Published in final edited form as:
Violence Vict. 2010 ; 25(3): 363–377.

Area Disadvantage and Intimate Partner Homicide: An Ecological Analysis of North Carolina Counties, 2004–2006

Aubrey Spriggs Madkour, Ph.D.[a], **Sandra L. Martin, Ph.D.**[b], **Carolyn Tucker Halpern, Ph.D.**[b], and **Victor J. Schoenbach, Ph.D.**[c]

[a]Department of Community Health Sciences, Tulane University School of Public Health & Tropical Medicine

[b]Department of Maternal and Child Health, University of North Carolina at Chapel Hill

[c]Department of Epidemiology, University of North Carolina at Chapel Hill

Abstract

Using data from the North Carolina Violent Death Reporting System and other sources, we examined ecologic relationships between county (n=100) disadvantage and intimate partner homicide (IPH), variability by victim gender and county urbanicity, and potential mediators. County disadvantage was related to female-victim homicide only in metropolitan counties (incidence rate ratio [IRR] 1.25); however, disadvantage was associated with male-victim IPH regardless of county urbanicity (IRR 1.17). None of the potential intervening variables examined (shelter availability, intimate partner violence services' funding), was supported as a mediator. Results suggest disparities across North Carolina counties in IPH according to county disadvantage. Future research should explore other potential mediators (i.e., service accessibility and law enforcement responses), as well as test the robustness of findings using additional years of data.

Keywords

gender; domestic violence; socioeconomic status; prevention

INTRODUCTION

Intimate partner violence (IPV) is defined as violence or threat of violence in a close relationship, including current or former spouses and dating partners (National Center for Injury Prevention and Control, 2006). Data from the 1995 National Violence Against Women Survey estimated women age 18 and older experience 4.8 million intimate partner assaults annually, while adult men experience 2.9 million such assaults (Tjaden & Thoennes, 2000). The CDC estimated that the costs of IPV against women in 1995 exceeded $5.8 billion, including nearly $4.1 billion in the direct costs of medical and mental health care and nearly $1.8 billion in the indirect costs of lost productivity (National Center for Injury Prevention and Control, 2003). Although no similar total cost estimates are available for male victims, another study found the average per-person cost of physical victimization for women was more than twice the cost of physical victimization for men (Arias & Corso, 2005). Given the prevalence and associated costs, intimate partner violence has been recognized as a major public health problem.

Correspondence to: Aubrey L. Spriggs, Ph.D., Assistant Professor, Department of Community Health Sciences, Tulane University School of Public Health and Tropical Medicine, 1440 Canal Street, TW-19, New Orleans, LA 70112, phone: (504) 988-1127, aspriggs@tulane.edu.

The most severe consequence of intimate partner violence is intimate partner homicide. From 1976 to 2005, about 11% of homicide victims were killed by an intimate partner (Fox & Zawitz, 2004). In 2005, 329 males and 1,181 females in the U.S. were killed by an intimate partner (Fox & Zawitz, 2007). There was a decrease in the number of intimate partner homicides between 1976 and 2005, but this decrease was greater for males than for females (Catalano, 2006; Puzone, Saltzman, Kresnow, Thompson, & Mercy, 2000). Rates of intimate partner homicide also declined in the last two decades for most partner types. Using data from the FBI's Supplemental Homicide Report data file, Puzone et al. (2000) found that between 1976 and 1995, the rate of homicide per 100,000 population declined significantly for wives (1.79 to 1.05), husbands (1.61 to 0.40), and boyfriends (1.55 to 0.50) but not for girlfriends (1.34 to 1.06) (Puzone et al., 2000).

There are many recognized risk factors for intimate partner homicide, including prior domestic violence, access to guns, estrangement or relationship breakup, having stepchildren, alcohol abuse, prior forced sex, threats to kill, and nonfatal strangulation (Campbell, Glass, Sharps, Laughon, & Bloom, 2007). Intimate partner homicide also has been related to contextual disadvantage (i.e., spatial concentration of poverty, unemployment, female-headed households, low education, public assistance receipt), but inconsistently across studies. Examining data from female-victim intimate partner homicides in Chicago between 1965–1995, Browning (2002) found neighborhood concentrated disadvantage was positively associated with such homicide rates (Browning, 2002). In another study using data from a large city, Frye and Wilt (2001) analyzed medical examiner data on female homicides in New York City between 1990 and 1997, finding that neighborhood socioeconomic status (SES) was negatively associated with intimate partner femicide rates (Frye & Wilt, 2001). Grana (2001) compared rates of domestic femicide across 32 states. The author found that in unadjusted analyses, the state poverty rate was significantly positively associated with the state's domestic femicide rate (Grana, 2001). However, after controlling for the proportion of the population that was Black, the proportion of young persons in the population, and south/non-south state location, the point estimate became nonsignificant. It is unclear how to interpret such findings, however, because adjustment for these factors had only a small effect on the magnitude of the point estimate itself, although precision decreased so that one could no longer be confident that the estimate was different from zero. Additionally, a theoretical explanation for adjusting for the percentage of the population which was Black was lacking.

Although these studies provide some information regarding the relationship between concentrated disadvantage and intimate partner homicide, a number of gaps in research remain. First, all noted studies focused on intimate partner femicide and did not explore how concentrated disadvantage may be related to females' killing their male partners. Given findings indicating couple-level economic status may be more closely related to male partner murder (Dugan, Nagin, & Rosenfeld, 1999), the relationship between concentrated disadvantage and female-perpetrated partner homicide should be explored further. Second, two of the three studies cited focused on large cities, while the other examined differences between states. Although one study found concentrated disadvantage to be related to general violent crime in non-metropolitan counties (Bouffard & Muftic, 2006), how concentrated disadvantage is related to intimate partner homicide in non-urban counties has not yet been explored. Because of differences between urban and rural communities in the use of informal versus formal social controls, population heterogeneity and density, as well as overall levels of extreme poverty (i.e., higher in rural compared to urban centers) (Bouffard & Muftic, 2006), the relationship between community characteristics and within-family crime may also differ. Further, it is unclear whether the state-level analysis performed by Grana would capture the relationship between area disadvantage and intimate partner homicide because social disorganization theory (described in detail below) is premised on the concept of informal social controls exerted at the local level.

Intimate partner homicide is "commonly the culmination of ongoing violence in the relationship (p. 190)"(Dugan et al., 1999). Further, the sparse evidence that is available on female-perpetrated intimate partner homicide suggests that the murder of a male by his female partner is often precipitated by abuse instigated by the male (Dugan et al., 1999). Therefore interventions targeting recognition of and intervention on abusive relationships have been the focus of most partner homicide prevention efforts. Changes in criminal justice responses to partner violence incidents, as well as the increase in victims' services, are believed to be at least partially responsible for the dramatic decrease in partner violence rates since the mid-1970s (Dugan et al., 1999; Dugan, Rosenfeld, & Nagin, 2003). However, such services, especially shelter services, are not equitably distributed across all communities. Tiefenthaler, Farmer and Sambria (2005), for example, found that services for victims of intimate partner violence were much more likely to be located in counties which were affluent and housed a major university (Tiefenthaler, Farmer, & Sambira, 2005). Therefore one mechanism by which community disadvantage may impact intimate partner homicide rates is through this differential distribution of preventive services.

This analysis will draw upon social disorganization theory in exploring how community contexts relate to intimate partner homicide. According to this theory, communities that are characterized by fewer material and structural resources are not as effective as those with more resources in regulating residents' behavior (Sampson, 1997; Sampson, Raudenbush, & Earls, 1997). That is, because residents in these communities have less time and fewer resources to invest in their relationships with one another and in local social institutions, concentrated disadvantage is thought to affect neighbors' ability to build mutual good will and trust (Sampson, Morenoff, & Gannon-Rowley, 2002). This lack of social capital in turn affects the willingness and ability of residents to intervene when they observe unacceptable behavior, as well as residents' ability to collectively lobby social institutions and the larger society for needed resources (Taylor, 1997). Social disorganization theory, as a general theory of deviance, suggests that concentrated disadvantage should be positively associated with violent crimes (including intimate partner homicide) across communities, despite their relative urbanicity. Therefore, it is expected that the rates of partner homicide in North Carolina counties will be positively associated with county concentrated disadvantage regardless of county urbanicity. Further, it is expected that this association will be at least partially mediated by the availability of domestic violence shelter services in the county.

METHODS

Data

Multiple data sources were utilized. First, data from the restricted use North Carolina Violent Death Reporting System (NC-VDRS) were employed. The NC-VDRS database is a repository for information on violent deaths (i.e., deaths involving "the intentional use of physical force or power against oneself, another person, or against a group or community") (Sanford et al., 2006) collected by multiple NC government agencies, including the State Department of Health (death certificates), law enforcement (incident and investigatory reports), and the state medical examiner (autopsy reports). Data include information on victims, suspected perpetrators, the manner of death, as well as the circumstances surrounding the death. Trained abstracters identify eligible incidents by matching death certificates and medical examiner information using manner of death and ICD-10 codes selected by the National Violent Death Reporting System. These abstracters then also review relevant records from the other NC database sources. Data on violent deaths in North Carolina have been collected since January 1, 2004. Data regarding NC county population and sociodemographic characteristics were derived from the 2000 decennial Census. Finally, data on North Carolina domestic violence services were provided by the North Carolina Council for Women / Domestic Violence Commission

(NCCFW). NCCFW conducts an annual survey of state domestic violence programs in which agency directors provide information on types and counts of services provided during the prior year. Additionally, Leslie Starsoneck, an independent consultant and former director of NCCFW, provided county-level data on total funding for domestic violence services received from Federal and State funding streams, derived from a review of public databases and legislation (Starsoneck, 2008).

Measures

The main outcome variable, county intimate partner homicide incidence rate, was derived based on deaths in NC-VDRS between 2004–2006 and inter-census county population estimates for years 2004–2006 published by the Census Bureau. An NC-VDRS death was defined as an intimate partner homicide if the victim-to-suspect relationship on the initial law enforcement response to incident report was coded as "1=Spouse or other intimate partner (current or ex)." Other deaths that occurred in the same incident (e.g., child also killed, perpetrator commits suicide, witnesses killed) were not included. The number of such deaths was summed within each North Carolina county and aggregated across the years to mitigate the problem of small total numbers in some counties (e.g., there were 89 intimate partner violence homicides in all of North Carolina in 2005). County rates were derived by dividing the number of deaths identified between 2004–2006 by the sum of the 2004–2006 midyear county population estimates. Rates were calculated separately by gender.

The main predictor variable, county disadvantage, was derived from a number of variables available in the 2000 Census. Consistent with past studies of social disorganization, these variables included proportion of households below the poverty line, proportion of female-headed households, proportion of households receiving public assistance, proportion of individuals aged 25+ without a high school diploma, and unemployment rate (Browning, 2002; Cunradi, Caetano, Clark, & Schafer, 2000; De Coster, Heimer, & Wittrock, 2006; Wight, Botticello, & Aneshensel, 2006). Racial/ethnic composition was not included because of the need to distinguish between economic and other sources of disadvantage (Massey, 1998). Principal components analysis was conducted at the county level to generate the county disadvantage score (i.e., loadings on the first principal component were used as item weights). Examination of factor scores and scree plots supported a single-factor solution.

One moderator variable, county urbanicity, was based on the United States Department of Agriculture (USDA) Urban-Rural Continuum Codes (United States Department of Agriculture, 2003). These codes form a classification scheme that distinguishes metropolitan (metro) counties by the population size of their metro area, and nonmetropolitan (nonmetro) counties by degree of urbanization and adjacency to a metro area or areas.[1] The metro and nonmetro categories have been subdivided into three metro and six nonmetro groupings, resulting in a nine-part county codification. The codes allow finer residential groupings beyond a simple metro-nonmetro dichotomy. Such codes have been used in other analyses of trends in intimate partner homicide over time (Gallup-Black, 2005). As in previous analyses of this question (Gallup-Black, 2005), categories were combined (urban metropolitan, urban non-metropolitan, rural) based on few counties being in certain levels.

Mediator variables were constructed using the data from NCCW. These included (all at the county level): a dichotomous indicator for whether a domestic violence shelter was available

[1]The Census Bureau defines an urbanized area wherever it finds an urban nucleus of 50,000 or more people. They may or may not contain any individual cities of 50,000 or more (152 currently do not). In general, they must have a core with a population density of 1,000 persons per square mile and may contain adjoining territory with at least 500 persons per square mile. Metro areas are defined for all urbanized areas regardless of total area population. In addition, inclusion as an outlying county is based on a single commuting threshold of 25 percent with no "metropolitan character" requirement.

in the county, per capita funding for domestic violence services (average across 2004–2006), number of days the shelter was full to capacity (2004–05), and number of referrals made to other shelters due to a shelter's being full (2004–05). The last two variables characterize the extent to which demand for shelter services is greater than the available services. Variables were examined both in continuous as well as categorical formats (i.e., quartiles) to explore possible non-linear relationships with homicide rates.

A number of control variables were also included in the analysis. The percentage of the population between the ages of 20–40 years was included, since young adulthood is the life stage when the incidence of partner violence is at its highest (Greenfeld et al., 1998). Also, county female-to-male sex ratio of persons age 15 and older was included. Sex ratio imbalances – in particular, having a shortage of "marriageable males" – have been associated with higher divorce rates, marital discord, teenage pregnancy, as well as with international differences in rates of violent crime (Barber, 2000; Secord, 1983; Wilson, 1990). Further, women tend to tolerate "bad behavior" (i.e., sex partner concurrency) from their partners when there is a perceived lack of partner choices (Adimora et al., 2001). Both linear and quadratic forms of the female-to-male sex ratio were included in models to allow for possible nonlinearities in the relationship.

Analyses

All analyses were conducted in Stata 9.2. Poisson regression models with population offset terms were employed to examine both the crude and adjusted relationships between county disadvantage and gender-specific intimate partner homicide rates. Interactions between county disadvantage and county urbanicity were included to test for differential effects of county disadvantage by county urbanicity. A high alpha level was used to test these interactions ($\alpha<0.20$) given the low power of these significance tests (Selvin, 2004). Mediation was empirically examined with the Baron and Kenny logical criteria for mediation (Baron & Kenny, 1986) as well as Sobel tests for mediation (Sobel, 1982).

RESULTS

Descriptive Results

Characteristics of intimate partner homicide decedents in North Carolina between 2004–06 (n=247) are presented in Table 1. The majority of victims were female (69.6%). The largest racial group represented was Whites (53.4%), followed by Blacks (42.5%), and Others (4.1%). About 5% of the victims were recorded as being of Hispanic ethnicity. The majority of suspected perpetrators were current or former boyfriends or girlfriends (54.7%), as opposed to current or former spouses (45.3%). The average victim age was 38.7 years, ranging from 15 to 84 years. The crude number of intimate partner homicides increased between 2004–05 then decreased between 2005–06; however, the rates decreased slightly between years.

Characteristics of North Carolina counties are presented in Table 2. Cumulatively across 2004–06, the average annual county intimate partner homicide rate per 100,000 population was 1.1 overall, 0.8 for female victims, and 0.3 for male victims. The average proportion of counties' population between ages 20–40 in 2000 was 27.5%, and the mean female-to-male sex ratio (multiplied by 100) for persons age 15 and above was 107.0. About three-quarters of counties had at least one shelter located within their boundaries. Average per capita Federal and state funding for intimate partner violence services varied widely between counties, with an interquartile range of $1.4 – $5.0.

Table 3 presents counties' disadvantage characteristics, both overall and separately by quartile of county disadvantage. Overall, counties' average median income was $34,900; percent below

poverty was 14.3%; percent of family households that were female-headed was 9.8%; percent unemployed was 4.4%; percent on public assistance was 3.2%; and percent of adults with less than a high school education was 26.0%. The disadvantage score derived from principal components analysis followed a standard normal distribution (mean=0, standard deviation=1). Average family income was negatively related to county disadvantage; all other indicators, except percentage of family households that were female-headed, were positively related to county disadvantage. Percentage of family households that were female-headed was maintained in the overall disadvantage score, however, for theoretical reasons and to be consistent with past studies of area disadvantage.

Female-Victim Model Results

Results (incidence rate ratios and 95% confidence intervals) for female-victim Poisson regression models are presented in Table 4. In the first model, multiple tests were conducted to assess overdispersion in the data; since none of the tests supported overdispersion, Poisson models were deemed appropriate. In the second model, the crude relationship between county disadvantage and female-victim intimate partner homicide is positive and statistically significant: a one standard deviation increase in the county disadvantage score is associated with a 12% higher female-victim intimate partner homicide rate. Supplementary models run using a categorical specification of county disadvantage (i.e., quintiles, quartiles, or tertiles) did not suggest non-linearity in this association. In the third model, all control variables were entered as well as interactions between county urbanicity and disadvantage. Interactions suggested that county disadvantage is significantly positively related to female-victim intimate partner homicide in metropolitan counties with an urban center (IRR 1.25, 95% CI 1.10 – 1.42), but unrelated to female-victim intimate partner homicide in non-metropolitan counties with an urban area (IRR 1.08, 95% CI 0.93 – 1.23) and rural counties (IRR 0.88, 95% CI 0.46–1.29). In subsequent models, service availability and funding mediators were examined using the Baron and Kenney criteria and Sobel tests. Some of these variables were related to both county disadvantage and female-victim homicide in crude tests (per capita funding for domestic violence services and number of shelter referrals made). However, adding these variables to the full model did not alter disadvantage effect estimates, and Sobel tests for mediation were non-significant. As such, we concluded none of these variables mediated the association between county disadvantage and female-victim homicide.

Male-Victim Model Results

Results (incidence rate ratios and 95% confidence intervals) for male-victim Poisson regression models are presented in Table 5. As with female victims, tests conducted for male victims using a null model do not suggest overdispersion, thus supporting use of a Poisson model. Results from the crude model (model 2) support a positive and statistically significant relationship between county disadvantage and male-victim intimate partner homicide rates: a one standard deviation increase in county disadvantage score is associated with a 12% higher male-victim homicide rate. Supplementary models run using categorical specifications of county disadvantage (i.e., quintiles, quartiles, or tertiles) did not suggest non-linearity in this association. In model 3, all control variables as well as interactions between county disadvantage and urbanicity were entered; however, because no interactions were significant even at a high p-value level (0.20), these interactions were dropped in model 4. Controlling for county demographic characteristics resulted in a stronger effect estimate for county disadvantage compared to the crude model: a one standard deviation increase in county disadvantage was associated with a 17% higher incidence rate for male-victim homicide. Although this effect estimate did lose some precision relative to the crude model, it remained statistically significant at the 0.05 level. In contrast to female-victim intimate partner homicide, none of the service availability or funding variables examined was significantly related to male-

victim intimate partner homicide even in crude analyses; thus we concluded none was supported as a mediator.

DISCUSSION

Previous studies suggest that area disadvantage is positively related to female-victim intimate partner homicide. However, small-area studies have been limited to large urban centers (i.e., Chicago and New York); further, no studies to date have examined the relationship between area disadvantage and male-victim intimate partner homicide. The purpose of this study was to address these gaps in the literature, contribute knowledge regarding socioeconomic disparities in intimate partner homicide across North Carolina counties, and explore possible mechanisms for any such disparities. There are four major findings in this study.

First, county disadvantage appears positively related to female-victim homicide, but only in metropolitan counties with an urban core. This finding is consistent with past studies in urban areas which have found a positive relationship between area disadvantage and female-victim homicide at smaller geographic levels (Browning, 2002; Frye & Wilt, 2001), but contributes new knowledge regarding this relationship outside of densely urban areas. Although we are unsure of the reason for differences by urbanicity, it is possible that variability in disadvantage is more strongly related to service availability or police responses in metropolitan counties with urban cores. As pointed out by other authors, there also are differences in population density and culture across the urban-rural continuum (Bouffard & Muftic, 2006), which also could account for these differences.

Our second finding is that the availability of shelter services and funding for domestic violence services do not appear to mediate the relationship between county disadvantage and female-victim IPH in metro counties. This finding was unexpected, given past research documenting a negative relationship between county disadvantage and shelter service availability (Tiefenthaler et al., 2005), and research documenting a connection between increased victims' services availability and declining rates of male-victim intimate partner homicide (Dugan et al., 1999; Dugan et al., 2003). There are a number of possible reasons for this null finding. First, it is possible that although services are available, limited accessibility may hinder their use by vulnerable groups. Measures of such accessibility, including adequate outreach and connection to other community agencies and health care providers, flexible accommodation of victims' children and pets, as well as cultural and linguistic competence of shelter staff could all affect whether available services are accessed (Faver & Strand, 2003; Grigsby & Hartman, 1997; Violence Working Group, 2002). Another possibility is that measuring services availability and funding in the same years we are examining intimate partner homicide prevents our ability to detect lagged effects. As future years of NC-VDRS data become available, it will be important to examine this possibility. Finally, it is also plausible that other factors, such as timely and appropriate police response to prior domestic violence incidents or availability/accessibility of legal advocacy services, are also important mediators of this relationship. Further research is warranted examining these potential pathways.

Our third finding is that county disadvantage is also related to male-victim intimate partner homicide consistently across county urbanicity. This is consistent with past individual-level research which has found socioeconomic status strongly related to male-partner murder, because females with low socioeconomic status may be more likely to believe there is no other escape from abuse than through the killing of the male partner (Dugan et al., 1999).

Finally, our analysis also did not support any of the included service availability or service funding variables as possible mediators of the relationship between county disadvantage and male-victim intimate partner homicide. In addition to the reasons cited for lack of findings

among female-victims, there are unique reasons why these variables may be unrelated to male-victim IPH. Male-victim intimate partner homicide likely reflects two different types of pre-existing partner violence: one in which the male is a perpetrator against his female partner, and one in which the violence is unidirectional, female against male. Although research suggests male-victim intimate partner homicide often results from the former type of pre-existing condition (Dugan et al., 1999), not all such homicides do. In the cases where the pre-existing partner violence is unidirectional female-against-male, it is unlikely that availability of shelter services would affect subsequent male-victim homicide, since shelter services are largely unavailable to male victims (Douglas & Hines, 2008; Hines, Brown, & Dunning, 2007). Therefore the mixture of these two types of male-victim homicide may hamper our ability to detect an association between shelter services' availability and male-victim homicide. Future research that can distinguish between these two types is needed to further examine mediational pathways.

Although this study has many strengths, including the use of a statewide registry of violent deaths and statewide annually-collected intimate partner violence services data, a number of limitations must also be acknowledged. First, although we have reported relations and associations, the ability to draw causal inferences is constrained by the fact that all of our data are ecologic. Multilevel data would provide stronger evidence that the relation between concentrated disadvantage and intimate partner homicide is causal. Second, intimate partner homicide is a rare event, especially for male victims. We averaged annual rates across three years to reduce estimates' instability; confidence limit ratios for the disadvantage effect estimates were 1.29 for female-victim homicides, and 1.32 for male-victim homicides, indicating relatively good precision. However, since 76% of counties experienced only 0–2 female deaths and 92% experienced 0–2 male deaths cumulatively during the study years, repeating analyses with data for additional years or additional states would increase confidence in the results. This could be accomplished when more years of data have accumulated in the NC-VDRS, or by using data from other states that have been participating longer in the National Violent Death Reporting System. A third limitation is the lag between when our disadvantage index was measured (2000) and the years when the deaths took place (2004–05). If counties rapidly changed during the intervening years on some of the indicators included in the disadvantage index, the index may not reflect counties' disadvantage at the time the intimate partner homicides occurred. However, since this lag is relatively short, we believe it is unlikely that county-level demographic characteristics would change sufficiently to affect counties' disadvantage score. A fourth limitation is our measurement of services may not adequately portray the availability or the breadth in both type and quality of services provided in each county. Data on number of beds per shelter were not collected by NCCFW until 2008; therefore we were unable to characterize beds per capita in each county during the study years. Further, domestic violence agencies in North Carolina must provide a hotline, shelter (or referrals to a shelter), advocacy, community education, and individual and group counseling in order to be eligible for state funding. Although beyond the scope of this paper, it is possible that synergies between these services (or their quality) are what explain the relationship between county disadvantage and intimate partner homicide. Finally, the NC-VDRS may under-ascertain or incorrectly identify intimate partner homicide, since information on the victim-to-suspect relationship derives from the initial incident response report by law enforcement (Biroscak, Smith, & Post, 2006; Paulozzi, Saltzman, Thompson, & Holmgreen, 2001). At the time of this initial report, the identity of the perpetrator will often not be known, and a suspected perpetrator may be cleared in subsequent investigations. Future research linking NC-VDRS data with conviction data may help identify new incidents or de-identify some incidents currently included in the analysis.

In the present analysis, county disadvantage was found to be related to female-victim intimate partner homicide only in metropolitan counties with an urban core, and to male-victim intimate

partner homicide regardless of county urbanicity. Further, victims' service availability and funding did not appear to mediate the relationship between county disadvantage and intimate partner homicide for either gender. Results suggest some disparities in intimate partner homicide across North Carolina counties according to county disadvantage. Further research is warranted regarding the mechanisms underlying these disparities. As suggested above, separating out male-victim intimate partner homicides by prior abuse history could result in different conclusions regarding the mediating role of victims' services availability. However, further exploration of other mediating mechanisms is warranted, including an examination of service accessibility as well as law enforcement responses to prior incidents. Finally, replicating analyses using different geographic units (i.e., different states, smaller geographic units within North Carolina) could also shed light on the generalizeability of findings, as well as the appropriate geographic unit on which analyses should be conducted.

Acknowledgments

This paper uses data from the North Carolina Violent Death Reporting System (NC-VDRS), which is operated by the NC Department of Health and Human Services Division of Public Health Injury and Violence Prevention Branch. It is funded by the National Center for Injury Prevention and Control at the Centers for Disease Control and Prevention, Cooperative Agreement U17CCU423098. Special thanks are due Tammy Norwood at the NC Department of Health and Human Services, who provided initial insights to the variables available in the NC-VDRS as well as guidance during the data request process. We also acknowledge Tara Minter at the North Carolina Council for Women / Domestic Violence Coalition (NCCFW), who generously shared domestic violence services survey data. Finally, we thank Leslie Starsoneck, independent consultant and former Director of the NCCFW, who shared data she had collected regarding county levels of domestic violence services funding, and who provided feedback on manuscript drafts.

Dr. Spriggs' time on this project was supported by the Carolina Population Center, NICHD NRSA predoctoral traineeship, grant number NIH-NICHD T32-HD07168. An earlier version of this manuscript was included as part of Dr. Spriggs' dissertation at the University of North Carolina at Chapel Hill.

REFERENCES

Adimora AA, Schoenbach VJ, Martinson FE, Donaldson KH, Fullilove RE, Aral SO. Social context of sexual relationships among rural African Americans. Sex Transm Dis 2001;28(2):69–76. [PubMed: 11234788]

Arias I, Corso P. Average cost per person victimized by an intimate partner of the opposite gender: A comparison of men and women. Violence and Victims 2005;20(4):379–391. [PubMed: 16250406]

Barber N. The sex ratio as a predictor of cross-national variation in violent crime. Cross-Cultural Research 2000;34(3):264–282.

Baron RM, Kenny DA. The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. Journal of Personality and Social Psychology 1986;51:1173–1182. [PubMed: 3806354]

Biroscak BJ, Smith PK, Post LA. A practical approach to public health surveillance of violent deaths related to intimate partner relationships. Public Health Reports 2006;121(4):393–399. [PubMed: 16827440]

Bouffard LA, Muftic LR. The "rural mystique": Social disorganization and violence beyond urban communities. Western Criminology Review 2006;7(3):56–66.

Browning CR. The span of collective efficacy: Extending social disorganization theory to partner violence. Journal of Marriage and the Family 2002;64(4):833–850.

Campbell JC, Glass N, Sharps PW, Laughon K, Bloom T. Intimate partner homicide - Review and implications of research and policy. Trauma Violence & Abuse 2007;8(3):246–269.

Catalano, S. Intimate Partner Violence in the United States. 2006 [Retrieved October 19, 2007]. from http://www.ojp.usdoj.gov/bjs/intimate/ipv.htm

Cunradi CB, Caetano R, Clark C, Schafer J. Neighborhood poverty as a predictor of intimate partner violence among white, black, and Hispanic couples in the United States: A multilevel analysis. Annals of Epidemiology 2000;10(5):297–308. [PubMed: 10942878]

De Coster S, Heimer K, Wittrock SM. Neighborhood disadvantage, social capital, street context, and youth violence. Sociological Quarterly 2006;47(4):723–753.

Douglas, EM.; Hines, DA. Partner Violence Services for Underserved Populations: A National Sample of Domestic Violence Agencies; Paper presented at the International Faamily Violence and Childhood Victimization Research Conference; 2008.

Dugan L, Nagin DS, Rosenfeld M. Explaining the decline in intimate partner homicide: The effects of changing domesticity, women's status, and domestic violence resources. Homicide Studies 1999;3 (3):187.

Dugan L, Rosenfeld R, Nagin DS. Exposure reduction or retaliation? The effects of domestic violence resources on intimate-partner homicide. Law & Society Review 2003;37(1):169–198.

Faver CA, Strand EB. To Leave or to Stay?: Battered Women's Concern for Vulnerable Pets. J Interpers Violence 2003;18(12):1367–1377. [PubMed: 14678611]

Fox, J.; Zawitz, M. Homicide Trends in the United States. Washington, DC: US Department of Justice, Bureau of Justice Statistics; 2004.

Fox, J.; Zawitz, M. Homicide Trends in the United States. Washington, DC: US Department of Justice, Bureau of Justice Statistics; 2007.

Frye V, Wilt S. Femicide and social disorganization. Violence against Women 2001;7(3):335–351.

Gallup-Black A. Twenty years of rural and urban trends in family and intimate partner homicide - Does place matter? Homicide Studies 2005;9(2):149–173.

Grana SJ. Sociostructural considerations of domestic femicide. Journal of Family Violence 2001;16(4): 421–435.

Greenfeld, LA.; Rand, MR.; Craven, D.; Klaus, PA.; Perkins, CA.; Ringel, C., et al. Violence by Intimates: Analysis of Data on Crimes by Current or Former Spouses, Boyfriends, and Girlfriends. Washington, D.C: U.S. Department of Justice, Bureau of Justic Statistics; 1998.

Grigsby N, Hartman BR. The Barriers Model: An integrated strategy for intervention with battered women. Psychotherapy: Theory, Research, Practice, Training 1997;34(4):485–497.

Hines DA, Brown J, Dunning E. Characteristics of callers to the domestic abuse helpline for men. Journal of Family Violence 2007;22(2):63–72.

Massey DS. Back to the future: The rediscovery of neighborhood context. Contemporary Sociology 1998;27(6):570–572.

National Center for Injury Prevention and Control. Costs of Intimate Partner Violence Against Women in the United States. Atlanta, GA: Centers for Disease Control and Prevention; 2003.

National Center for Injury Prevention and Control. Intimate Partner Violence Fact Sheet. 2006 [Retrieved October 19, 2007]. from http://www.cdc.gov/ncipc/dvp/ipv_factsheet.pdf

Paulozzi LJ, Saltzman LE, Thompson MP, Holmgreen P. Surveillance for homicide among intimate partners ---United States, 1981--1998. Morbidity and Mortality Weekly Report 2001;50(SS03):1–16. [PubMed: 11215787]

Puzone CA, Saltzman LE, Kresnow M-J, Thompson MP, Mercy JA. National Trends in Intimate Partner Homicide: United States, 1976–1995. Violence Against Women 2000;6(4):409–426.

Sampson RJ. Collective regulation of adolescent misbehavior: Validation results from eighty Chicago neighborhoods. Journal of Adolescent Research 1997;12(2):227–244.

Sampson RJ, Morenoff JD, Gannon-Rowley T. Assessing "neighborhood effects": Social processes and new directions in research. Annual Review of Sociology 2002;28:443–478.

Sampson RJ, Raudenbush SW, Earls F. Neighborhoods and violent crime: A multilevel study of collective efficacy. Science 1997;277(5328):918–924. [PubMed: 9252316]

Sanford C, Marshall SW, Martin SL, Coyne-Beasley T, Waller AE, Cook PJ, et al. Deaths from violence in North Carolina, 2004: how deaths differ in females and males. Inj Prev 2006;12 suppl_2:ii10–ii16. [PubMed: 17170164]

Secord PF. Imbalanced Sex-Ratios - the Social-Consequences. Personality and Social Psychology Bulletin 1983;9(4):525–543.

Selvin, S. Statistical Analysis of Epidemiologic Data. New York City: Oxford University Press; 2004.

Sobel, ME. Asymptotic confidence intervals for indirect effects in structural equation models. In: Leinhardt, S., editor. Sociological Methodology. Washington, D.C.: American Sociological Association; 1982. p. 290-312.

Starsoneck, L. Public Funding Matrix. Spriggs, A., editor. Chapel Hill, NC: 2008.

Taylor RB. Social order and disorder of street blocks and neighborhoods: Ecology, microecology, and the systemic model of social disorganization. Journal of Research in Crime and Delinquency 1997;34 (1):113–155.

Tiefenthaler J, Farmer A, Sambira A. Services and intimate partner violence in the United States: A county-level analysis. Journal of Marriage & Family 2005;67(3):565–578.

Tjaden, P.; Thoennes, N. Extent, nature, and consequences of intimate partner violence: findings from the National Violence Against Women Survey. Washington, D.C: U.S. Department of Justice; 2000. (No. NCJ 181867)

United States Department of Agriculture. Measuring Rurality: Rural-Urban Continuum Codes, 2003. 2003 [Retrieved January 4, 2008]. from http://www.ers.usda.gov/Briefing/Rurality/ruralurbcon/

Violence Working Group. The North Carolina Domestic Violence Programs Survey: A Description of Service Provision Focused on Meeting the Needs of Special Populations. Chapel Hill, NC: IPRC, UNC Chapel Hill; 2002.

Wight RG, Botticello AL, Aneshensel CS. Socioeconomic context, social support, and adolescent mental health: A multilevel investigation. Journal of Youth and Adolescence 2006;35(1):115–126.

Wilson, WJ. The Truly Disadvantaged. Chicago: University of Chicago Press; 1990.

Table 1

Homicide Victim Characteristics, 2004–06 (n=247)

	N (%)
Gender	
Male	75 (30.4%)
Female	172 (69.6%)
Race	
White	132 (53.4%)
Black	105 (42.5%)
Other	10 (4.1%)
Hispanic	13 (5.3%)
Perpetrator	
Spouse/Ex-Spouse	112 (45.3%)
Girlfriend/Boyfriend, current or ex	135 (54.7%)
Year of death	
2004	77 (31.2%)
2005	88 (35.6%)
2006	82 (33.2%)
	Mean (SD)
Age, years	38.7 (13.7)

Table 2

North Carolina Counties (n=100): Intimate partner violence deaths 2004–06, partner violence services 2004–06, and Census characteristics 2000

	Mean (SD)	Median	Interquartile Range
Census characteristics, 2000			
Population, 2000 (thousands)	80.5 (108.1)	47.9	23.9 – 91.7
Percent population age 20–40	27.5 (3.9)	27.7	24.5 – 29.3
Female:Male sex ratio, ages 15 and above	107.0 (7.4)	106.8	104.2 – 111.3
Partner violence services, 2004–06			
Average annual per capita funding for IPV services	$3.6 ($3.1)	$2.8	$1.4 – $5.0
Average annual shelter days full	147.6 (236.0)	52.5	1.5 – 209.0
Average annual shelter referrals	19.4 (35.6)	6	0.0 – 28.0
Intimate partner homicide, 2004–06			
Total deaths per county	2.5 (3.3)	1	0 – 3
Female deaths per county	1.7 (2.3)	1	0 – 2
Male deaths per county	0.8 (1.3)	0	0 – 1
Overall county rate per 100,000 pop.	1.1 (0.9)	1.0	0 – 1.6
Female county rate	0.8 (0.9)	0.5	0 – 1.2
Male county rate	0.3 (0.5)	0.0	0 – 0.5
	N (%)		
Census characteristics			
Urbanicity			
Urban, metropolitan	40 (40%)	--	--
Urban, nonmetropolitan	39 (39%)		
Rural	21 (21%)		
Partner violence services			
Has a shelter in the county, 2008[a]	73 (73%)	--	--

[a] If shelter capacity in 2008 was recorded as being greater than zero, this was taken as an indicator of there being a shelter in the county. Shelter capacity information was first collected by NCCW in 2005–06, but many counties had missing data. The next year such data was available was 2008. Although capacity has changed in the intervening years, the location of shelters has not (personal communication with Tara Minter).

Table 3

Mean county disadvantage characteristics, overall and by disadvantage index quartile (n=100)

	Overall	Disadvantage Index Quartiles			
		Quartile 1	Quartile 2	Quartile 3	Quartile 4
Median income (thousands $)	34.9 (57.6)	41.8 (4.5)	36.6 (2.9)	32.0 (2.6)	29.1 (2.3)
Percent below poverty	14.3 (4.3)	9.8 (1.6)	12.2 (1.8)	15.4 (2.3)	19.9 (2.2)
Percent family households female-headed	9.8 (3.1)	8.3 (1.9)	8.9 (2.2)	8.4 (2.6)	13.5 (2.4)
Percent unemployed	4.4 (1.3)	3.2 (0.5)	3.9 (0.7)	4.6 (1.0)	5.9 (1.2)
Percent on public assistance	3.2 (1.4)	2.0 (0.4)	2.7 (0.5)	3.2 (0.7)	5.1 (1.0)
Percent adults with less than high school education	26.0 (6.3)	19.9 (5.4)	24.1 (5.3)	28.7 (3.5)	31.4 (3.4)

Table 4

Poisson regression results: Incidence rate ratios for female-victim intimate partner homicide, 2004–2006

	Incidence Rate Ratios (95% Confidence Intervals)		
	Model 1	**Model 2**	**Model 3**
Predictors			
Disadvantage		1.12 (1.04 – 1.20)**	1.25 (1.10 – 1.42)**
Percent Age 20–40			0.99 (0.95 – 1.04)
Sex ratio			1.45 (0.91 – 2.31)§
Sex ratio, squared			1.00 (1.00 – 1.00)
Urbanicity			
Urban, metro			Referent
Urban, nonmetro			0.78 (0.51 – 1.13)
Rural			0.98 (0.39 – 2.48)
Interactions			
Urban nonmetro*disadvantage			0.86 (0.72 – 1.04)§
Rural*disadvantage			0.70 (0.43 – 1.14)§
Model fit			
Pseudo-R^2	--	0.03	0.06
Likelihood Ratio X^2 (df)	--	8.95 (1)**	17.34 (8)*
Goodness-of-fit X^2 (df)[a]	108.96 (99)	100.01 (98)	91.61 (91)

§ p<0.20

† p<0.10

* p<0.05

** p<0.01

*** p<0.001

[a] Additional goodness-of-fit tests (square root of the ratio of the model deviance to the degrees of freedom, square root of the ratio of the model Pearson statistic to the degrees of freedom) also suggested overdispersion was not present in the data.

Table 5

Poisson regression results: Incidence rate ratios for male-victim intimate partner homicide, 2004–2006

	Incidence Rate Ratios (95% Confidence Intervals)			
	Model 1	**Model 2**	**Model 3**	**Model 4**
Predictors				
Disadvantage		1.12 (1.01 – 1.24)*	1.09 (0.89 – 1.35)	1.17 (1.02 – 1.35)*
Percent Age 20–40			1.02 (0.95 – 1.11)	1.03 (0.96 –1.12)
Sex ratio			1.71 (0.91 – 3.20)†	1.72 (0.92 – 3.22)†
Sex ratio, squared			1.00 (0.99 – 1.00)†	1.00 (0.99 – 1.00)†
Urbanicity				
Urban, metro			Referent	Referent
Urban, nonmetro			1.41 (0.74 – 2.68)	1.32 (0.72 – 2.43)
Rural			0.76 (0.11 – 5.36)	1.12 (0.30 – 4.27)
Interactions				
Urban nonmetro*disadvantage			1.13 (0.85 – 1.49)	--
Rural*disadvantage			1.38 (0.63 – 3.02)	
Model fit				
Pseudo-R^2	--	0.02	0.06	0.06
Likelihood Ratio X^2 (df)	--	4.01 (1)*	11.53 (8)	10.42 (6)§
Goodness-of-fit X^2 (df)[a]	85.53 (99)	81.53 (98)	74.01 (91)	75.12 (93)

§ p<0.20

† p<0.10

* p<0.05

** p<0.01

*** p<0.001

[a] Additional fit tests (square root of the ratio of the model deviance to the degrees of freedom, square root of the ratio of the model Pearson statistic to the degrees of freedom) also suggested overdispersion was not present in the data.