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# Effects of domestic violence policies, alcohol taxes and police staffing levels on intimate partner homicide in large US cities

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## ABSTRACT

**Objective** To assess the relationships between intimate partner homicide (IPH) and public policies including police staffing levels in large US cities.

**Design** The research uses a multiple time-series design to examine the effects of statutes aimed at restricting access to firearms for perpetrators of domestic violence, allowing or mandating arrest for violators of domestic violence restraining orders (DVROs), beer excise taxes, and police staffing levels on IPH in 46 of the largest US cities from 1979 to 2003. Both total IPH and IPH committed with a firearm are analysed. Generalised estimating equations using a Poisson distribution are used to regress IPH on the policies and potential confounders.

**Results** State statutes restricting those under DVROs from accessing firearms, and laws allowing the warrantless arrest of DVRO violators, are associated with reductions in total and firearm IPH. Police staffing levels are also negatively associated with total and firearm IPH. There was no evidence that other policies to restrict firearm access to domestic violence offenders or alcohol taxes had a significant impact on IPH.

**Conclusions** Reducing access to firearms for DVRO defendants, increasing police staffing levels and allowing the warrantless arrest of DVRO violators may reduce the city-level risk of IPH. Future research should evaluate factors that may mediate the effects of these laws and increased police staffing levels on IPH to determine whether there are opportunities to increase their protective effects. Further research is needed on firearm law implementation to determine why the other tested laws were not found effective.

Intimate partner homicide (IPH) is a global problem; one review of studies from multiple countries shows that IPH accounts for up to 70% of femicides (the killing of women) and 9% of homicides of men.<sup>1</sup> In the USA, intimate partners account for one third of perpetrators of femicides and 4% of perpetrators of homicides of men.<sup>2</sup> Over 60% of IPHs in the USA from 1976 to 2005 were committed with firearms.<sup>3</sup> Violent events between intimates that involve firearms are more likely to end in death than those involving knives, other weapons or bodily force.<sup>4</sup> Furthermore, the risk of femicide by an intimate partner increases by five-fold when an abuser has access to a firearm.<sup>5</sup>

Numerous studies link alcohol use, particularly heavy and binge drinking, with intimate partner violence (IPV), and some studies indicate a link between alcohol use and the severity of physical aggression used in an IPV event.<sup>6</sup> State-level alcohol consumption is positively associated with IPH;

however, causal connections between alcohol, forms of abuse and IPH are not entirely clear.<sup>7</sup> A meta-analysis of 112 studies that assessed the effects of alcoholic beverage taxes and prices on drinking reported that increasing taxes and prices decreases alcohol use.<sup>8</sup> An increase in alcohol price or tax could lower consumption among drinkers who are at risk of committing IPV. Higher state excise taxes on beer are associated with lower overall and severe violence against children.<sup>9</sup> Furthermore, alcohol price is negatively associated with the risk of violence against wives; however the results regarding violence against husbands are mixed.<sup>10</sup>

Over 65% of intimate partner femicide victims are physically abused by their perpetrators prior to the homicide.<sup>11</sup> Roughly half of violent incidents between partners are reported to the police by female victims.<sup>12</sup> About half of all female victims of IPH and near-lethal IPV obtained a domestic violence restraining order (DVRO), had their abuser arrested, or reported stalking or threatening behaviours to the police during the year preceding the lethal or near-lethal event.<sup>13</sup> Furthermore, IPV perpetrators are less likely to recidivate after a police report is made regardless of whether an arrest occurred.<sup>14</sup> These statistics suggest that the police have opportunities to intervene in IPV and prevent future homicide.

The current study is an investigation of the impacts of targeted IPV policies, alcohol taxes and police staffing levels on IPH. Movement on many of these policies occurred around the same period, the early to mid-1990s, and they could act as confounders for each other; estimating their effects on IPH simultaneously is an important contribution of this research. To the authors' knowledge, this is the first study to examine the effects of police staffing levels and alcohol taxes on IPH with a multiple time-series design, to which research on policy changes is particularly suited. This research will provide advocates and policy makers with a better understanding of the impacts of targeted IPV policies, alcohol taxes and police staffing levels on IPH.

## METHODS

### Study design and population

We used a multiple time-series design to study trends in IPH and firearm IPH in 46 of the largest US cities from 1979 to 2003. Data on IPH were obtained from the FBI's Supplementary Homicide Reports (SHR).<sup>15</sup> The dependent variables were measured as counts of homicide victims, or

homicide victims killed with firearms, of at least 15 years of age identified as spouses, former spouses, boyfriends, girlfriends or homosexual partners of the offenders.

### Independent variables

Two sets of targeted IPV policies were examined in this research, including policies designed to limit a known IPV perpetrator's access to firearms. We examined state laws reducing access to firearms for those under DVROs; state laws reducing a domestic violence (DV) misdemeanor's access to firearms; and state laws allowing police officers to confiscate firearms from the scene of DV. To be consistent with previous research, we used data on the passage of these laws, found in Vigdor and Mercy.<sup>16</sup> As a control, the models included federal laws to reduce access to firearms for those under DVROs and for DV misdemeanants.

We also estimated the effects of laws that allow police to make warrantless arrests for DVRO violations and laws that mandate arrest when officers see evidence of a DVRO violation. Data on these laws up to the year 1996 were obtained from Dugan *et al*<sup>17</sup> and updated using the LexisNexis State Capital database. IPV-targeted laws were represented by dichotomous variables set to one if a city-year was subject to the law and zero if it was not.

Data on police staffing levels were collected from the Uniform Crime Reports.<sup>18</sup> Consistent with prior research, police staffing levels were measured as the natural logarithm of the number of sworn officers per 1000 persons.<sup>19–20</sup> Because the measurement of police staffing levels occurs annually on 1 October, the variable was lagged by 1 year in the models to more accurately represent contemporary levels.

Given the low cost, wide appeal, and price elasticity of beer, the beer excise tax was used in this research.<sup>21</sup> State taxes are often used in research as a measure of alcohol price because the majority of variation in price across states is due to differing tax rates.<sup>22</sup> Data regarding the federal, state and city excise taxes on beer per gallon were originally collected by Markowitz *et al*.<sup>23</sup> The federal tax was measured as a dichotomous variable to represent its single, large increase during the study period, while state and local taxes were combined in a continuous variable and adjusted for inflation to 1983 cents.

The models included as a control the prevalence of firearm ownership, measured as the percentage of suicides committed with firearms in the county in which the majority of each study city resides.<sup>24</sup> This measure is positively correlated with femicide at the state level.<sup>25</sup> However, while it is a good proxy in the cross-section, it has only been weakly related to temporal changes in household prevalence of gun ownership.<sup>24</sup> Data were obtained from the CDC WONDER database.<sup>26–27</sup>

This study built on similar research by Dugan *et al*<sup>17</sup> that examined the effects of state and local policies and victim resources on IPH in US cities from 1976 to 1996, using and updating that dataset with information from the same governmental agencies as the original data.

The percentages of the population over 15 years of age, married and divorced, were included as controls because of their previous significant associations with IPH.<sup>28</sup> The percentage of the population that was Black was included as a control due to the higher rates of IPH experienced by Blacks than Whites.<sup>3</sup>

Feminists posit that IPV is largely determined by gender inequality. Prior research on the link between gender inequality (as measured by differences in educational levels) has shown both positive and negative relationships depending on the race, gender and marital status of victims.<sup>17</sup> We measure gender equality by the ratio of the percentage of women over 25 years of

age with bachelor's degrees to the percentage of men over 25 years of age with bachelor's degrees, and include this as a control variable. Population data are from the decennial censuses.<sup>29–32</sup>

Lack of financial resources reduces the abilities of women to leave abusive relationships.<sup>17</sup> Public assistance programmes, such as Aid to Families with Dependent Children (AFDC), now Temporary Assistance for Needy Families (TANF), may contribute to a woman's financial ability to leave an abusive relationship. Higher AFDC benefits are associated with lower rates of IPH victimisation of men.<sup>17</sup> Per capita income, obtained from the US Bureau of Economic Analysis,<sup>33</sup> and AFDC/TANF benefit levels for a family of four, obtained from the US House of Representatives' Green Books,<sup>34–37</sup> were both measured in 1983 dollars.

City fixed effects were used to control for unmeasured factors that cause IPH rates to vary from city to city. A linear trend term controlled for omitted factors such as gradual changes in the social norms and resources relevant to IPV that may affect IPH rates nationally over time, while year dummies approximated factors that caused the national rates to change from year to year. The linear trend term was interacted with city fixed effects to account for factors that cause IPH rates to vary over time differently across cities. To control for broader trends in lethal violence and the unmeasured social forces underlying those trends, the non-intimate partner homicide rate for adults aged 25 years and older was included in the analysis.<sup>15</sup>

### Statistical approach

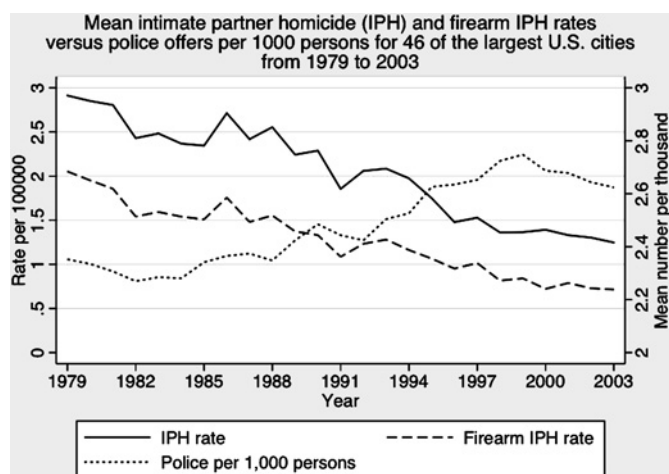
The statistical models used generalised estimating equations, clustered by city, to control for serial correlation of model errors, common in longitudinal data.<sup>38</sup> The offset for the dependent variable was the natural logarithm of the number of people at risk in that city-year. There was no evidence of overdispersion, therefore the count data were modelled by the Poisson distribution.

Endogeneity, which can result if IPH influences the passage of the policies under study, can bias model estimates. The influence of previous levels of IPH and firearm IPH on the passage of each policy was tested; the only significant association found was the negative effect of the three-year lag of firearm IPH levels on passage of the misdemeanor firearm restriction law. To reduce any bias endogeneity might introduce into the models, each of the policies, with the exception of the beer tax variables, was lagged by 1 year in the models. The bias introduced by feedback endogeneity, however, is largely removed from the present models because of the large number of time periods under study.<sup>39</sup>

Due to the multiple hypotheses under study, a post-hoc Bonferroni correction was used and regression estimates were considered statistically significant if the corrected p-value for a two-tailed test was less than 0.05.

### RESULTS

On average, mean IPH and firearm IPH rates per 100 000 persons for the study cities decreased from 1979 to 2003, while the average number of sworn police officers per 1000 persons increased modestly from the early 1980s to 1999, then began a downward trend (figure 1). The number of cities in states with the laws under study also increased throughout the time period (table AI). Of the 27 states and 25 years included in the research, 14 states and two cities changed their level of taxation on beer (table AII). Increases in the tax were usually less than 7 cents per gallon. The relative, 1983 value of the state excise tax decreased over time, increasing people's economic ability to buy beer; the



**Figure 1** Mean intimate partner homicide (IPH) and firearm IPH rates versus police officers per 1000 persons for 46 of the largest US cities from 1979 to 2003.

only increase in the excise tax experienced by many cities was the doubling of the federal tax in 1991, when it increased from 29 to 58 cents per gallon.

Table 1 presents model estimates. The second, third and fourth columns of the table display the incident rate ratios (IRR), 95% CIs and Bonferroni-corrected p-values produced by the regression on IPH, while the next three columns display the estimates produced by the regression on firearm IPH.

State laws restricting access to firearms for those under DVROs were associated with a 19% reduction in IPH risk (IRR 0.81, 95% CI 0.68 to 0.95) and a 25% reduction in firearm IPH risk (IRR 0.75, 95% CI 0.62 to 0.92). Neither the estimated effects of the state law restricting access to firearms for DV misdemeanants nor the firearm confiscation law were statistically significant or in the hypothesised direction.

DVRO violation warrantless arrest laws were associated with a 16% decrease in IPH (IRR 0.84, 95% CI 0.75 to 0.94) and firearm IPH (IRR 0.84, 95% CI 0.73 to 0.96). The number of police officers per 1000 persons was negatively associated with both IPH (IRR 0.68, 95% CI 0.53 to 0.87) and firearm IPH risk (IRR 0.60, 95% CI 0.45 to 0.79).

## DISCUSSION

This analysis suggests that state laws restricting access to firearms for those under DVROs, laws allowing the police to arrest DVRO violators, and higher police staffing levels reduce the risk of IPH. This research looked at areas of policy relevant to IPV—IPV-targeted laws, alcohol taxes and police staffing levels—each of which experienced change during the early to mid-1990s. By estimating their effects simultaneously, we prevented these policies from potentially confounding each other's estimated effects on IPH.

The reduction in IPH in response to DVRO firearm restriction laws found here is consistent with research by Vigdor and Mercy that examined the effects of these laws on IPH at the state level.<sup>16</sup> Our research, based on city-level data, provides additional evidence that these state laws may suppress IPH. Similar to Vigdor and Mercy,<sup>16</sup> the current study estimated that laws restricting access to firearms for DV misdemeanants and laws allowing police to confiscate firearms from the scene of DV do not affect IPH. The apparent lack of effectiveness of these laws may be due to inadequate enforcement, otherwise porous gun laws that allow prohibited individuals to obtain firearms, and/or low levels of convictions among IPV offenders.

Barriers to effective enforcement of laws designed to disarm IPV offenders have been documented.<sup>40</sup> As with most policy evaluations, this study did not control for policy implementation. Additional research is needed to determine best practices for implementing these policies and whether their effects on IPH depend on enforcement measures.

Consistent with previous research,<sup>17</sup> laws allowing the warrantless arrest of DVRO violators were associated with decreases in IPH. The mechanism by which this policy may reduce IPH is unclear. It is unknown whether these laws result in increases in arrests and charges; however the threat of arrest may deter some perpetrators from violating DVROs and subsequently using lethal violence. We found no association between laws mandating the arrest of DVRO violators and IPH. Dugan *et al* reported that these statutes were associated with reduced risks for specific subgroups of IPH victims (eg, White, unmarried women).<sup>17</sup> If these laws only affect certain subgroups, the effects may not be detectable on the aggregated victim groups examined here. We did not disaggregate groups by gender, race or relationship type because doing so would reduce

**Table 1** Estimated impact of domestic violence policies, police staffing levels and beer excise taxes on intimate partner homicide in 46 US cities from 1979 to 2003

Parameter	Intimate partner homicide			Firearm intimate partner homicide		
	IRR	95% CI	p Value	IRR	95% CI	p Value
<b>Firearm restriction laws</b>						
State DVRO	0.81	0.68 to 0.95	0.044	0.75	0.62 to 0.92	0.020
State misdemeanour	1.08	0.91 to 1.27	1	1.18	0.99 to 1.41	0.248
Firearm confiscation	1.10	0.92 to 1.31	1	1.19	0.97 to 1.46	0.384
<b>DVRO violation laws</b>						
Warrantless arrest	0.84	0.75 to 0.94	0.012	0.84	0.73 to 0.96	0.048
Mandatory arrest	1.11	0.98 to 1.27	0.404	1.05	0.89 to 1.24	1
Log of police per 1000 persons	0.68	0.53 to 0.87	0.008	0.60	0.45 to 0.79	<0.001
State beer excise tax*	1.00	0.99 to 1.01	1	1.00	0.99 to 1.01	1
Federal beer tax increase	1.03	0.80 to 1.32	1	1.11	0.80 to 1.54	1
Deviance statistic and $\chi^2$ test	1418.64		<0.001	1248.34		<0.001

Data were modelled by generalised estimating equations using a Poisson distribution; all policies, except for beer excise tax variables, were lagged by 1 year; estimates from the control variables used in the models are reported in table AIII.

p Values adjusted using post-hoc Bonferroni correction for multiple hypotheses.

\*State beer excise taxes were measured in 1983 cents.

IRR, incidence rate ratio; DVRO, domestic violence restraining order.

annual counts to such an extent that city-level rates would be unstable.

Higher police staffing levels were linked with lower risks of IPH. Arrest can deter repeat IPV, including lethal forms,<sup>5 14 17</sup> and we hypothesised that increased police staffing enhances the ability of police to arrest perpetrators of IPV, either through having more resources available or because it may indicate an ability of police jurisdictions to have specialised DV units. The effects of higher levels of police staffing on IPH may also be due to the increased incarceration of IPV offenders for non-IPV crimes. Perpetrators of IPV are more likely to commit acquaintance and stranger violence than those who do not engage in IPV, and many IPV perpetrators have non-violent criminal histories.<sup>41 42</sup> A decrease in IPH is expected if a sufficient amount of IPV perpetrators are in jail or prison.

We found no support for the hypothesis that higher beer taxes reduce IPH risk. However, the small tax increases that occurred during the study period were possibly not large enough to change consumer behaviour to the extent needed to affect IPH.

While we found significant effects of certain policies and police staffing levels on IPH, the overall fit of our models, as determined by deviance statistics, was poor, suggesting that factors not included in the models may explain variation in rates of IPH. Over the past 30 years, numerous changes occurred which may be implicated in the decrease of IPH, such as the passage of laws allowing or mandating warrantless arrest for IPV perpetration and laws increasing the availability and strength of DVROs. Increases in women's economic standing and the proliferation of social services for victims are also hypothesised to reduce the risk of IPH by providing women with options other than staying in the relationships.<sup>28</sup> These policies and societal changes were beyond the scope of this research.

This study is limited by relying on imperfect SHR data to measure IPH. The SHR is a voluntary reporting system and, as such, many jurisdictions fail to report for a given time period. Among those reported homicides, the relationship between victim and perpetrator is sometimes unknown, excluded or miscoded, making it difficult to ascertain the true number of IPH victimisations. To account for this, the models were retested, with similar results, using the adjustment for SHR underreporting used in Dugan *et al.*<sup>17</sup>

This research tested the effects of the 1-year lag of the policy variables on IPH. We also tested alternative models with non-lagged policy variables and found that the estimates of policy effects differed from those derived from our policy-lagged models. For example, while the IRR did not change considerably, in the alternative models the DVRO firearm restriction law did not have a significant impact on IPH; however in the lagged models, it did (estimates from the alternative models available on request). It is preferable to use lagged policy variables to reduce any bias that might result if the policies were passed in response to IPH levels, and also to better reflect the lag between

### What this study adds

- ▶ State statutes designed to limit access to firearms for those under domestic violence restraining orders are associated with a reduction in intimate partner homicide at the city level, net of other criminal justice statutes targeted at perpetrators of intimate partner violence.
- ▶ Laws allowing the warrantless arrest of violators of domestic violence restraining orders are associated with a reduction in intimate partner homicide, as are high police staffing levels.

a law going into effect and its full implementation. In the alternative models, the policy variables switched on in the year of policy adoption, measuring the effect of the policy before implementation and substantive changes in police practice could be made. For these reasons, we believe the lagged policy variable models are more trustworthy.

This study adds to a small, but growing, body of research that provides evidence that state laws restricting those under DVROs from accessing firearms and allowing the warrantless arrest of DVRO violators save lives, and that increasing the number of police officers in a city may reduce IPH, as well. Laws allowing the warrantless arrest of DVRO violators are now widespread, and future research should focus on how these laws may reduce IPH so that their protective effect may be replicated in other state and local policies. Future research should also evaluate factors that may mediate the effect of state laws restricting those under DVRO laws from accessing firearms and increased police staffing levels on IPH to determine if there are opportunities to increase their protective effect.

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**Competing interests** None.

**Ethics approval** This study was conducted with the approval of the Johns Hopkins Bloomberg School of Public Health.

**Contributors** AZ is the guarantor of the paper, and as such had full access to the data and accepts full responsibility for the data and the analyses. Both AZ and DW contributed to the research conception and design, analysis and interpretation of data, and drafting and approval of the final version to be published.

**Provenance and peer review** Not commissioned; externally peer reviewed.

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### What is already known on this subject

- ▶ Firearms are the weapons used in the majority of intimate partner homicides.
- ▶ Once a violent event is reported to them, police have the opportunity to intervene in intimate partner violence, and potentially prevent intimate partner homicide.

## Original article

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## APPENDIX

Table A1 Year of passage of criminal justice statutes

State	Domestic violence misdemeanor gun restriction	DVRO* defendant gun restriction	Firearm confiscation allowed	Warrantless arrest for DVRO violation	Mandatory arrest for DVRO violation
Arizona		1996	1996	1980	1991
California	1994	1991	1984	1993	1995
Colorado	1994–98	1994		1991	1991
Georgia				1986	
Hawaii	1988	1993	1996	1980	
Illinois	1996	1996	1993	1986	
Indiana		1999	2002	1985	
Louisiana				1983	
Maryland		1996	1996	1992	1992
Massachusetts		1994		1978	1978
Michigan		1996		1978	
Minnesota	1992			1978	1983
Missouri				1980	1989
Nebraska			2004	1989	1989
New Mexico				1987	
New York	1993	1996		1995	1996
North Carolina		1995		1987	
Ohio			1994	1979	2003
Oklahoma			1993	1986	
Oregon				1977	
Pennsylvania	1995	1995	1986	1986	
Tennessee			1995	1979	
Texas	2001	1996		1983	
Virginia		1994		1992	2004
Washington	1993			1979	
Wisconsin		1996		1989	1996

\*DVRO, domestic violence restraining order.

Table A11 Changes in state and city beer taxes in cents per gallon

State or city	Year	Amount changed	State or city	Year	Amount changed
Arizona	1984	8	New York City	1980	12
California	1991	16	North Carolina	1999	-0.2
Hawaii	1986	40	Ohio	1989	3
	1988	5		1993	6.7
	1989	7	Cleveland	1990	16
Illinois	1999	11.5	Oklahoma	1984	8
Indiana	1981	2	Tennessee	1981	1.6
Minnesota	1987	2		2002	1.2
New Mexico	1981	1	Texas	1984	3.3
	1983	9	Washington	1981	3.5
	1993	17		1982	0.6
	1994	6		1989	6.5
New York	1983	1		1993	3
	1989	5.5		1995	4.6
	1990	10		1997	3
	1999	-7.5			
	2001	-1			
	2003	-1.5			

**Table AIII** Estimated impact of control variables on intimate partner homicide in 46 US cities from 1979 to 2003

Parameter	Intimate partner homicide			Firearm intimate partner homicide		
	IRR	95% CI	p Value	RR	95% CI	p Value
% Black	0.98	0.91 to 1.06	1	0.95	0.86 to 1.05	1
% married	1.02	0.92 to 1.14	1	1.03	0.93 to 1.14	1
% divorced	1.07	0.92 to 1.24	1	1.10	0.94 to 1.28	1
AFDC/TANF benefit*	1.00	1.00 to 1.00	1	1.00	1.00 to 1.00	1
Income per capita*	1.00	1.00 to 1.00	0.328	1.00	1.00 to 1.00	1
Unemployment rate	1.03	0.98 to 1.07	0.928	1.07	1.01 to 1.13	0.096
Educational ratio	0.47	0.33 to 0.67	<0.001	0.26	0.12 to 0.53	<0.001
Prevalence of firearm ownership	1.45	0.87 to 2.43	0.624	1.44	0.69 to 2.99	1
Adult, non-intimate homicide rate	1.01	1.01 to 1.02	<0.001	1.01	1.01 to 1.02	<0.001

Data modelled by generalised estimating equations using a Poisson distribution, estimates of federal law variables, city and year fixed effects, linear time trend, and the interaction of city fixed effects with linear time trend not reported.

p Values adjusted using post-hoc Bonferroni correction for multiple hypotheses.

\*Per capita income and AFDC/TANF benefits measured in 1983 dollars.

IRR, incidence rate ratio; AFDC, Aid to Families with Dependent Children; TANF, Temporary Assistance for Needy Families.

