciences and Education (DBASSE); National Research Council. Firearm-Related Violence; 2013.
27. Gius M. The effects of state and federal background checks on state-level gun-related murder rates. Appl Econ. 2015;47(38):4090–101.
28. Rudolph KE, Stuart EA, Vernick JS, Webster DW. Association between Connecticut's permit-to-purchase handgun law and homicides. Am J Public Health. 2015;105(8):e49–54.
29. Pridemore WA. A cautionary note on using county-level crime and homicide data. Homicide Stud. 2005;9(3):256–68.
30. Steidley T. Concealed carry weapons license database. Ann Arbor, MI: Inter-university Consortium for Political and Social Research (distributor). 2021. https://www.openicpsr.org/openicpsr/project/149062/version/V1/view. Accessed 7 July 2022.
31. Lüdtke O, Robitzsch A. A comparison of different approaches for estimating cross-lagged effects from a causal inference perspective. Struct Equ Model Multidiscip J. 2022;29(6):888–907.
32. Selig JP, Little TD. Autoregressive and cross-lagged panel analysis for longitudinal data. In: Laursen B, Little TD, Card NA, editors. Handbook of developmental research methods. The Guilford Press; 2012. p. 265–278.
33. Du H, Bentler PM. Distributionally weighted least squares in structural equation modeling. Psychol Methods. 2022;27(4):519.
34. Coffman DL, Millsap RE. Evaluating latent growth curve models using individual fit statistics. Struct Equ Modeling. 2006;13(1):1–27.
35. Wintemute GJ, Parham CA, Wright MA, Beaumont JJ, Drake CM. Weapons of choice: previous criminal history, later criminal activity, and firearm preference among legally authorized young adult purchasers of handguns. J Trauma Acute Care Surg. 1998;44(1):155–60.
36. Barry CL, Stone EM, Crifasi CK, Vernick JS, Webster DW, McGinty EE. Trends in public opinion on US gun laws: majorities of gun owners and non–gun owners support a range of measures. Health Aff. 2019;38(10):1727–34.
37. Crifasi CK, Ward JA, McGinty EE, Barry CL, Webster DW. Public opinion on laws regulating public gun carrying. Prev Med. 2022;159:107067.
38. Associated Press. Roughly 18 guns were seized everyday at US airports last year. 2023. https://apnews.com/article/politics-transportation-security-administration-philadelphia-airport-c68de51fe36a39c544e030a92b9602cb. Accessed 20 May 2023.
39. Webster DW, Donohue JJ, Klarevas L, et al. Firearms on college campuses: research evidence and policy implications. Report of the Johns Hopkins Center for Gun Policy and Research. Baltimore, MD: Johns Hopkins Bloomberg School of Public Health; 2016.