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Licensed firearm dealer availability and intimate partner homicide: A multilevel analysis in sixteen states

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ABSTRACT

This paper investigates the association between legal access to firearms in the community through licensed dealers and homicides perpetrated by intimate partners (IPH). We conducted a series of multilevel negative binomial models to assess the relationship between the rate of county-level federally licensed firearm dealers and intimate partner homicides, by gender and age, controlling for leading macro-level correlates of IPH. The rate of county-level federally licensed firearm dealers is significantly associated with intimate partner homicides in urban counties, regardless of gender and age. Although data cannot discern that the rate of licensed firearm dealers is linked to greater legal firearm access, our findings focus attention on the role of community factors, including gun stores, as significant risk factors for violence. Policies to reduce legal options to purchase firearms, especially for those with prior domestic violence offenses, may help to decrease intimate partner homicide, but better data tracking is needed to help us understand how guns move from purchase into the hands of IPH perpetrators.

1. Introduction

Of all intimate partner homicides (IPH), 98% are perpetrated by a man against a woman and more than half are carried out with a firearm (Petrosky et al., 2017; Violence Policy Center, 2017). Although research suggests that the presence of a gun is a robust and significant risk factor for femicide in abusive relations (Campbell et al., 2003), little is known about the role of legal firearm availability in the community through federally licensed dealers and the risk of intimate partner homicide. Recent studies have been conducted to understand how guns are acquired by those that commit violent crime, but the results are often derived from small samples and tend to focus predominantly on how guns are obtained illegally (Braga et al., 2012; Chesnut et al., 2017; Cook et al., 2015; Cook, 2018; Rexing et al., 2017). But the majority of firearms in the US are originally purchased legally from a federally licensed dealer or from unlicensed sellers at gun shows or in private sales. Although there is a federal mandate for background checks on all purchases made with a federally licensed dealer, currently 28 states do not require any type of background check for guns purchased at a gun show or through private sale. The focus of the present study is specifically on federally licensed firearm dealers.

Research suggests that the availability of firearms in the home significantly increases the risk of a number of violent outcomes including homicide (Hemenway and Miller, 2000; Hepburn and Hemenway, 2004; Miller et al., 2002a; Monuteaux et al., 2015), suicide (Kellermann et al., 1992; Miller et al., 2002a), and accidental firearm death among children (Miller et al., 2002b). Studies indicate that the influence of firearms on lethal violence also depends on factors such as gun caliber (Braga and Cook, 2018), regional gun culture (Lynch and Jackson, 2019; Lynch et al., 2018), and firearm storage practices (Azrael et al., 2018; Grossman et al., 2005). Given the complex and multifaceted relationship between firearm availability and violence, analysis is needed at both the individual and community levels. With limited exceptions (Price et al., 2004; Wiebe et al., 2009), few studies have examined how access to legal guns in the community relates to gun violence, and no research has been conducted to specifically assess the association between firearm dealer density and IPH at the county level.

In 2017, there were approximately 135,000 federally licensed firearms dealers and manufacturers in the United States (Steidley et al., 2017). Dealers include local gun stores, “big box” stores like Walmart and Bass Pro Shops, and pawnshops, all of which legally sell firearms to licensed customers (Steidley et al., 2017). There is evidence to suggest that the legal purchase of a gun can increase the risk of violent death. In a case-control study, Cummings et al. (1997) found that the legal purchase of a handgun was associated with long-term risk of violent death. Steidley et al. (2017) found that the prevalence of gun shops in

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neighborhoods increase the risk of homicide and robbery across 89 large U.S. cities. Similarly, Wiebe et al. (2009) found increased risk of homicide for urban counties with a greater concentration of firearms dealers. However, Price et al. (2004) did not find an association between number of firearms dealers and homicide at the state level. The somewhat mixed findings of these studies related to community gun availability and lethal violence suggest a need to better understand the role of community legal firearm availability in different kinds of violent deaths, including IPH.

We argue that there are three possible mechanisms that underlie the relationship between the concentration of firearm dealers in the community and the risk of IPH. First, greater access to a firearms dealer may facilitate the ease by which a person can purchase a gun for preemptive protection (Griffiths and Chavez, 2004). This may especially be the case in urban communities with high levels of violence, leading citizens to feel that they must be armed in the event of a conflict. Greater access to firearms dealers in the community may therefore operate as a "facilitating" or "aggravating" factor (Clarke, 1997) that pushes a person to have a gun in the home when they otherwise might not have. Second, a person may be more likely to purchase a gun with the intention of harming or killing an intimate partner if they (a) live closer to a gun store or (b) are surrounded by more purchasing options in their surrounding community. Greater access to firearms dealers may provide less time to "cool down" after an altercation, facilitating the purchase of a gun specifically for violence. Finally, a greater number of legal firearms dealers in the community may increase the availability of illegal guns through localized alternative markets fueled by gun store robberies or straw purchases (Wintemute, 2009, 2010).

In any of these three cases, greater direct access to a gun increases the risk for IPH by a factor of 5 (Campbell et al., 2003). Firearm ownership is more common in rural versus urban areas, so as others have argued (Branas et al., 2004; Wiebe et al., 2009), there may be less need to purchase a new firearm from a licensed dealer to achieve lethal partner violence if there are already firearms in the home. Given that there are also qualitative differences in firearm deaths by county type, including a higher rate of gun suicides in rural areas and higher rate of gun homicides in urban areas (Branas et al., 2004), and intimate partner deaths in rural areas (Reckdenwald et al., 2018), our analyses of the relation between licensed firearm dealers and partner homicides will consider the moderating role of county type.

2. Methods

2.1. Data and measures

Intimate partner homicide data were acquired from the National Violent Death Registry System (NVDRS), an incident-based reporting system by the Centers for Disease Control and Prevention (CDC) that contains records related to victims, suspects, and the victim-suspect relationship in a homicide. The NVDRS compiles data from several sources including death certificates, medical examiner records, and law enforcement reports. The current study relies on data from the 16 states for which IPH data were compiled annually and included in the NVDRS for the years 2010–2016 (i.e., Alaska, Colorado, Georgia, Kentucky, Maryland, Massachusetts, New Jersey, New Mexico, North Carolina, Oklahoma, Oregon, Rhode Island, South Carolina, Utah, Virginia, Wisconsin). These criteria generated 4120 death records based on the years 2010–2016 in which circumstances were known and a victim's murder was considered to be intimate partner violence related, including 2464 perpetrated with a firearm. Total, firearm, and non-firearm IPH incidents were then aggregated by state and county to create total-, gender-, and age group-specific death counts for the period 2010–2016.

Firearm dealer data were captured using the rate of federal firearm licensees that includes the number of licensed importers, pawnshops, and sellers of firearms per 100,000 residents. These data were obtained from the Bureau of Alcohol, Tobacco and Firearms (ATF) 2015 Listing of Federal Firearms Licensees. Informed by an important body of work on the role of statutory interventions (Zeoli et al., 2017; Zeoli et al., 2019), we control for the state-level variation in the presence of laws pertaining to firearms restrictions for perpetrators of IPV (DVRO gun laws). We include the presence of any state-level DVRO gun restriction law and whether there are any additional provisions regarding the dispossession of a gun (Zeoli et al., 2019). We also included the presence of purchases restrictions in the form of state permits and universal background checks. Seven of the 16 states in our study require background checks of some kind when purchasing from unlicensed firearm dealers, to be conducted or processed through licensed dealers. Finally, we included the combination of DVRO restriction laws and permit to purchase as the combination of laws limiting firearm acquisition has been associated with a 16% reduction in IPH compared to having a DVRO firearm restriction in a state without a permit to purchase law (Zeoli et al., 2017).

As in prior studies of intimate partner homicide, we control for the non-intimate homicide rate of each county across the same time. This was constructed by summing all non-intimate homicides between 2010 and 2016 reported in the NVDRS and creating a county rate per 10,000 people, which was then log transformed. All other population data were collected from the American Communities Survey 2011–2015. This includes several county measures: the ratio of females to males; gender equality (the average of the ratio of females to males age 16–64 in the labor force; and the ratio of females to males in professional or managerial occupations); a weighted economic disadvantage factor combining six items (the percentage of families in poverty, the percentage of households who received public assistance, the percentage of persons 16–64 unemployed, the percentage of people without health insurance, the percentage of family households headed by a female, and because it loaded onto the same measure, the percentage of the population African American – Eigenvalue = 3.10); the percentage of men over the age of 15 who are divorced; whether a county is considered rural or urban; and a weighted immigration factor combining, the percentage of the county that is Hispanic, the percentage who are non-citizens, and the percentage with limited English proficiency (Eigenvalue = 2.048).

2.2. Data analysis

As our data have a hierarchical structure and our dependent variables are count measures with overdispersion, multilevel negative binomial models were used to model our data. A negative binomial model fit our data well, as it often does even when there are a large number of zeros present as in homicide data (Allison, 2009). A Vuong test comparing our full model estimating total IPH incidents using a negative-binomial versus zero-inflated negative binomial model was insignificant ($z = 1.56$). Nevertheless, to consider the possibility that other modelling strategies could alter the outcomes of our models, we also replicated all analyses using 1) a zero-inflated negative binomial model that assumes that separate processes drive the excess zeros and the counts, thus the excess zeros can be modelled independently, and 2) a hurdle model to generate a zero-truncated homicide variable including the option of clustering by state (McDowell, 2003). Substantive results were similar across the three approaches. All analyses were conducted in Stata version 15 (Stata Corp LP, College Station, TX).

Our first model (Table 2) estimates the association between each of our control measures and the count of firearm and non-firearm intimate partner homicides, offset by the total county population (log transformed). We estimate these models separately to confirm that the rate of federally licensed firearm dealers is associated with firearm homicides specifically. In Table 3, we then estimate firearm intimate homicides with female and male victims (offset by the natural log of the county female and male population, respectively) separately to assess whether the effect of legal gun dealers on homicide is moderated by gender. Finally, we categorized victims by age to avoid small counts

Table 1
Descriptive characteristics of counties and states in sample.

Variable	Mean (SD)/percent
IPH 2010–2016	
Total homicides	3.67 (7.76)
Total firearm homicides	2.20 (4.67)
Total non-firearm homicides	1.48 (3.60)
Female victims (w/ firearm)	1.44 (3.02)
Male victims (w/ firearm)	0.75 (1.95)
Victims aged 18–29 (w/ firearm)	0.58 (1.64)
Victims aged 30–44 (w/ firearm)	0.77 (1.81)
Victims aged 45+ (w/ firearm)	0.78 (1.62)
County-level measures	
Rate of licensed gun dealers	3.56 (0.91)
Rural	46%
Economic disadvantage	
Poverty	8.96%
Public assistance	15.63%
Unemployed	4.73%
Uninsured	15.51%
African American	13.01%
Female headed households	18.49%
Divorce	11.07%
Non IP homicide rate	1.585 (1.96)
Gender equality	
Ratio F:M labor force	0.88 (2.28)
Ratio F:M professional jobs	1.47 (0.35)
Sex ratio	1.01 (0.09)
Immigration	
Hispanic	7.89%
Non-citizen	3.02%
Limited English	1.80%

and to exclude victims younger than 18, given the very low rate of IPH for this group. Categories used include ages 18–29, ages 30–44, and ages 45 and higher. In each analysis, we also include interactions for the rate of gun stores and rural location based on prior research suggesting that guns may have a different cultural role in each location (Gillespie and Reckdenwald, 2017; Steidley et al., 2017; Wiebe et al., 2009).

3. Results

Both the rate of federally licensed firearm dealers and intimate partner homicides varied greatly. Table 1 reports an average number of homicide incidents between 2010 and 2016 of 3.67 per county, ranging from zero to a high of 80. The mean rate of federally licensed firearm dealers was 49 dealers per 100,000 of the county-population. This ranged significantly from a low of zero to a high of over 1110. Given the large standard deviation associated with the measure, it was log transformed (after adding a constant of 1 to each rate) prior to inclusion in our multivariate analyses.

Table 2 shows the association between our county- and state-level measures and all homicides perpetrated by a firearm (Model 1) and non-firearm homicides (Model 2). Counties with a higher rate of federally licensed firearm dealers have a significantly higher incidence rate for firearm perpetrated IPH (IRR = 1.172, $P = .021$). The rate of licensed gun dealers was not associated with non-firearm intimate partner homicides (IRR = 0.918, $P = .237$), suggesting that a higher rate of dealers may increase the likelihood of a gun-perpetrated homicide in the home, but not act as a larger signal for other forms of lethal violence among intimate partners.

Model 1 also reveals a significant interaction effect between the rate of gun stores and rural county, which indicates that the association between gun stores and firearm IPH was limited to urban counties. Although our results confirm previous studies' findings that rural counties have a higher incidence rate of partner homicides with a firearm compared to urban areas ($P < .001$), a higher presence of licensed firearm dealers in urban counties is associated with more

Table 2
Multilevel negative binomial analysis of homicides by an intimate partner.

Variable	Gun homicides		Non-gun homicides	
	IRR	(95% CI)	IRR	(95% CI)
Gun dealer rate	1.202	(1.062, 1.361)	0.918	(0.797, 1.058)
Rural	3.050	(1.763, 5.274)	0.500	(0.223, 1.122)
Gun dealers * rural	0.754	(0.645, 0.881)	1.196	(0.957, 1.494)
Economic disadvantage	1.199	(1.096, 1.312)	1.387	(1.236, 1.557)
Divorce	1.054	(1.021, 1.089)	1.063	(1.020, 1.107)
Non-IP homicide rate	1.040	(1.018, 1.063)	1.028	(1.003, 1.054)
Gender equality	0.966	(0.777, 1.202)	0.952	(0.700, 1.296)
Sex ratio	0.800	(0.309, 2.072)	1.376	(0.380, 4.985)
Recent immigration	0.954	(0.899, 1.013)	0.995	(0.930, 1.065)
Gun laws	0.758	(0.624, 0.920)	0.882	(0.733, 1.063)
Chi^2		203.07		184.75

Note. IRR = incident rate ratio; CI = confidence interval.

firearm IPH incidents. These associations held even while controlling for variation in protective legislation measures.

The state presence of policies pertaining to DVRO gun laws, additional dispossession provisions, and private gun sale background checks were highly inter-correlated. Each policy was entered into models separately, with DVRO gun laws and private sale background checks each having a significant negative association with IPH. Additional provisions regarding dispossession laws were not significantly associated with IPH incidence. Final models displayed included the combination of DVRO laws and background checks. Counties in states with these policies aimed at keeping guns out of the hands of DV perpetrators also experienced a lower rate for firearm IPH incidents (IRR = 0.758; $P = .005$). We also explored whether the presence of DVRO and private sale background check laws moderated the association between gun stores and gun homicides. The interaction coefficient was not significant (IRR = 1.042, CI = [0.956, 1.135]) and therefore not included in the final model displayed.

Table 2 also reveals several additional factors associated with a higher incidence rate for both firearm and non-firearm IPH, including economic disadvantage, the percentage of divorced men, and the non-partner homicide rate.

Table 3 further reveals a significant association between the rate of licensed firearm dealers and female firearm homicide deaths (IRR = 1.185; $P = .023$), and male firearm deaths (IRR = 1.332; $P = .006$). In supplemental analyses (not shown), the rate of firearm dealers was not associated with female-victim or male-victim IPH incidents not involving a gun. As before, rural counties had a higher incidence rate of homicide irrespective of gender, and economic disadvantage and the non-intimate homicide rate were significantly associated with IPH against male victims and female victims in the

Table 3
Multilevel negative binomial analysis of homicides by an intimate partner by gender.

Variable	Female victims		Male victims	
	IRR	(95% CI)	IRR	(95% CI)
Gun dealer rate	1.185	(1.024, 1.372)	1.332	(1.088, 1.631)
Rural	2.485	(1.245, 4.961)	4.359	(1.875, 10.137)
Gun dealers * rural	0.790	(0.650, 0.960)	0.684	(0.536, 0.872)
Economic disadvantage	1.162	(1.043, 1.296)	1.279	(1.109, 1.475)
Divorce	1.051	(1.011, 1.092)	1.054	(1.000, 1.111)
Non-IP homicide rate	1.028	(1.000, 1.055)	1.072	(1.036, 1.109)
Gender equality	0.945	(0.723, 1.235)	1.006	(0.714, 1.416)
Sex ratio	0.472	(0.147, 1.517)	1.213	(0.268, 5.482)
Recent immigration	0.952	(0.888, 1.022)	0.963	(0.870, 1.066)
Gun laws	0.826	(0.687, 0.994)	0.635	(0.496, 0.813)
Chi^2		96.63		165.44

Note. IRR = incident rate ratio; CI = confidence interval.

Table 4
Multilevel negative binomial analysis of homicides by an intimate partner by age.

Variable	18–29 victims		30–44 victims		45+ victims	
	IRR	(95% CI)	IRR	(95% CI)	IRR	(95% CI)
Gun dealer rate	1.260	(1.012, 1.569)	1.389	(1.139, 1.693)	1.324	(1.088, 1.611)
Rural	2.916	(1.128, 7.534)	3.818	(1.560, 9.348)	4.402	(1.682, 11.520)
Gun dealers * rural	0.736	(0.558, 0.972)	0.705	(0.546, 0.911)	0.682	(0.522, 0.891)
Economic disadvantage	1.251	(1.056, 1.482)	1.250	(1.085, 1.441)	1.176	(1.020, 1.356)
Divorce	1.089	(1.024, 1.158)	1.031	(0.980, 1.085)	1.047	(0.996, 1.100)
Non-IP homicide rate	1.083	(1.042, 1.125)	1.056	(1.021, 1.093)	0.976	(0.934, 1.020)
Gender equality	0.991	(0.647, 1.518)	1.032	(0.726, 1.465)	0.893	(0.637, 1.252)
Sex ratio	0.679	(0.117, 3.956)	3.174	(0.630, 15.981)	0.345	(0.082, 1.456)
Recent immigration	1.028	(0.920, 1.149)	0.928	(0.841, 1.024)	0.941	(0.854, 1.037)
Gun laws	0.701	(0.574, 0.855)	0.770	(0.635, 0.933)	0.837	(0.671, 1.044)
Chi^2		124.9		144.25		127.54

Note. IRR = incident rate ratio; CI = confidence interval.

same pattern.

Table 4 shows the results of the multilevel negative binomial analysis of age-specific gun partner homicides. The gun store rate remained significantly associated with homicides perpetrated against younger and older victims alike. An increase in the federally licensed firearm dealer rate was significantly associated with a higher incidence rate for homicides against victims ages 18–29 (IRR = 1.260; P = .039), 30–44 (IRR = 1.389; P = .001), and 45 or older (IRR = 1.324; P = .005). Again, this relationship was strongest in urban counties compared to rural ones. This is in contrast to other county-level measures commonly associated with homicide and violence, which showed more variation across victim age groups. As an example, the percentage of divorced males was associated with homicides perpetrated against younger victims (P = .007), but not older victims. Several other interesting differences emerged across age groups. As an example, counties in states with gun laws restricting firearm access for domestic violence perpetrators saw lower intimate partner homicides of younger victims (18–29 and 30 to 44), but gun laws were not associated with the incidence of homicides of older victims over the age of 45. Higher county disadvantage was consistently associated with a higher IPH incidence rate across age.

4. Discussion

We found that the rate of licensed firearm dealers was consistently associated with more homicides perpetrated against intimate partners irrespective of gender or age. Although the incidence of IPH was higher in rural counties, the association of federally licensed firearm dealers with homicides was limited to urban areas. We argue that there may be a higher reliance on licensed gun stores in urban areas to acquire guns for violent use, whereas a greater existing availability of guns in rural areas means that legal gun stores are less important in the acquisition of a new gun to commit violence (Wiebe et al., 2009). In other words, there may already be firearms in many rural homes which are used to enact IPH, precluding the need for the offender to go out and purchase a new firearm for that purpose. It is also likely that people obtain guns more frequently through other means such as private sales or gun shows in rural areas, thus relying less on gun stores than those in urban areas. We caution that in urban areas, the presence of firearm dealers may also be related to other cultural or structural community factors not explored in this paper. Nevertheless, after controlling for economic disadvantages and other structural correlates, the association of gun stores and firearm IPH in urban areas appeared robust. Given the magnitude of the effects of economic disadvantage and non-intimate violent crime, however, we suggest that several dimensions of environmental adversity are part of the prevention effort in partner homicide events.

To our knowledge, this is the first study to assess the availability of legal guns via the rate of federally licensed firearm dealers and its implications for lethal intimate partner violence. The focus on legally available guns in the county represents an under theorized and understudied risk factor for IPH. Studies assessing the risk of intimate partner homicide, and related studies advocating policy responses to help prevent intimate partner violence turning lethal, are largely conducted at the individual-level. This may be due to the perceived private nature of violence in intimate partner relationships. Legal access to guns in the community may be the most fruitful policy arena within which the prevention of homicide is achievable. Thus, we interpret our findings slightly differently than other recent studies of licensed firearm dealers. Although some scholars have suggested that gun stores promote crime and violence in a community via a signaling effect of disorganization (Steidley et al., 2017), we argue that the presence also results in a higher likelihood of a gun already in the home, a higher likelihood that an aggrieved partner may more easily acquire a gun immediately after or during an altercation, and potentially greater availability via illegal channels. This interpretation is further supported when considering that we did not find a significant association between firearms dealers and non-firearm IPH incidents.

Although the evidence presented here suggests that there may be a relationship between the rate of legal firearms dealers and lethal partner violence, our data cannot discern how and when perpetrators are actually acquiring guns. While the NVDRS data does include narratives about the timing of gun purchases for some cases, this information was not included in enough law enforcement reports for us to draw any firm conclusions. Given the complexity and variation between states in controlling gun access for people charged with domestic violence, policy makers and researchers alike would benefit from more complete data tracking the journey of a gun from dealer to involvement in IPH. If guns used in IPH incidents are being acquired directly from a store shortly before an incident, then restricting impulsive purchases of guns (e.g. mandating a cooling off period) may become an important policy target in the prevention of IPH, something that has been associated with reduction in suicide (Lewiecki and Miller, 2012). To this end we also echo previous calls (Zeoli et al., 2019) that law enforcement should ask further questions about a suspect's use of and access to guns, ensuring that restrictions on gun access for suspects are upheld and enforced from original purchase. Evidence to date suggests that DVRO firearm restriction statutes are implemented and enforced with varying success, and often not associated with reductions in IPH when only possession is restricted (Zeoli et al., 2016). Similarly, reductions in IPH are not seen in states that allow purchase from unlicensed dealers where states either fail to enter disqualifying information in background check systems or require no background check at all.

4.1. Limitations

Like all macro-level studies of violence, this study has several

limitations. Like prior studies of IPH, we chose to aggregate all IPH incidents across the entire time period 2010–2016 to minimize the number of counties with zero counts. While this decision bolsters confidence in our findings, it necessarily limited our ability to examine change in guns and IPH over time. Using data from the NVDRS also limited our sample to 16 states in the US. Given many of the states included in the NVDRS have a large percentage of rural counties with low minority populations, our study did not examine the relationship between legal gun availability and race- or ethnic-specific IPH. Race and ethnicity are important in understanding trends in IPH over the last 20 years. As an example, Hispanic (Azziz-Baumgartner et al., 2011) and foreign-born (Sabri et al., 2018) women are more likely to be killed because of intimate partner violence than non-Hispanic or U.S born women. The limitations do not undermine the strength of the current results pertaining to the wide-ranging influence of legal firearm availability. Given the strong association between firearm availability and homicide incidents in urban counties, ease of access is likely associated with homicides irrespective of race and ethnicity. Future research also needs to expand upon a focus on lethal violence, however, to include information on non-lethal firearm injury in intimate relationships.

5. Conclusion

Gun violence research has been severely hampered by limits to funding, the federal Dickey amendment often cited as an effective barrier to building a larger knowledge base around gun violence and prevention (Krisberg, 2018). Amidst louder calls for research into gun violence in the United States by academics, politicians, and front-line workers in the medical field (Branas et al., 2017; Galea and Vaughan, 2018), it is imperative that we consider firearm and intimate partner violence a multidisciplinary issue that requires more funding and research into many complex areas (such as gun policy, gun availability, policing, and cultural norms) to improve public safety. Within this, we stress that a policy focus on illegal firearms or military style weapons does not alleviate the risk that intimate partner violence turns lethal. Rather research and policy need to reflect the complexities of firearm violence, including intimate partner violence.

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