

Intimate Partner Homicide Rates in Relation to Programs in, and Characteristics of, US States:

2011-2015

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Abstract

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An ecologic study was conducted to assess the relationship between Intimate Partner Homicide (IPH) rates (both overall and firearm-related) and programs and policies within each state.

These programs and policies included: Availability of Domestic Violence Shelters (per capita), Availability of Batterer Intervention Programs (per capita), Minimum Wage, Annual Household Income, and Domestic Violence Firearm Laws. 5-year cumulative Intimate Partner Homicide rates from 2011-2015 were collected on 17 U.S. States from the National Violent Death Reporting System. From December 2017 to March 2018, data was collected and analyzed using two-sample t-tests and linear regression. The average 5-year cumulative IPH rate among the sample was 2.77 per 100,000 persons and the average 5-year cumulative firearm-related IPH rate was 1.61 per 100,000 persons; with firearm related IPH accounting for over half (58.1%) of

overall IPH. States with high availability of Batterer Intervention Programs had 1.14 additional IPH per 100,000 persons than states with low availability of Batterer Intervention Programs (95% CI -1.14 to 0.53, $p=0.04$). States with more Domestic Violence Firearm Laws had lower overall and firearm-related IPH rates as compared to states with fewer Domestic Violence Firearm Laws [$r=-0.33$, $p=0.001$ (firearm-related IPH)]. The researcher raises several questions regarding validity of the positive association examined between IPH rates and Batterer Intervention Programs, including the potential for reverse causality. The researcher also discusses the potential public health and policy implications of the negative association observed between firearm-related IPH rates and Domestic Violence Firearm Laws.

Introduction

Intimate Partner Homicide (IPH) is a violent and fatal attack perpetrated by a current or former intimate partner, which can include a spouse, boyfriend/ girlfriend, dating partner, or ongoing sexual partner (Breiding, Basile, Smith, Black, & Mahendra, 2015). IPH represents a significant burden to public health in the United States, with nearly 1,800 IPH deaths occurring in the United States each year (Federal Bureau of Investigation; U.S. Department of Justice, 2013). IPH represents 16.3% of all homicides with known victim/offender relationships (Cooper & Smith, 2011). While there has been an overall decline in IPH in the last 25-30 years, global surveillance of IPH rates indicate that the declines in IPH are relatively modest compared to other forms of homicide (United Nations Office on Drugs and Crime, 2013). Additionally, the declines in IPH in the United States specifically have mostly been driven by declines in IPH in specific sub-sets of victims, namely male victims; female IPH victimization rates have remained relatively stable (Block & Christakos, 1995; Fox & Zawitz, 2007; Parks, Johnson, McDaniel & Gladden, 2014). Since women represent the majority (85%) of IPH victims (Parks, Johnson, McDaniel & Gladden, 2014), it is clear that there is a continued need to understand and explore trends and factors associated with IPH.

Due to the complexity of the social and environmental factors involved with IPH, it also results in costs to society at large, including psychological costs to the children who are traumatized by the violent death of a parent or guardian. These costs are also borne by the people and institutions (schools, mental health providers, and foster care and/or state agencies) that are tasked with caring for the child victims (Lysell, Dahlin, Langstrom, Lichtenstein, & Runeson, 2016). Additionally, there are economic costs to society both from

the loss of lives and the lost productivity from premature death, estimated to be \$893 million per year (1995 dollars) (Max, Rice, Finkelstein, Bardwell, & Leadbetter, 2004). The legal costs of trying homicide offenses in the United States only add to this economic burden (DeLisi, Kosloski, Sween, Hachmeister, Moore & Drury, 2010). In addition to reducing the public health burden, there is also potential for great cost savings (both psychosocial and monetary) by preventing IPH.

Though IPH presents a complex array of challenges to the public health community as well as to the larger society, it is also a highly preventable health issue. Several studies have examined potential risk reduction interventions, programs, or policies related to Intimate Partner Violence (IPV) and IPH. There is a wealth of research on the initial interventions developed to address IPV in the US, namely Domestic Violence (DV) Shelters and Batterer Intervention Programs (BIPs). The emergence of the Battered Women's Movement in the mid-1960s brought with it the establishment of not only the country's first DV arrest laws, but also the first DV Shelters (Hosley, Mbilinyi & Wilder Research, 2005). Shortly thereafter, in the late 1970s, the country saw the establishment of the first BIPs which were developed as both a means for providing a therapeutic response to DV offenders and also as a means to relieve an overcrowded court system tasked with managing the increased criminal offenses related to the country's newest DV arrest laws (Adams, 2003).

Existing research on the impact of both DV Shelters and BIPs mainly focus on their effectiveness in reducing the re-occurrence of nonfatal injury or re-arrest related to IPV, and not IPH specifically. Additionally, most studies measured risk at the individual (victim or offender) level. Previous research on the effectiveness of DV Shelters in reducing IPV is mixed.

Some studies observed decreases in risk of re-abuse for victims who utilize DV Shelters, while other studies observed little to no impact on re-abuse (Wathen & MacMillan, 2003). However, many of these studies relied on self-reported re-abuse or re-offense from the victim, rather than measuring IPV or IPH in a more objective manner (through arrest records or reports, for example). A few studies have measured the association between the utilization of DV Shelters and IPH specifically; most notably, work by Dugan et al. (1999; 2000) indicated a significant association between increased utilization of DV services and decreased rates of IPH. (Dugan, Nagin & Rosenfeld, 1999; Dugan, Nagin & Rosenfeld, 2000). Two smaller, state-specific studies (one in California and one in North Carolina) examined the association between DV service availability and IPH rates specifically. The study in North Carolina examined area disadvantage and IPH rates in 100 North Carolina counties between 2004-2006 and found there to be no association between DV shelter availability or services and IPH rates (Wells & DeLeon-Granados, 2002). The study in 58 counties of California between 1987-2000 observed a reduced risk of IPH in relation to DV Shelter availability in some sub-sets of victims, namely African-American males across the state and within urban areas, Hispanic women within urban areas, and women in rural areas (Madkour, Martin, Halpern & Schoenbach, 2010). There was no significant association found between DV shelter availability and IPH in the overall population, however. While the study in California is particularly informative, this research analysis will expand upon this by examining this association using the most recent IPH data available and across multiple states.

Results of research on the relationship between IPH and the presence of BIPs is equally varied (Eckhardt, Murphy, Black & Suhr, 2006). Some studies showed modest improvements in

offender behavior following completion of a BIP (Babcock, Green & Robie, 2004; Cunha & Gonçalves, 2015; Feder & Wilson, 2005; Jackson et al., 2003), while others show no change on offender behavior (Feder & Wilson, 2005; Jackson et al., 2003), and still others observed a small increase in the incidence of re-abuse or re-offense following completion of a program (Feder & Wilson, 2005).

The field of IPV research has recently seen a proliferation of research examining associations between firearm policy and IPH risk. While research on DV shelters and BIPs have been more varied in their conclusions, research on the association between IPH and firearm policies has largely revealed a strong relationship between the presence of a more stringent firearm policy and reduced rates of IPH, particularly rates of firearm-related IPH. In the most recent and notable research study on this, Díez et al. (2017) show that states with both “possession” laws (prohibiting possession of firearms) and “relinquishment” laws (requiring relinquishment of firearms) experienced 9.7% lower IPH rates and 14.0% lower firearm-related IPH rates as compared to states without these types of laws (Díez et al., 2017). Several other studies have also observed this association (Zeoli, Malinski & Turchan, 2016; Zeoli et al., 2017).

Another major class of IPV and IPH research is devoted to the relationship between socioeconomic factors and risk of IPV. A cultural shift in public health research towards use of a Social Determinants of Health (SDOH) framework in analyzing public health issues has meant that public health issues, like IPV and IPH, are now being assessed as a part of a larger system of social, economic, and political institutions known as the SDOH. In the IPV and IPH field, one way this has manifested itself is in research on the association between IPV and socioeconomic factors like annual earnings, income, and pay rates (Niolon et al., 2017). Many of these studies

show an association between higher socioeconomic indicators and reduced individual-level risk of IPV (Matjasko, Niolon & Valle, 2013; Capaldi, Knoble, Shortt, & Kim, 2012; Cunradi, 2010). However, there is a dearth of knowledge on the relationship between socioeconomic factors at the ecological level and IPH rates specifically.

This research will aim to fill important gaps by assessing IPH at the state level to explore whether associations observed at the individual level translate to similar associations at the larger ecological level. This research measures associations for combinations of different determinants of IPH, including traditional DV services and interventions, socioeconomic determinants, and DV firearm policy using the most recently available data across several US States. A limitation of the existing research in the field is its narrow focus on one type of determinant of health in assessing IPH risk. It is understandable that many studies are designed to examine the influence of a single predictor on a health outcome since rigorous epidemiological research investigations tend to follow a reductionist approach to investigation. However, there is an important need in the Public Health field for research that assesses a combination of different determinants of health within a single sample. The risk group perspective within the SDOH conceptual framework argues that the cumulative health hazards or determinants within a community are key to understanding how to reduce risk and improve health outcomes (Dahlgren, Göran & Whitehead, 2007). Furthermore, the SDOH framework posits that there are four layers of determinants of health. These include: (1) The major socioeconomic, cultural, and environmental conditions people live in, (2) the material and social conditions that people live in (3) the social and inter-personal connections and networks people engage in, and (4) the individual lifestyle factors of each person. There are four analogous

policy levels within which interventions can be implemented to improve health. This framework will be used to try to understand how DV services (at the material and social condition level) and socioeconomic factors and DV firearm policies (at the major socioeconomic level) interact to impact the cumulative health of US States as it pertains to IPH rates.

The question guiding this research is, “How do IPH rates compare between US States with different characteristics or policies?” Specifically, the primary objective of this study is to understand if and how IPH rates differ between US States with different characteristics and policies related to their DV Shelter and BIPs availability, socioeconomic status, and DV firearm policy.

Methods

Study Design and Population

This is an ecological study conducted in the 17 US States that participated in the Centers for Disease Control and Prevention's National Violent Death Reporting System (NVDRS). Only states with available IPH data within the NVDRS between the years of 2011-2015 were included in the study. Data collection occurred in December 2017-March 2018.

Data Sources

Overall and firearm-related IPH rates were collected from the NVDRS. The NVDRS is a national surveillance system that collects data on all violent deaths in 42 US States, the District of Columbia, and Puerto Rico (Centers for Disease Control and Prevention [CDC] WISQARS™, 1981-2016). It includes deidentified data on homicides and suicides, including relationship of the victim/offender, intent, mechanism, and location of death. These data are extracted from various sources and then linked within the reporting system. Major sources of data include: Death certificates, Coroner/medical examiner reports, Law enforcement reports, and Toxicology reports (CDC WISQARS™, 1981-2016). The NVDRS began collecting data on violent deaths in 2002. Inclusion in the NVDRS is based on whether a state applied for and was successfully awarded a cooperative agreement through the CDC (CDC, 2017).

DV shelter data were collected from three national DV Shelter directories: (1) The *Domestic Shelters* directory, (2) The *Women's Shelters* directory, and (3) The *Women's Law* directory (DomesticShelters, 2017; Women's Shelters, 2017; Women's Law, 2017). These three shelter directories were selected because they represent the largest and most comprehensive listings of DV shelters publicly available. Due to the uncertainty regarding the accuracy of data

available in online directories of this nature, a listing of shelters from each directory was collected and compared. Duplicate entries were eliminated and shelters appearing on only one list were investigated by researching available information found at specific shelter websites when possible. BIPs data for each state was collected from the State's Department of Justice directory of certified BIP programs.

State population and socioeconomic data were collected from the 2000 Decennial Census and US Census Bureau (United States Census Bureau, 2013).

Data on DV firearm policies were collected from the Giffords Law Center Campaign to Prevent Gun Violence resource centers (Giffords Law Center, 2017; Brady Campaign, 2017). The Giffords Law Center maintains the most comprehensive compilation of data on US firearm policies. The Giffords Law Center provide regular assessments of firearm laws by state, vetting the breadth and quality of firearm policies within all US States. These assessments are produced by legal experts and disseminated in the form of scorecards, toolkits, information sheets, and factsheets. The firearm data included in this analysis is extracted from a 50-state analysis of DV firearm policy conducted in 2014 (Giffords Law Center, 2014).

Measures

Outcome/Dependent Variable: Intimate Partner Homicide Rates (Cumulative 5-year Overall and Firearm-related rates)

The outcome variable, 5-year IPH rate (overall and firearm-related), was constructed using enumerated IPH data from the NVDRS for the years 2011-2015 and state population estimates from the 2010 Decennial Census. All IPH rates represent the cumulative 5-year IPH rates per 100,000 persons within the state.

Independent Variables:

Per capita DV shelter and BIPs prevalence was calculated to determine DV Shelter Availability and BIPs Availability respectively. Dates that DV shelters and BIPs were in operation were not consistently available within directories. Therefore, DV Shelter and BIPs Availability represent the availability of each measure at the time of data collection (2017-2018) only.

Minimum wage and Annual Household Income data from 2011-2015 were collected from the US Census Bureau and an average value for 2011-2015 was calculated.

Type and count of DV firearm laws were assessed using the Giffords Law Center's 50-state analysis of DV firearm laws factsheet. Four essential types of DV firearm laws were considered in the Giffords Law Center's assessment of a state's quality of DV firearm policy: (1) policies that prohibited misdemeanor domestic abusers from purchasing or possessing firearms and/or authorized or required them to surrender firearms, (2) policies that prohibited people issued a DV protective order from purchasing or possessing firearms and/or authorized or required them to surrender firearms, (3) policies that prohibited those facing a stalking offense from purchasing or possessing firearms and/or authorized or required them to surrender firearms, and (4) policies that required background checks be completed for all firearm sales (Giffords Law Center, 2014). These particular types of DV gun laws are intentionally tracked and analyzed by legal experts as a robust measure of the quality of DV firearm policy in the state. Total count of DV firearm laws were summed to derive the DV Firearm Laws count for each state included within the study sample. Higher values indicate a higher number of DV firearm laws present within the state.

For ease of interpretation, all independent variables (with the exception of the DV Firearm Laws variable) were transformed from continuous interval variables to categorical (dichotomous response) variables based on the median values of the variable. States with values lower than the median were assigned to a “Low” category and States with values higher than the median were assigned to a “High” category. DV Firearm Law was not transformed into a categorical variable because of the monotonic trend in the outcome variable across levels of the variable. Furthermore, the discrete and quantitative count of DV Firearm Laws were presumed to provide for an already meaningful interpretation of any observed association discovered. See Table 1 for detail on all measures and data sources.

Analysis

The analysis was conducted in Stata 14. Student’s t-test was used to test for associations between overall IPH rates and independent variables that had been transformed into categorical variables: DV Shelter and BIPs Availability, Minimum Wage, and Annual Household Income. Linear regression testing was performed to test for an association between firearm-related IPH rates and DV Firearm laws. Tests for collinearity, unequal variances, and skew were performed prior to regression testing.

Results

Descriptive Data

Descriptive characteristics for all 17 states included in the study sample are presented in Table 2. The states included within the sample were: Alaska, Colorado, Georgia, Kentucky, Massachusetts, Maryland, North Carolina, New Jersey, New Mexico, Ohio, Oklahoma, Oregon, Rhode Island, South Carolina, Utah, Virginia, and Wisconsin. IPH data for all states were available for the 2011-2015 time period with the exception of yearly firearm-related IPH data for Rhode Island and yearly minimum wage data for South Carolina (both of which are discussed below). The average cumulative 5-year overall IPH rate among all (n=17) states included in the sample was 2.77 per 100,000 persons for 2011-2015. The average 5-year cumulative firearm-related IPH rate for (n=16) states in the study sample was 1.61 per 100,000 persons for 2011-2015 (Rhode Island was not included because yearly number of firearm-related IPH for all 5 years included in the time period was less than 10 and was therefore not reported to retain anonymity). Firearm-related IPH therefore accounted for over half (58.1%) of overall IPH in 2011-2015 among the states included in the study sample. There was substantial variation in overall cumulative 5-year IPH rates among the States, with Massachusetts having the lowest overall cumulative 5-year IPH rate at 1.17 IPH per 100,000 persons and Alaska having the highest rate at 5.63 IPH per 100,000 persons. See Appendix, Figure 1a.

There was an average of 0.90 DV shelters per 100,000 persons and 1.34 BIPS per 100,000 persons among all (n=17) states in the study sample. After transforming into a categorical variable, the DV Shelter Availability variable resulted in two levels, with states with >0.74 DV shelters per capita assigned to the “High Availability” category (n=8) and states with

≤ 0.74 DV shelters per capita assigned to the “Low Availability” category (n=9). See Appendix, Figure 1b. Once transformed into a categorical variable, the BIPs Availability variable resulted in two levels, with states with > 1.27 BIPs per capita assigned to the “High Availability” category (n=9) and states with ≤ 1.27 BIPs per capita assigned to the “Low Availability” category (n=8). See Appendix, Figure 1c.

Averages for state minimum wage and annual household income were \$7.30 per hour and \$55,278.07 annually, respectively. After transforming into a categorical variable, the Minimum Wage variable resulted in two levels, with states with $> \$7.45$ minimum wages per hour assigned to the “High Minimum Wage” category (n=8) and states with $\leq \$7.45$ minimum wages per hour assigned to the “Low Minimum Wage” category (n=8) (yearly minimum wage data for all five years included in the time period for South Carolina were not included because the state has no established state minimum wage). See Appendix, Figure 1d. Once transformed into a categorical variable, the annual household income variable resulted in two levels, with states with $> \$52,236.20$ annual household income assigned to the “High Income” category (n=8) and states with $\leq \$52,236.20$ annual household income assigned to the “Low Income” category (n=9). See Appendix, Figure 1e.

The average number of DV firearm laws present for the 17 states in the study sample was 1.17, the standard deviation was 1.15, and the median number was 0. Number of DV firearm laws ranged from 0 to 4. The most prevalent types of DV firearm laws were policies directed at individuals issued a DV protective order (n=6 states) and policies directed at individuals facing a stalking offense (n=7 states). The least prevalent types of DV firearm laws

were policies directed at individuals charged with DV misdemeanor offenses (n=3 states) and policies that required background checks for firearm sales (n=4 states). See Appendix, Table 1.

Bivariate Models

Table 3 outlines results of the individual bivariate models including each state characteristic or policy and the cumulative 5-year overall IPH rate. States with high BIPs availability had, on average, 1.14 additional IPH per 100,000 persons than states with low BIPs availability (95% CI -1.14 to 0.53, $p=0.04$.) See Figures 1 and 2. States with high DV shelter availability had, on average, 0.71 additional IPH per 100,000 persons than states with low DV shelter availability (95% CI -2.05 to 0.61, $p=0.26$), but this difference was well within the limits of chance. States with high minimum wages had, on average, 0.35 less IPH per 100,000 persons than states with low minimum wages (95% CI -1.01 to 1.71, $p=0.58$). Similarly, States with high annual household incomes had, on average, 0.76 less IPH per 100,000 persons than states with low annual household incomes (95% CI -0.46 to 1.99, $p=0.20$). Both differences were well within the limits of chance given no true association. States with 4 DV firearm laws had 50.9% lower overall IPH rates ($M=1.61$ IPH, $SD=0.39$) as compared to states with no DV Firearm Laws ($M=3.28$ IPH, $SD=1.24$), 55.0% lower overall IPH rates as compared to states with 1 DV Firearm Law ($M=3.58$ IPH, $SD=0.14$), and 11.7% lower overall IPH rates as compared to states with 2 DV Firearm Laws ($M=1.88$ IPH, $SD=0.66$) ($r=-0.46$, $p=0.013$). See Figure 3.

The association between number of DV Firearm Laws and 5-year firearm-related IPH rates was analyzed using linear regression (see Table 4). States with more DV firearm laws had lower firearm-related IPH rates as compared to states with fewer DV firearm laws: States with 4 DV firearm laws had 65.9% lower firearm-related IPH rates ($M=0.65$, $SD=0.42$) than states with

no DV Firearm Laws ($M=1.91, SD=0.5$), 71.4% lower firearm-related IPH rates than states with 1 DV Firearm Law ($M=2.28, SD=0.04$), and 35.6% lower firearm-related IPH rates than states with 2 DV Firearm Laws ($M=1.01, SD=0.21$) ($r=-0.33, p=0.001$). See Figure 4.

Discussion

This research sought to provide insight into how US States with different characteristics and policies compare in terms of both their overall and firearm-related IPH rates.

The first finding from this study is that states with higher availability of DV Shelters and BIPs (higher per capita rates) had higher 5-year overall IPH rates. While only the association between BIPs Availability and overall IPH rate was statistically significant, these findings were nonetheless surprising. It was anticipated that since the availability of more DV services, like DV shelters and BIPs, provide both victims and offenders with resources to escape violent relationships and/or decrease the violence within these relationships, their abundance would then be associated with decreased IPH rates (Dugan, Nagin & Rosenfeld, 2004). To the authors knowledge there are no existing studies that directly compare BIPs availability with IPH rates, and this study is therefore the first to observe such an association. Two of the most recent and notable meta-analytic reviews of the effectiveness of exposure to a BIP show considerable variation in their impact on IPV outcomes (Feder & Wilson, 2005; Babcock, Green & Robie, 2004). In Feder and Wilson's 2005 meta-analytic review of BIPs studies, the authors conclude that existing research does not provide a strong enough evidence-base to show that the presence of a BIP can reduce risk of re-abuse or re-offence for the offender. In one quasi-experimental study comparing BIP program completers to those who dropped out of the program, those who completed the program experienced lower re-abuse rates (measured using police reports) at the 15-month follow-up point (Gondolf, 1998). However, the quasi-experimental study design used introduces difficulties in assessing the meaning of the observed differences in the two comparison groups. Since batterers who complete a BIP program may be

fundamentally different from ones that drop out, it is difficult to assess if the observed decrease in re-abuse rates was truly due to the BIP intervention. In a more rigorous trial done among US Navy personnel in San Diego, those randomized to a 36-week BIP program (2 treatment arms) were compared to those randomized to a no-treatment control group; no differences in re-offense/re-arrest (as measured by both police and partner/victim report) were observed between the treatment groups and the control group at the 1-year follow-up point (Dunford, 2000).

One limitation this study faced was the fact that the main outcome (IPH rates) was measured during the same time period (2011-2015) as the indicator variables were measured. This introduces uncertainty on whether the observed exposure (high level of BIPs availability) preceded the main outcome of increased IPH rates or if the high availability of BIPs resulted from high IPH rates. For example, historically BIPs have been established as a means to manage high numbers of DV arrests seen in a particular region's court system (Adams, 2003). The proliferation of BIPs in a particular region or state may simply be a response to high rates of IPV and IPH in the region.

Another reason why this study may have found a spuriously positive association between BIPs availability and IPH rates is the presence of confounding: that is, it is possible that users of a BIP could be at an inherently higher risk of IPH than those couples who do not avail themselves of such a program. For example, pre-trial diversions are fairly common legal tools that allow an offender to avoid a court hearing or conviction in exchange for their participation

in a program, service, or other treatment. Pre-trial diversions are intended to provide an alternative non-legal treatment for offenses that are thought to be more appropriately managed outside of the legal realm (National Conference of State Legislatures [NCSL], 2017). Pre-trial diversions are also used as a mechanism for addressing the overburdened court system, allowing offenders to be diverted away from the court prior to a hearing or conviction (NCSL, 2017). In fact, pre-trial diversions are becoming increasingly more common in DV arrests specifically, and participation in a BIP is one of the most common requirements included within DV pre-trial diversions (Goddard, 2014). While pre-trial diversions are lauded by many as a practical solution to heavy caseloads in the legal system, they are potentially problematic for DV cases because in the absence of a hearing or conviction, a DV offender can avoid facing DV firearm policy intended to reduce risk of IPH (Goddard, 2014). The presence and type of pre-trial diversions in a county or court district could over-estimate the true relationship between BIPs Availability and IPH rates. It may be that states experiencing particularly high rates of IPV respond by creating more pre-trial diversion programs and/or making them easier to enroll in and therefore amplify the potential confounding between BIPs and IPH rates. Future research might explore this potential confounder more and if there does appear to be a confounding influence, then there could be broader political and legal implications for how and if BIPs are incorporated into pre-trial diversions for DV offenses.

Our observation of a positive (though non-significant) association between DV Shelter availability and IPH rates was surprising because one of the largest panel studies that measured the relationship between the availability of DV services (specifically DV legal advocacy resources and DV hotlines) and IPH rates found that higher rates of DV legal advocacy services were

associated with decreased IPH rates (Dugan, Nagin & Rosenfeld, 2004). The researchers used homicide data from the FBI's Uniform Crime Reporting program in 48 of the largest US Cities in the country from 1976-1996. One challenge to their findings, however, is that the observed negative association between DV legal advocacy resources and IPH rates was only observed among white female victims; indeed, there was a positive association between DV legal advocacy and DV hotlines among black female victims. The authors explain that some DV services may follow the *exposure reduction* theory in which the presence of the service provides the victim with a pathway out of a violent relationship and therefore reduces exposure to violence and homicide and that other DV services fit within the *retaliation effect (or backlash effect) theory* (Dugan, Nagin & Rosenfeld, 2000). A *backlash effect* occurs when an event increases the risk of violence without decreasing the batterer's opportunity to commit the violent act. The authors explain that a retaliation effect in response to use of DV legal advocacy resources and/or hotlines may explain the increased IPH rates observed among black female IPH victims in their study. The retaliation effect theory may partially explain the positive association observed in the present study between DV shelter availability and IPH rates.

In a large panel data study, researchers examined crime data from the National Crime Victimization Survey (NCVS). Researchers collected data on IPV rates from a sample of 525,615 observations on women ages 18 and over from NCVS. County-level data was collected between 1992-1998 (Farmer & Tiefenthaler, 2003). While the researchers found no significant association between DV shelter or DV hotline utilization and likelihood of re-abuse, they did also did not observe a positive association between DV shelter use and IPV rates as was observed in this study. Findings from our study may differ from the NCVS study because of the

difference in the main outcome measure, IPV rates versus IPH rates. One other reason for the differences in the findings in our study and the NCVS study is that some researchers have found that DV shelters tend to be located in more affluent neighborhoods (Tiefenthaler, Farmer, & Sambira, 2005). Therefore, the measure of DV shelter availability at the state level may not capture utilization patterns at the county or neighborhood level, as the NCVS study may have done.

A third reason why the results from this study failed to identify a reduction in IPH associated with DV shelter availability relates to the relatively small difference between the availability of DV shelters across states. The difference in mean DV shelter availability between the two groups was just 0.88 DV shelters per 100,000 persons. This may not be adequate enough variation to detect a true association between DV shelter availability and IPH rates, whether that association be positive or negative.

The third finding from this study is that states with more comprehensive DV firearm policies have lower overall and firearm-related IPH rates as compared to states with less comprehensive DV firearm policies. This result confirms the wealth of existing research on the association between DV firearm policy and IPH rates. Two recent studies used the Federal Bureau of Investigation's Uniform Crime Reports to measure this association (Zeoli et al., 2017; Diez et al., 2017). This study used a different data set, the NVDRS. The NVDRS has more complete and comprehensive data on individual victims as well as their relationship to the offender (Paulozzi, Mercy, Frazier & Annett, 2004). The ability of the present study to confirm the negative and significant association between DV firearm policy and firearm-related IPH rates enriches the evidence base on improved firearm policy and decreased IPH rates.

A strength of our study was the ability to collect data on IPH through the NVDRS, a national reporting system containing data on all violent death within the 42 states that participate in the program. The ability to specify the relationship of the offender/victim and even the mechanism (i.e., firearm-related IPH) was essential in measuring the associations observed within this study. For example, IPH as a measure of the effectiveness of BIPs is a more objective measure of IPV outcomes than are (particularly self-reported or self-assessed) reports of re-abuse or re-offense. IPH can also be considered a more stable measure as compared to IPV reports because IPH is often the unfortunate end to many years of continued IPV abuse sustained by a victim, allowing it to also be an adequate measure of repeated and continuous IPV in the years leading up to the homicide.

There are several additional limitations (beyond the ones previously discussed) to this research. The first is the relatively small number of units (states) available for observation. True small-to-moderate associations with the prevalence of programs intended to reduce the rate of IPH could not be reliably identified in a sample of this size.

Due to the complex social and environmental (both health and legal) nature of IPH, implications from this research extend to public health practitioners and legal and health-related decision-makers. For public health practitioners, findings from this study confirm the importance of comprehensive DV firearm policy in reducing IPH rates. This has implications for deeper collaboration and cross-sector research and work for public health practitioners, members of the DV community (therapists, victims and advocates, community coalitions) and legal experts and policy-makers.

Application of the SDOH conceptual framework in considering the impact of multiple determinants of IPH positioned across multiple layers of influence was helpful in contextualizing the two significant findings from this research: We can characterize US States based on their IPH rates if we understand how many BIPs they provide and how comprehensive their DV firearm laws are. An SDOH conceptual framework also allowed us to critically examine the larger social and environmental factors (for example within legal context and practice) to better understand how these associations function within the larger political and social environments to influence IPH rates.

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Table 1. Description and data sources for dependent and Independent variables

Measure	Description	Data Source
<i>Outcome (Dependent) Variable</i>		
Intimate Partner Homicide Rate	5-year cumulative IPH rate per capita (per 100,000 persons) from 2011-2015 5-year cumulative Firearm-related IPH Rate: IPH due to firearms only (per 100,000 persons)	Center for Disease Control's National Violent Death Reporting System (NVDRS)
<i>Exposure (Independent) Variables</i>		
Domestic Violence (DV) Shelter Availability (Low vs. High)	-Per capita number of domestic violence shelters (shelters per 100,000 persons) -States designated as either Low or High DV Shelter Availability group dependent upon their DV shelter rate.	- <i>DomesticShelters.org</i> national directory - <i>Women's Shelters</i> nationwide directory of women's shelters - <i>Women'sLaw.org</i> nationwide shelters database
Batterer Intervention Programs (BIPs) Availability (Low vs. High)	-Per capita number of batterer intervention programs (BIPs per 100,000 persons) -States designated as either Low or High BIPs Availability group dependent upon their BIPs rate.	Dept. of Justice state/governmental directory for each state
Min Wage (Low vs. High)	-Average of Min Wage taken from years 2011-2015 -States designated as either Low or High Ratio group dependent upon Min Wage Rates	US Census Bureau
Average Household Income (Low vs. High)	-Average Household Income taken from years 2011-2015 -States designated as either Low or High Income group dependent upon Average Household Income	US Census Bureau
State Domestic Violence Firearm Laws	Breadth of Quality Domestic Violence Firearm Laws present in state (2014): 1. No (0) Quality Domestic Violence Firearm law present 2. One (1) Quality Domestic Violence Firearm laws present 3. Two (2) Quality Domestic Violence Firearm laws present 4. Four (4) Quality Domestic Violence Firearm laws present	-Giffords Law Center Gun Law Database and Research Center: State DV Law Factsheets

Table 2. Descriptive characteristics for (n=17) US States, 2011-2015

State Characteristics	N	Mean (SD)	Median	Min	Max
2010 Census Characteristics					
Population	17	5,513,114.05 (3,150,207.81)	5,029,196	710,231	11,536,504
5-year Intimate Partner Homicide Rates (2011 - 2015)					
Total IPH Rate*	17	2.77 (1.21)	2.58	1.17	5.63
Firearm IPH Rate*	16	1.61 (0.71)	1.58	0.32	2.55
Traditional DV Services Availability *					
DV Shelter Prevalence*	17	0.98 (0.76)	0.74	0.35	3.51
BIPs Prevalence*	17	1.34 (1.08)	1.27	0.12	3.43
Socioeconomic Characteristics (2011 - 2015)					
Minimum Wage	16	\$7.30 (\$1.05)	\$7.45	\$4.62	\$8.92
Average Annual Household Income	17	\$55,278.07 (\$10,342.61)	\$52,236.20	\$42,887.40	\$72,685.40
State DV Firearm Laws					
State DV Firearm Laws	17	1.17 (1.55)	0	0	4
<i>*Per capita (per 100,000 persons); Data collected 2017-2018</i>					

Table 3. Results of Bivariate Models for State Characteristics and Cumulative 5-year overall IPH Rate

Cumulative 5-year Overall IPH Rate			
	<i>n</i>	<i>Difference in Rate (95% CI Difference)</i>	<i>p-value</i>
DV Shelter Availability*			
Low Availability	9	-0.71 (-2.05 – 0.61)	0.26
High Availability	8		
Batterer Intervention Programs (BIPs)			
Low Availability	8	-1.14 (-2.28 - -0.01)	0.04
High Availability	9		
Minimum Wage			
Low Min Wage	8	0.35 (-1.01 – 1.71)	0.58
High Min Wage	8		
Average Household Income			
Low Income	9	0.76 (-0.46 – 1.99)	0.2
High Income	8		
State DV Firearm Laws**			
	<i>n</i>	<i>Mean (SD)</i>	<i>p-value</i>
<i>None</i>	9	3.28(1.24)	0.013
<i>One DV Law</i>	2	3.58(0.14)	
<i>Two DV Laws</i>	3	1.88(0.66)	
<i>Four DV Laws</i>	3	1.61(0.39)	
<i>Coefficient = -0.46</i>			

*Welch t-test

**Linear Regression

Table 4. Results of Bivariate Model for DV Firearm Laws and Cumulative 5-year Firearm-related IPH Rate

Cumulative Firearm-related IPH Rate			
	<i>Mean</i>	<i>SD</i>	<i>p-value</i>
State DV Firearm Laws*			
<i>None (n=9)</i>	1.91	0.5	0.001*
<i>One DV Law (n=2)</i>	2.28	0.04	
<i>Two DV Laws (n=2)</i>	1.01	0.21	
<i>Four DV Laws (n=3)</i>	0.65	0.42	
<i>Coefficient = -0.33</i>			

*Linear regression

Figure 1. Results of Bivariate Linear Regression for Batterer Intervention Program (BIPs) Availability and 5-year overall cumulative IPH Rate

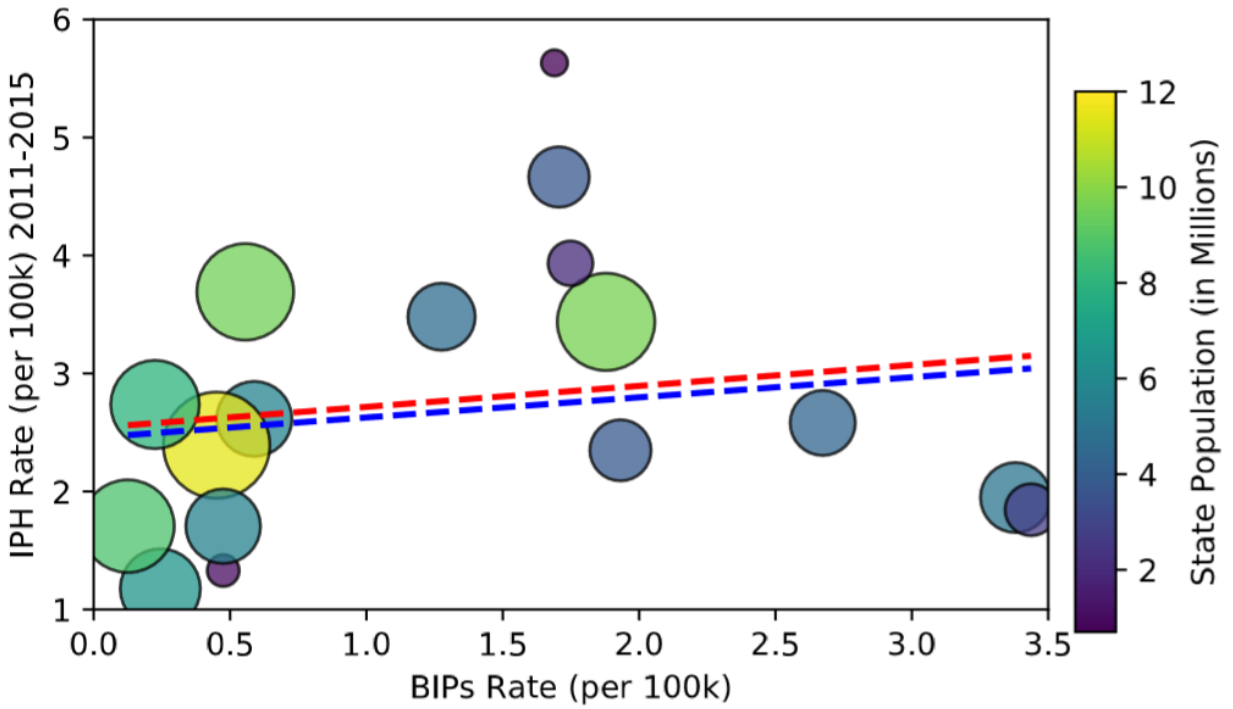


Figure 2. Boxplots of High and Low Availability Batterer Intervention Program (BIPs) and Total IPH Rate

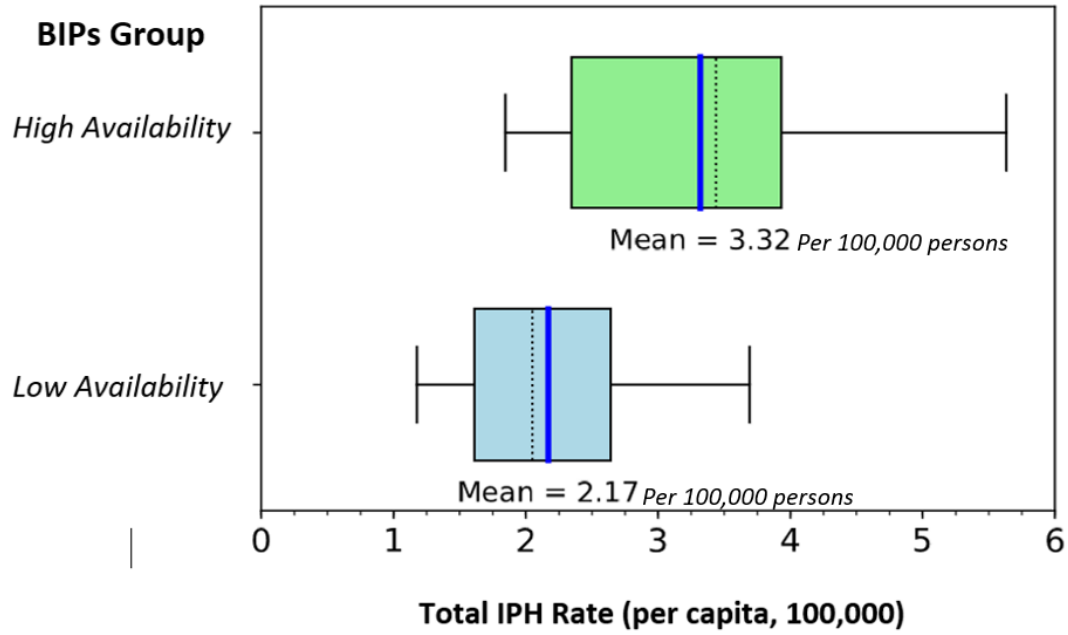


Figure 3. Results of Bivariate Linear Regression for DV Firearm Law and 5-year overall cumulative IPH Rate

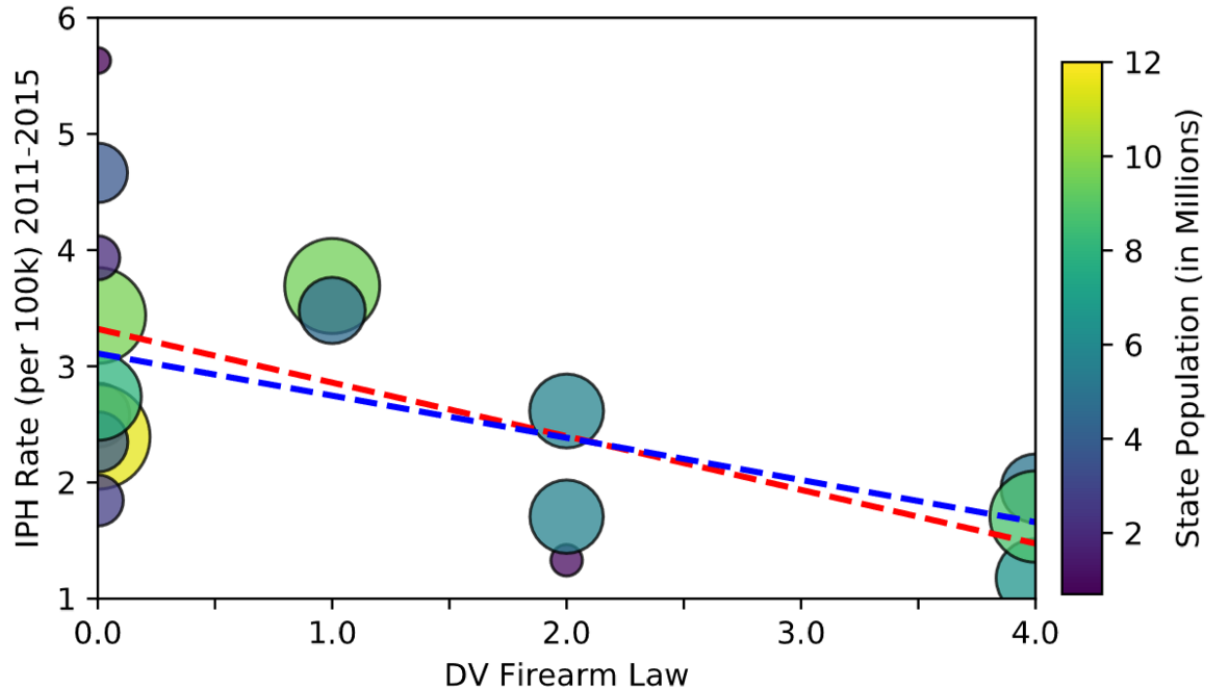
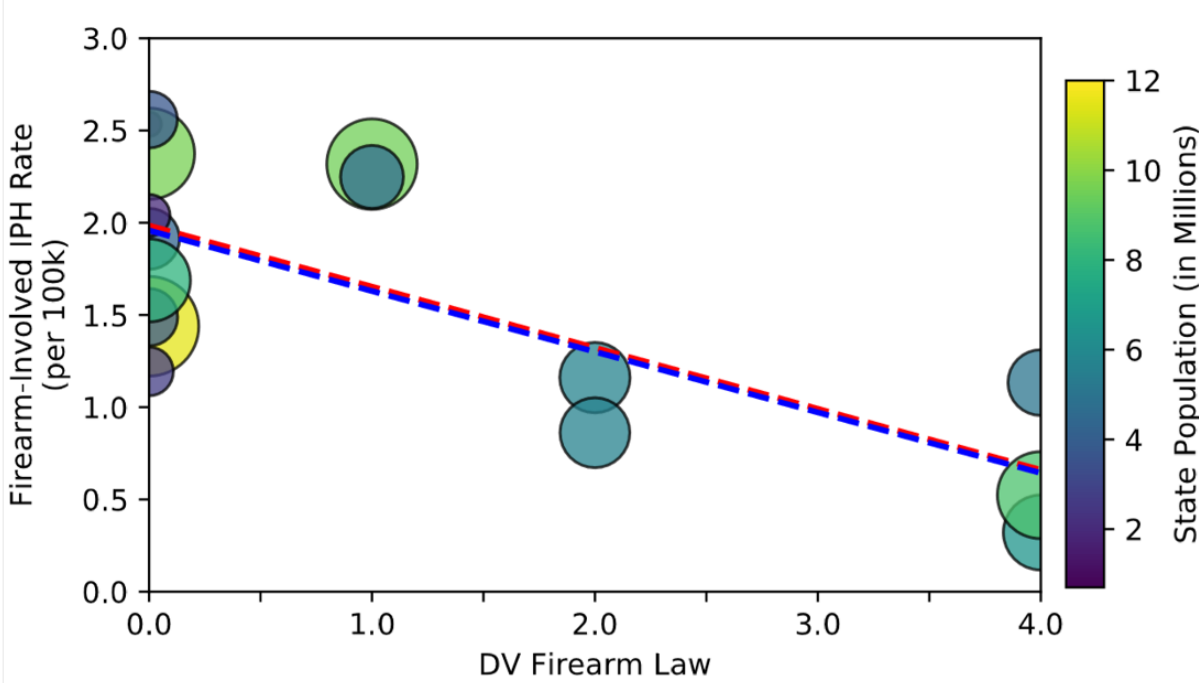


Figure 4. Results of Bivariate Linear Regression for DV Firearm Law and 5-year cumulative Firearm-related IPH Rate



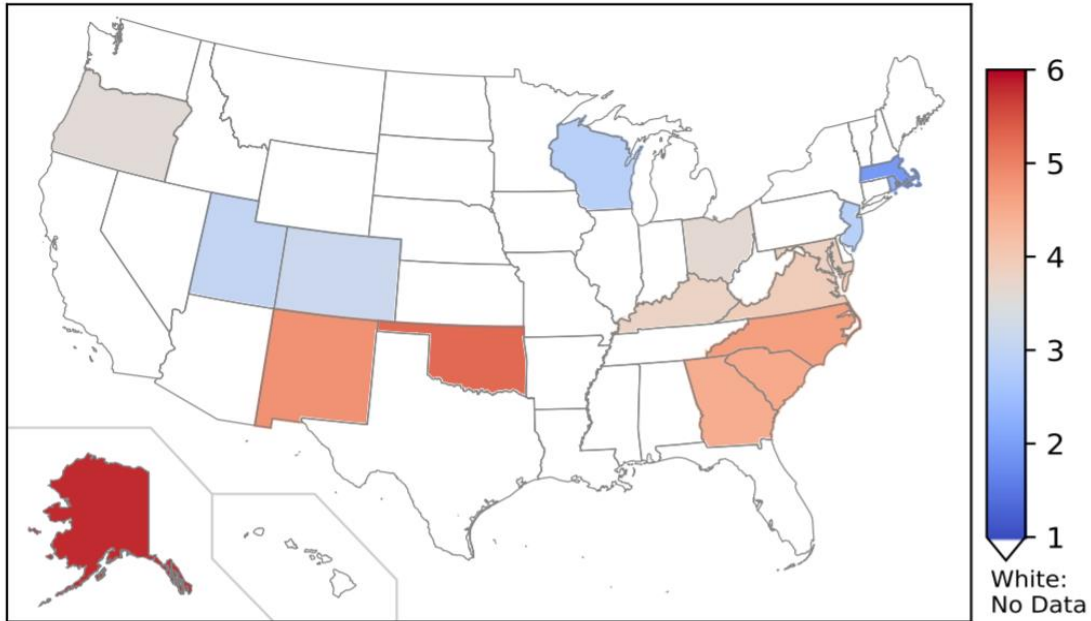
Appendix

Appendix, Table 1. Domestic Violence Firearm Laws in (n=17) US States, 2011-2015

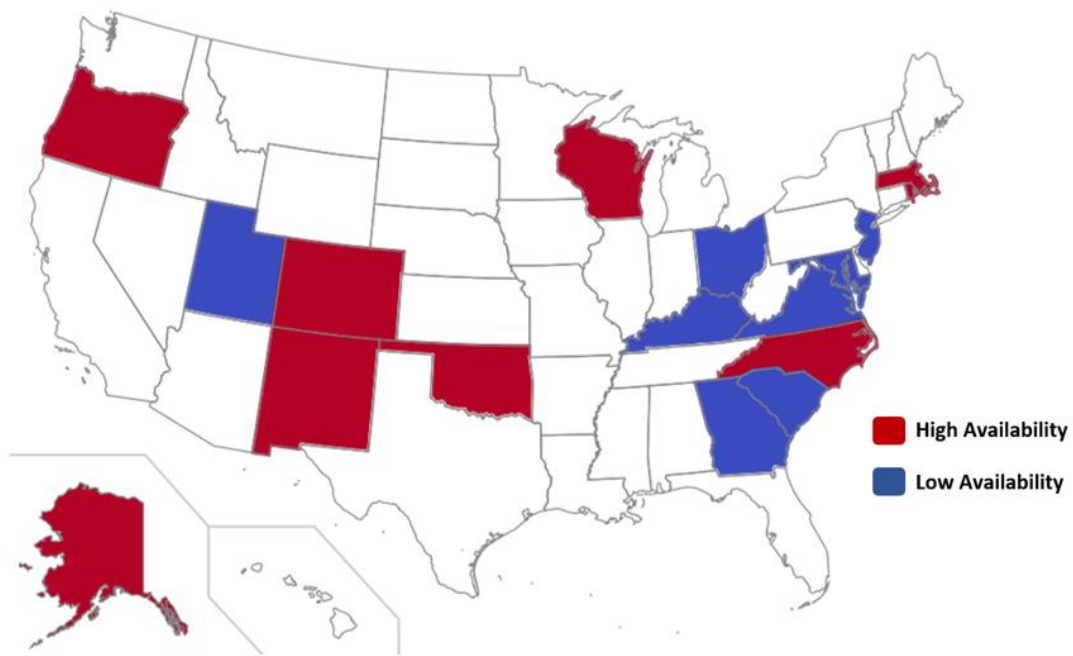
State	Stalkers	DV Mis-demeanants	DV Protective Orders	Background Checks	Total DV Firearm Laws
Alaska					0
Colorado	✓	✓	✓	✓	4
Georgia					0
Kentucky					0
Massachusetts	✓	✓	✓	✓	4
Maryland	✓		✓		2
North Carolina			✓		1
New Jersey	✓	✓	✓	✓	4
New Mexico					0
Ohio					0
Oklahoma					0
Oregon					0
Rhode Island	✓			✓	2
South Carolina	✓				1
Utah					0
Virginia					0
Wisconsin	✓		✓		2

Source: Gun Law Factsheets | Giffords Law Center to Prevent Gun Violence. (n.d.). Retrieved from <http://lawcenter.giffords.org/resources/factsheets/>

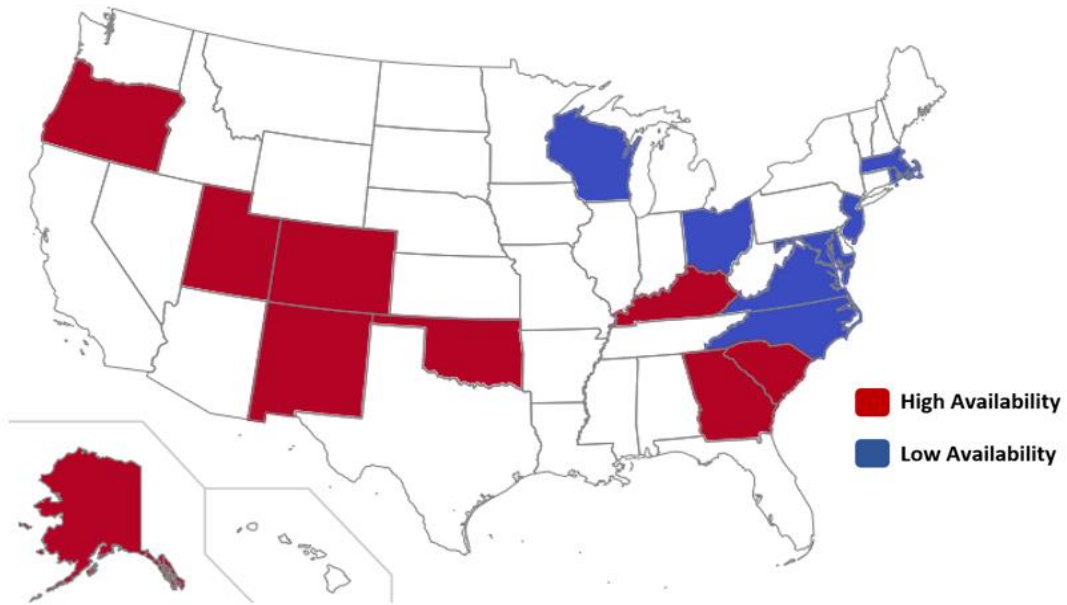
Appendix, Figure 1a. Variation in 5-year overall IPH Rates for 17 US States, 2011-2015



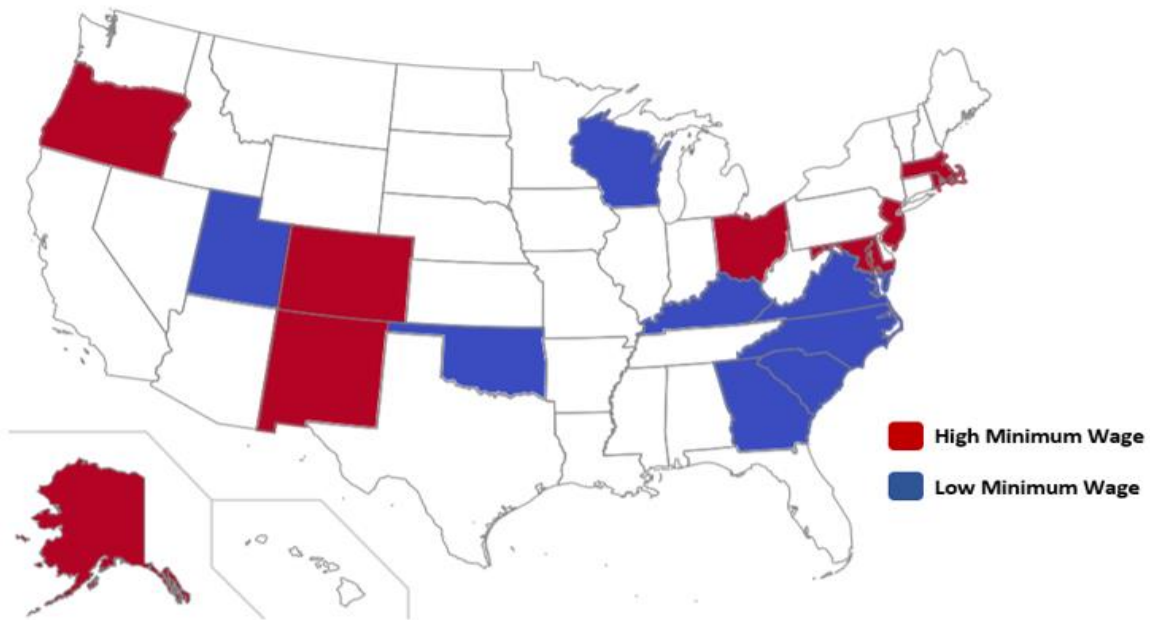
Appendix, Figure 1b. Per Capita Domestic Violence Shelter Availability, High and Low Availability States (2017) (n=17)



Appendix, Figure 1c. Per Capita Batterer Intervention Program (BIPs) Availability,
High and Low Availability States (2017) (n=17)



Appendix, Figure 1d. Average Minimum Wage, by High and Low Minimum Wage
Groups (2011-2015) (n=16)



Appendix, Figure 1e. Average Annual Household Income, by High and Low

Income Groups (2011-2015) (n=17)

