Published in final edited form as:
Alcohol Clin Exp Res. 2009 January ; 33(1): 169–176. doi:10.1111/j.1530-0277.2008.00825.x.

Alcohol Availability and Intimate Partner Violence Among US Couples

Christy M. McKinney, **Raul Caetano**, **Theodore Robert Harris**, and **Malembe S. Ebama**
From the University of Texas Houston School of Public Health, Dallas, Texas

Abstract

Objectives—We examined the relation between alcohol outlet density (the number of alcohol outlets per capita by zip code) and male-to-female partner violence (MFPV) or female-to-male partner violence (FMPV). We also investigated whether binge drinking or the presence of alcohol-related problems altered the relationship between alcohol outlet density and MFPV or FMPV.

Methods—We linked individual and couple sociodemographic and behavioral data from a 1995 national population-based sample of 1,597 couples to alcohol outlet data and 1990 US Census sociodemographic information. We used logistic regression for survey data to estimate unadjusted and adjusted odds ratios between alcohol outlet density and MFPV or FMPV along with 95% confidence intervals (CIs) and *p*-values. We used a design-based Wald test to derive a *p*-value for multiplicative interaction to assess the role of binge drinking and alcohol-related problems.

Results—In adjusted analysis, an increase of one alcohol outlet per 10,000 persons was associated with a 1.03-fold increased risk of MFPV (*p*-value for linear trend = 0.01) and a 1.011-fold increased risk of FMPV (*p*-value for linear trend = 0.48). An increase of 10 alcohol outlets per 10,000 persons was associated with 34% and 12% increased risk of MFPV and FMPV respectively, though the CI for the association with FMPV was compatible with no increased risk. The relationship between alcohol outlet density and MFPV was stronger among couples reporting alcohol-related problems than those reporting no problems (*p*-value for multiplicative interaction = 0.01).

Conclusions—We found that as alcohol outlet density increases so does the risk of MFPV and that this relationship may differ for couples who do and do not report alcohol-related problems. Given that MFPV accounts for the majority of injuries related to intimate partner violence, policy makers may wish to carefully consider the potential benefit of limiting alcohol outlet density to reduce MFPV and its adverse consequences.

Keywords

Alcohol Outlet Density; Alcohol Availability; Intimate Partner Violence; Multilevel

ALCOHOL OUTLET DENSITY (AOD), the number of alcohol outlets per capita or per roadway miles in a given geographic area, is associated with a wide range of adverse health and social consequences. A high AOD has been linked to an increase in arrests for public drunkenness, traffic accidents, injuries, suicide, and sexually transmitted diseases (Cohen et al., 2006; Escobedo and Ortiz, 2002; Gruenewald and Ponicki, 1995; Treno et al., 2001; Watts and Rabow, 1983). Studies have also reported that a high AOD is positively associated with

Reprint requests: Christy M. McKinney, PhD, MPH, University of Texas Houston School of Public Health, Dallas Regional Campus, 5323 Harry Hines Boulevard, V8.112, Dallas, TX 75390-9128; Fax: 214-648-1081; E-mail: E-mail: christy.mckinney@utsouthwestern.edu.

interpersonal violence such as physical assault and child abuse (Freisthler et al., 2005; Scribner et al., 1995; Zhu et al., 2004). Only one study has examined the relation between AOD and intimate partner violence (IPV). The authors of this ecologic study found a positive association between AOD and domestic violence in unadjusted, but not adjusted analysis (Gorman et al., 1998). Contextual studies have demonstrated that relative to affluent areas, IPV is more frequent in impoverished neighborhoods characterized by high levels of poverty, unemployment and female-headed households, and low levels of income, education and home ownership (Cunradi, 2007; Cunradi et al., 2000; Miles-Doan, 1998; O'Campo et al., 1995; Pearlman et al., 2003). Impoverished neighborhoods tend to have high AODs (Pollack et al., 2005; Zhu et al., 2004) and ecologic studies have demonstrated that areas with high AODs have greater demand, sales, and aggregate-level consumption of alcohol than areas with low AOD (Gruenewald et al., 1993a,b).

Markers of risky drinking, such as heavy drinking or alcohol-related problems, are established risk factors for IPV (Coker et al., 2000; Cunradi et al., 1999). It may be that a higher AOD through greater physical availability and access to alcohol increases risky drinking, and thereby elevates the likelihood of IPV. However, findings concerning AOD and individual-level alcohol consumption patterns have been inconsistent. Some have reported that individuals who live in areas with a high AOD drink more than individuals living in areas with a low AOD (Scribner et al., 2000; Weitzman et al., 2003). However, another study found that heavy drinking (>7 or >14 drinks per week for females and males, respectively) was more frequent among individuals living in affluent neighborhoods with a low AOD (Pollack et al., 2005). Others have reported that restaurant density is most strongly associated with frequency of drinking (Gruenewald et al., 2002). However, many of the alcohol measures used in these studies (e.g., volume or heavy drinking defined as having more than a certain number of drinks per week) may not be good markers of the pattern of drinking associated with an increased risk of IPV (Cunradi, 2007).

We hypothesized that a higher AOD, through greater physical availability of alcohol, would lead to increased alcohol consumption and thereby increase the risk of IPV. We also anticipated the association between AOD and IPV would be stronger among risky drinkers who engage in binge drinking (or report having alcohol-related problems) compared to those who do not have such markers of risky drinking. We theorized a higher AOD through increased alcohol availability would facilitate risky drinking thereby elevating the risk of IPV; those with markers of risky drinking who lived in low AOD areas with more restricted access to alcohol may not have engaged in risky drinking as frequently (or intensely).

MATERIALS AND METHODS

Population Sample and Scope of Data Collection

We conducted a national population-based survey of couples aged 18 years and older in the 48 contiguous US in 1995 using a multistage random probability sampling method (Caetano and Clark, 1998). All 1,635 couples (85% response) were interviewed; each couple member was interviewed individually and face-to-face by a study interviewer in private using a structured questionnaire. Of the initial 1,635 couples, we excluded the following: 16 couples because the privacy of their interviews was compromised; 4 same-sex couples, a group too small to analyze; 2 couples who were missing zip code; 14 couples whose zip code corresponded to an area with no housing units or population; and 2 couples who lived in zip codes with implausibly high AOD values, leaving 1,597 couples in the study. Because zip code is the smallest geographic level for which national alcohol outlet data exist, the survey data were linked via zip code (n = 587) to socioeconomic and demographic data from the 1990 US Census (GeoLytics Inc., 1998) and alcohol outlet data from the 1997 US Department of Commerce, Economics and Statistics Administration (USDCESA, 1997).

Measures of Intimate Partner Violence

Survey participants were asked about a series of physically violent behaviors taken from the Conflict Tactics Scale, Form N (Straus, 1990). Each respondent was asked whether (s)he or their partner had behaved in the following manner toward their partner in the past year: thrown something; pushed, grabbed, or shoved; slapped; kicked, bit, or hit; hit or tried to hit with something; beat up; choked; burned or scalded; forced sex; threatened with a knife or gun; or used a knife or gun (Straus, 1990). Each respondent reported separately their behavior toward their partner and their partner's behavior toward them. MFPV was considered present if they or their partner reported the male had committed any of the specified violent behaviors in the past year regardless of whether FMPV was also reported. Likewise, FMPV was considered present if either or both dyad member(s) reported the female had committed any of the listed behaviors in the past year regardless of whether MFPV was also reported. Those who reported that no violent behaviors had occurred in the past year were categorized as not having experienced MFPV (or FMPV). Thus our study outcomes MFPV and FMPV were couple-level measures.

Measures of Alcohol Availability

We used North American Industry Classification System (NAICS) codes to identify the number and type of alcohol drinking places and liquor stores by zip code (US Census Bureau, 2008). Because stores such as restaurants, drug stores, and grocery stores may or may not sell alcohol beverages depending on state and local licensing laws, an indicator (may sell alcohol = 1, may not = 0) based on state retailing licensing law information (DISCUS, 1996) were multiplied to NAICS counts for each of these business types and the resulting counts were added to the count of alcohol outlets. We also grouped alcohol outlets into off- and on-premise alcohol outlets. Off-premise alcohol outlets are liquor stores and vendors that sell alcohol for consumption elsewhere. On-premise outlets are establishments such as restaurants or bars where alcohol is typically purchased and consumed onsite. Alcohol outlets were classified as either on-premise or off-premise according to their presumed predominant role based on the NAICS code; we were unable to identify outlets that could be classified jointly as both on- and off-premise alcohol outlets. Our estimated number of off- and on-premise outlets were generally consistent with estimates in the *Adams Liquor Handbook*, a comprehensive alcohol sourcebook on the US (Adams Media Incorporated and the Beverage Information Group, 1999).

To obtain the density of alcohol outlets, we divided the number of outlets by the total population size for each zip code based on 1990 US Census estimates to create an AOD per 10,000 persons. This method was used to estimate total, on-premise and off-premise AOD. Reports suggest the relation between AOD and assaultive violence is nonlinear (Livingston, 2008; Livingston et al., 2007). Therefore, in unadjusted analysis of MFPV and FMPV, we compared a quadratic and cubic model separately to a linear model of AOD and found neither was an improvement over the linear model (both p-values >0.15). We also considered categorizing AOD but decided on a linear parameterization since there is no clear standard for categorizing AOD and the risk of IPV may vary within derived categories.

Measures of Binge Drinking and Alcohol-Related Problems

Alcohol consumption was estimated based upon survey respondents' reported frequency and quantity of drinking over the past 12 months. A standard drink was defined as 4 ounces of wine, 12 ounces of beer, or 1 ounce of spirits. Binge drinking was defined as consuming 5 or more drinks per occasion at least once within the past year. Couples in which either or both the male and/or female reported binge drinking were classified as having been exposed to binge drinking. Participants who responded positively to having experienced at least one of 25 items encompassing alcohol-related problems in the past year were classified as having an alcohol problem. Questions about alcohol-related problems pertained to alcohol dependence

characteristics such as impaired control, withdrawal and tolerance and social consequences such as alcohol-related health, work or financial problems, accidents, or problems with the police (Caetano et al., 2001). Couples in which either or both the male and/or female reported having either social and/or dependence alcohol-related problems were classified as having alcohol-related problems. Couples in which neither in the dyad reported binge drinking (or alcohol-related problems) were classified as unexposed. Because this was an initial assessment of the hypothesis that risky drinking modifies the association of AOD and IPV and because of limited statistical power to detect finer distinctions, we used comprehensive couple-level and overall measures of risky drinking (e.g., social and dependence alcohol-related problems combined).

Individual and Couple Level Family, Behavioral, and Sociodemographic Characteristics

Survey respondents' self-reported ethnicity was categorized as follows: persons reporting Hispanic ethnicity were classified as Hispanic. The remaining subjects were classified as non-Hispanic white; non-Hispanic black; or non-Hispanic other. Couples concordant on ethnicity were classified as that ethnicity; couples of non-Hispanic other ethnicity and couples discordant on ethnicity were classified as other/mixed ethnicity. Respondents who reported a parent or caregiver had ever hit them with something, beaten them up, burned or scalded them, threatened them with a knife or gun, or used a knife or gun against them during childhood were categorized as having a history of childhood physical abuse. Those who reported no such history were categorized as not having experienced childhood physical abuse. Survey participants who reported any use of cocaine, crack cocaine, heroin, opium, marijuana, hash, or grass in the 12 months prior to the survey were categorized as having a history of illicit drug use; otherwise participants were considered not to have used illicit drugs. Male and female demographics including age, educational attainment, and employment status and the couple's household income collected through the survey were also included in our analyses (Table 1).

Zip Code Level Sociodemographic Characteristics

We identified relevant zip code level sociodemographic characteristics obtained from the 1990 US Census which were released in 1992 and reflect the zip code universe at or near 1992. We examined the proportion of residents by zip code who were married, black, Hispanic, foreign born, unemployed; who were living in poverty, a female-headed household, a household making >$75,000 per year, or an owner-occupied home; or who had finished high school, finished college, or moved in the past 5 years.

Statistical Analyses

All statistical analyses were performed using the survey sampling adjustment implemented in Stata 10.0 (College Station, TX), which accounts for stratification, sampling weights, and clustering. Standard error estimates were based on Taylor series linearization. These adjustments make it possible to draw inferences from our findings to the population of couples in the United States. Because our adjustment for clustering at the primary sampling unit (PSU) level also accounts for clustering below the PSU level, no further adjustment for clustering in zip codes was necessary (Binder, 1983; Williams, 2000).

We calculated descriptive statistics for individual, couple and zip code level characteristics across categories of IPV. We used logistic regression for survey data to estimate unadjusted and adjusted associations between AOD and MFPV (or FMPV) along with 95% confidence intervals (CIs) and *p*-values for these odds ratios (ORs). In each model we adjusted for factors identified a priori as potential confounders of the relationship between AOD and MFPV (or FMPV), defining potential confounders as factors plausibly related to both AOD and IPV but not in the causal pathway (Koepsell and Weiss, 2003). Selection of potential confounders was based on existing literature and our knowledge of the relationships between relevant variables.

Because our modeling goal was to obtain an unbiased estimate of the association between AOD and MFPV (or FMPV), we developed our models by evaluating the impact of potential confounding factors on our estimated association between AOD and MFPV (or FMPV) (Kleinbaum, 1994a; Rothman, 2002). Potential confounders found not to change estimates to a meaningful degree when removed from our initial models, generally by less than 10% (Maldonado and Greenland, 1993; Rothman, 2002), were excluded from the presented models since in such cases there was little evidence of confounding. Our modeling approach did not employ significance tests in variable selection since confounding is an issue of validity and not an issue of random error (or statistical significance) (Kleinbaum, 1994b; Rothman, 2002; Savitz, 2003).

In our initial models, we adjusted for all a priori identified individual, couple and zip code level potential confounding factors (Tables 1 and 2); binge drinking and alcohol-related problems were not included as adjustment variables since they were considered separately as potential effect modifiers. We first considered the change in the estimate related to zip code level variables; we subsequently considered couple and individual-level factors. Specific adjustment variables for each model are listed in Table 3. The same adjustment variables as notated in Table 3 for MFPV and FMPV were employed in models examining the association between AOD, binge drinking or alcohol-related problems, and each type of IPV. Associations presented (Table 3, and Figs. 1 and 2) were based on AOD as a linear predictor with select values chosen to illustrate associations at various levels of AOD and other continuous variables (typically a 10-unit change). All individual and couple level covariates were categorized for all analyses as presented except age, which was analyzed as a continuous variable (Table 1); all zip code level covariates (Table 2) were examined as continuous variables.

We anticipated that the association between AOD and MFPV (or FMPV) would be stronger among risky drinkers than among individuals who do not engage in risky drinking. We theorized that among risky drinkers, greater physical availability to alcohol may increase the frequency, duration or intensity of alcohol intake and thereby put individuals living in high AOD areas at greater risk of IPV relative to risky drinkers living in low AOD areas who have more restricted access to alcohol. To evaluate risky drinking as a modifier of the association between AOD and IPV, we fit adjusted logistic regression models with multiplicative interaction terms between couple level binge drinking and AOD to estimate the odds ratio with MFPV (or FMPV) for those who did and did not binge drink. We used a survey design-based Wald test to derive a *p*-value for the interaction. The same approach was used to evaluate the role of alcohol-related problems. We also estimated associations between off- and on-premise AOD and MFPV (or FMPV) to evaluate a secondary hypothesis that off-premise AOD would be more strongly related to IPV than on-premise AOD, given that IPV typically occurs in private settings such as the home. Lastly, we evaluated the impact of potentially influential values of AOD on the association with IPV by reanalyzing our data for total AOD truncating values >30 to a value of 30 (the top 2% ranged from >30 to 82).

Concerning the a priori identification of potential confounding factors, many studies have reported that IPV is associated with individual or couple level (Coker et al., 2000; Thompson et al., 2006; Tjaden and Thoennes, 2000) as well as neighborhood level (Cunradi et al., 2000) sociodemographic or behavioral characteristics. Based on these and other studies (Burke et al., 2006; O'Campo et al., 2005), we theorized an impoverished neighborhood may have more social isolation or disorganization (Sampson et al., 1997; Van Wyk et al., 2003) that may contribute to a stressful and/or isolated living environment (Van Wyk et al., 2003) which may increase the risk of IPV. Multilevel studies have demonstrated that higher AODs tend to be located in impoverished neighborhoods and associated with neighborhood level factors (Pollack et al., 2005; Zhu et al., 2004). We speculated that similar individual or couple level

sociodemographics could also be related to AOD and potentially confound the relation between AOD and IPV.

RESULTS

Sample Characteristics

We observed similar distributions of individual and couple level characteristics with MFPV and FMPV (Table 1). Men and women in couples who reported either type of IPV tended to be younger, employed, and have a history of childhood physical abuse or illicit drug use relative to those reporting no MFPV or no FMPV. Relative to their counterparts, a greater proportion of couples who experienced either type of IPV were non-white, cohabitating, and reported binge drinking or alcohol-related problems in the past year. Those reporting MFPV lived in zip codes with a higher AOD than those reporting no MFPV; AOD was similar among those reporting FMPV or no FMPV (Table 1). Couples reporting MFPV or FMPV lived in zip codes where a higher proportion of residents were black; Hispanic; living in poverty; or living in female-headed households. Other zip code level sociodemographics were generally similar across couple's MFPV and FMPV status.

Logistic Regression Findings

In unadjusted analyses, total AOD and on-premise AOD appeared positively associated with MFPV though estimates were somewhat statistically unstable; no association was observed for off-premise AOD and MFPV or any type of AOD and FMPV (Table 2). In adjusted analyses, both total AOD and on-premise AOD were positively associated with MFPV (*p*-value for linear trend = 0.01 for both total and on-premise AOD). Estimated associations between off-premise AOD and MFPV and all types of AOD and FMPV demonstrated an apparent slight increased risk, though confidence intervals were compatible with a wide range of estimates including no association (Table 2).

After adjusting for potential confounding factors, an increase of 10 alcohol outlets per 10,000 persons was associated with a 34% (1.030^{10}) increased risk of MFPV (Table 3). An increase of 10 alcohol outlets per 10,000 persons was associated with a 12% increased risk of FMPV, though the 95% CI was compatible with no increased risk. The adjusted models for on- and off-premise AOD and MFPV (or FMPV) controlled for the same variables and had similar ORs and 95% CIs for all model variables as the adjusted model for total AOD and MFPV (and FMPV) in Table 3 (data not shown). At higher levels of AOD, the risk of MFPV increased such that a 25-unit increase in AOD doubled the risk of MFPV (adjusted OR = 2.1, 95% CI: 1.2, 3.6). A 25-unit increase in AOD appeared to slightly increase the risk of FMPV (adjusted OR = 1.3, 95% CI: 0.6, 2.5) though this estimate was statistically unstable (Fig. 1).

Alcohol-related problems appeared to modify the relationship between AOD and MFPV (*p*-value for interaction = 0.01) (Fig. 2). As we hypothesized, the association between AOD and MFPV was stronger among couples reporting alcohol-related problems than among couples reporting no alcohol-related problems. We found no evidence of a multiplicative interaction between AOD, alcohol-related problems and FMPV (*p*-value for interaction = 0.84); or AOD, binge drinking, and MFPV or FMPV (*p*-values for interaction = 0.80 and 0.84, respectively) (data not shown).

Sensitivity Analyses

In our subanalysis using a truncated measure of total AOD of 30 (data not shown), unadjusted ORs were similar with our reported estimates though less precise. Adjusted ORs for total AOD and MFPV were also similar to our reported estimates though ORs were stronger at cut points above 20 than our reported estimates; however the *p*-value for the linear trend was slightly

larger (p-value = 0.03). Adjusted ORs for total AOD and FMPV were stronger, however these ORs also lacked the precision of our reported estimates (p-value for linear trend = 0.21). The p-value for the multiplicative interaction term between AOD and alcohol-related problems for MFPV was marginal (p-value = 0.07).

DISCUSSION

We know of no epidemiologic study that has examined the relation between AOD and IPV incorporating individual and couple level data. The findings of this national population-based study of couples indicate that as the density of alcohol outlets increases so does the risk of MFPV. Our results also suggest that the relation between AOD and MFPV is stronger among couples who report having alcohol-related problems than among couples who report no alcohol-related problems. Though AOD appeared to increase the risk of FMPV slightly, lack of precision precludes us from concluding whether AOD influences this type of IPV.

Our findings related to MFPV are consistent with most studies reporting that physical availability of alcohol increases interpersonal and family violence (Freisthler et al., 2005; Scribner et al., 1995; Zhu et al., 2004). In contrast to the ecologic study of AOD and IPV (Gorman et al., 1998), we found that AOD remained a strong predictor of MFPV after adjusting for multilevel sociodemographic factors. It may be that these disparate findings are related to examining different out-comes: MFPV versus IPV which includes both MFPV and FMPV. Alternatively, by accounting for individual, couple and neighborhood sociodemographic and behavioral factors, we may have been better able to control for factors that obscured the association between AOD and MFPV. Given that our adjusted estimates were stronger than the unadjusted, any residual confounding may likely have biased our estimates toward the null. Contrary to our expectation, on-premise AOD was positively associated with the risk of MFPV. It may be that drinking in bars, which some have linked to physical violence (Graham et al., 2006; Gruenewald et al., 2006), facilitates risky drinking, increasing the risk of MFPV. Other findings concerning off- and on-premise associations with MFPV and FMPV were statistically unstable, limiting our ability to interpret these findings.

Our findings also suggest that the relationship between AOD and MFPV varies among couples who do and do not have alcohol-related problems. This is consistent with studies that we (Cunradi et al., 1999, 2000, 2002) and others (Coker et al., 2000) have done that demonstrate IPV is positively associated with alcohol-related problems at the level of the individual. This finding is also consistent with the notion that among individuals with alcohol-related problems, greater physical availability of alcohol may increase the frequency (or duration or intensity) of risky drinking, which in turn puts these individuals who live in high AOD areas at increased risk of IPV relative to similar individuals living in low AOD areas. Nevertheless, the cross-sectional nature of our data does not permit us to infer that AOD increases the prevalence of alcohol-related problems, which in turn increases the risk of IPV. Though scientifically plausible, we are unable to discern the temporal relationships between AOD, alcohol-related problems and MFPV with this cross-sectional data. Furthermore, binge drinking did not appear to modify the relationship between AOD and MFPV (or FMPV). Perhaps because binge drinking does not capture the complex nature of the type of risky drinking correlated with IPV, it did not modify the relation between AOD and IPV. Alternatively, small numbers may have prevented us from being able to detect a difference in the ORs for binge drinkers and nonbinge drinkers (of the association between AOD and MFPV or FMPV); or binge drinking may simply not modify the relationship between AOD and IPV. Of course, our findings only address binge drinking as an effect modifier of the relation between AOD and IPV; binge drinking may be still be related to AOD and/or IPV in other ways, e.g., binge drinking may be independently associated with IPV.

Zip code is an imprecise and typically larger proxy of neighborhoods, the ideal geographic area for which we theorized AOD would influence IPV risk. As such, the variation within zip codes may have been high resulting in less variation between neighborhoods (O'Campo, 2003): this may have decreased our ability to detect associations, for example, with FMPV or for off-premise AOD. Mismeasurement of AOD is also likely given we did not have 1995 estimates for alcohol outlets, were unable to identify outlets that jointly sold alcohol for on- and off-premise consumption, nor did we have local licensing law information. Misclassification due to lack of current information would likely result in nondifferential misclassification biasing our estimates toward the null. Assuming local licensing laws typically make access to alcohol more restrictive, the number of outlets per state laws may have over-estimated the AOD for such areas. Such differential misclassification of AOD would likely bias our estimates toward the null. It is also possible that our results were subject to uncontrolled confounding from unidentified confounding factors; additionally residual confounding due to imprecise measurement or parameterization may have been present. Intimate partners who were not included in our sample such as dating partners tend to be younger and as a result may be more likely to engage in risky drinking and be an increased risk of IPV than our sample of married or cohabitating couples. Thus, our findings may not be generalizable to this population. Though our analysis with truncated values of AOD resulted in slightly different estimates and *p*-values, our inference was not altered by these findings. Lastly, the prevalence of MFPV (13.6%) and FMPV (18.2%) (Schafer et al., 1998) suggests IPV is not rare; thus our OR estimates may be biased away from the null. These threats to the validity of our findings limit our ability to infer causality in this cross-sectional study.

Our findings contribute to the growing body of knowledge linking alcohol availability to an increased risk of interpersonal violence. Our results provide policy makers with information that suggests reducing AOD may decrease the risk of MFPV. Because MFPV accounts for the majority of IPV-related injuries and effective primary prevention efforts at the level of the individual are limited (Whitaker et al., 2006), policy makers may wish to carefully consider the potential benefit of limiting AOD to reduce MFPV and its adverse consequences.

Acknowledgments

SOURCES OF FUNDING

This work was supported by grant #R37-AA10908 from the National Institute on Alcohol Abuse and Alcoholism to the University of Texas, School of Public Health.

REFERENCES

Adams Media Incorporated and the Beverage Information Group. Adams Liquor Handbook. Adams; New York: 1999. On-and Off-Premise Retail Outlets-1997; p. 308-309.

Binder DA. On the variances of asymptotically normal estimators from complex surveys. Int Stat Rev 1983;51:279–292.

Burke JG, O'Campo P, Peak GL. Neighborhood influences and intimate partner violence: does geographic setting matter? J Urban Health 2006;83:182–194. [PubMed: 16736368]

Caetano R, Clark CL. Trends in alcohol-related problems among whites, blacks, and Hispanics: 1984-1995. Alcohol Clin Exp Res 1998;22:534–538. [PubMed: 9581665]

Caetano R, Nelson S, Cunradi CB. Intimate partner violence, dependence symptoms and social consequences from drinking among white, black and Hispanic couples in the United States. Am J Addict 2001;10:60–69. [PubMed: 11268822]

Cohen DA, Ghosh-Dastidar B, Scribner R, Miu A, Scott M, Robinson P, Farley TA, Bluthenthal RN, Brown-Taylor D. Alcohol outlets, gonorrhea, and the Los Angeles civil unrest: a longitudinal analysis. Soc Sci Med 2006;62:3062–3071. [PubMed: 16423436]

Coker AL, Smith PH, McKeown RE, King MJ. Frequency and correlates of intimate partner violence by type: physical, sexual, and psychological battering. Am J Public Health 2000;90:553–559. [PubMed: 10754969]

Cunradi CB. Drinking level, neighborhood social disorder, and mutual intimate partner violence. Alcohol Clin Exp Res 2007;31:1012–1019. [PubMed: 17403065]

Cunradi CB, Caetano R, Clark CL, Schafer J. Alcohol-related problems and intimate partner violence among white, black and Hispanic couples in the US. Alcohol Clin Exp Res 1999;23:1492–1501. [PubMed: 10512315]

Cunradi CB, Caetano R, Clark CL, Schafer J. Neighborhood poverty as a predictor of intimate partner violence among White, Black, and Hispanic couples in the United States: a multilevel analysis. Ann Epidemiol 2000;10:297–308. [PubMed: 10942878]

Cunradi CB, Caetano R, Schafer J. Alcohol-related problems, drug use, and male intimate partner violence severity among US couples. Alcohol Clin Exp Res 2002;26:493–500. [PubMed: 11981125]

DISCUS. Summary of State Laws & Regulations Relating to Distilled Spirits. Vol. 29th ed.. Distilled Spirits Council of the United States Inc; Washington, DC: 1996.

Escobedo LG, Ortiz M. The relationship between liquor outlet density and injury and violence in New Mexico. Accid Anal Prev 2002;34:689–694. [PubMed: 12214963]

Freisthler B, Needell B, Gruenewald PJ. Is the physical availability of alcohol and illicit drugs related to neighborhood rates of child maltreatment? Child Abuse Negl 2005;29:1049–1060. [PubMed: 16168479]

GeoLytics Inc.. CensusCD + Maps 2.0. GeoLytics Inc.; East Brunswick, NJ: 1998.

Gorman DM, Labouvie EW, Speer PW, Subaiya AP. Alcohol availability and domestic violence. Am J Drug Alcohol Abuse 1998;24:661–673. [PubMed: 9849776]

Graham K, Osgood DW, Wells S, Stockwell T. To what extent is intoxication associated with aggression in bars? A multilevel analysis. J Stud Alcohol 2006;67:382–390. [PubMed: 16608147]

Gruenewald PJ, Freisthler B, Remer L, Lascala EA, Treno A. Ecological models of alcohol outlets and violent assaults: crime potentials and geospatial analysis. Addiction 2006;101:666–677. [PubMed: 16669900]

Gruenewald PJ, Johnson FW, Treno AJ. Outlets, drinking and driving: a multilevel analysis of availability. J Stud Alcohol 2002;63:460–468. [PubMed: 12160105]

Gruenewald PJ, Millar AB, Treno AJ. Alcohol availability and the ecology of drinking behavior. Alcohol Health Res World 1993a;17:39–45.

Gruenewald PJ, Ponicki WR. The relationship of the retail availability of alcohol and alcohol sales to alcohol-related traffic crashes. Accid Anal Prev 1995;27:249–259. [PubMed: 7786392]

Gruenewald PJ, Ponicki WR, Holder HD. The relationship of outlet densities to alcohol consumption: a time series cross-sectional analysis. Alcohol Clin Exp Res 1993b;17:38–47. [PubMed: 8452207]

Kleinbaum, DG. Modeling strategy for assessing interaction and confounding. In: Dietz, K.; Gail, M.; Krickberg, K.; Tsiatis, A.; Samet, J., editors. Logistic Regression, A Self-Learning Text. Vol. 2nd ed.. Springer-Verlag; New York, Berlin, Heidelberg: 1994a. p. 191-226.

Kleinbaum, DG. Modeling strategy guidelines. In: Dietz, K.; Gail, M.; Krickberg, K.; Tsiatis, A.; Samet, J., editors. Logistic Regression, A Self-Learning Text. Vol. 2nd ed.. Springer-Verlag; New York, Berlin, Heidelberg: 1994b. p. 161-190.

Koepsell, TD.; Weiss, NS. Epidemiologic Methods: Studying the Occurrence of Illness. Vol. 1st ed.. Oxford University Press; New York: 2003. Confounding and its control; p. 247-280.

Livingston M. Alcohol outlet density and assault: a spatial analysis. Addiction 2008;103:619–628. [PubMed: 18339106]

Livingston M, Chikritzhs T, Room R. Changing the density of alcohol outlets to reduce alcohol-related problems. Drug Alcohol Rev 2007;26:557–566. [PubMed: 17701520]

Maldonado G, Greenland S. Simulation study of confounder-selection strategies. Am J Epidemiol 1993;138:923–936. [PubMed: 8256780]

Miles-Doan R. Violence between spouses and intimates: does neighborhood context matter? Soc Forces 1998;77:623–645.

O'Campo P. Invited commentary: advancing theory and methods for multilevel models of residential neighborhoods and health. Am J Epidemiol 2003;157:9–13. [PubMed: 12505885]

O'Campo P, Burke J, Peak GL, McDonnell KA, Gielen AC. Uncovering neighbourhood influences on intimate partner violence using concept mapping. J Epidemiol Community Health 2005;59:603–608. [PubMed: 15965146]

O'Campo P, Gielen AC, Faden RR, Xue X, Kass N, Wang MC. Violence by male partners against women during the childbearing year: a contextual analysis. Am J Public Health 1995;85:1092–1097. [PubMed: 7625502]

Pearlman DN, Zierler S, Gjelsvik A, Verhoek-Oftedahl W. Neighborhood environment, racial position, and risk of police-reported domestic violence: a contextual analysis. Public Health Rep 2003;118:44–58. [PubMed: 12604764]

Pollack CE, Cubbin C, Ahn D, Winkleby M. Neighbourhood deprivation and alcohol consumption: does the availability of alcohol play a role? Int J Epidemiol 2005;34:772–780. [PubMed: 15737966]

Rothman, KJ. Epidemiology: An Introduction. Oxford University Press; New York: 2002. Using regression models in epidemiologic analysis; p. 181-197.

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

Savitz, DA. Interpreting Epidemiologic Evidence. Oxford University Press; New York: 2003. Confounding; p. 137-161.

Schafer J, Caetano R, Clark CL. Rates of intimate partner violence in the United States. Am J Public Health 1998;88:1702–1704. [PubMed: 9807541]

Scribner RA, Cohen DA, Fisher W. Evidence of a structural effect for alcohol outlet density: a multilevel analysis. Alcohol Clin Exp Res 2000;24:188–195. [PubMed: 10698371]

Scribner RA, MacKinnon DP, Dwyer JH. The risk of assaultive violence and alcohol availability in Los Angeles County. Am J Public Health 1995;85:335–340. [PubMed: 7892915]

Straus, MA. Measuring intrafamily conflict and violence: the Conflict Tactics (CT) Scales. In: Straus, MA.; Gelles, RJ., editors. Physical Violence in American Families: Risk Factors and Adaptations to Violence in 8,145 Families. Transaction Publishers; New Brunswick, NJ: 1990. p. 29-47.

Thompson RS, Bonomi AE, Anderson M, Reid RJ, Dimer JA, Carrell D, Rivara FP. Intimate partner violence: prevalence, types, and chronicity in adult women. Am J Prev Med 2006;30:447–457. [PubMed: 16704937]

Tjaden, P.; Thoennes, N. Extent, Nature, and Consequences of Intimate Partner Violence: Findings From The National Violence Against Women Survey. U.S. Department of Justice; Washington, D.C.: 2000.

Treno AJ, Gruenewald PJ, Johnson FW. Alcohol availability and injury: the role of local outlet densities. Alcohol Clin Exp Res 2001;25:1467–1471. [PubMed: 11696666]

US Census Bureau. Development of NAICS. US Census Bureau; Washington, DC: 2008.

USDCESA. Econ 97Z Report Series Economic Census. US Department of Commerce, Economics and Statistics Administration; Washington, DC: 1997.

Van Wyk JA, Benson ML, Fox GL, DeMaris A. Detangling individual-, partner-, and community-level correlates of partner violence. Crime Delinq 2003;49:412–438.

Watts RK, Rabow J. Alcohol availability and alcohol-related problems in 213 California cities. Alcohol Clin Exp Res 1983;7:47–58. [PubMed: 6342449]

Weitzman ER, Folkman A, Folkman MP, Wechsler H. The relationship of alcohol outlet density to heavy and frequent drinking and drinking-related problems among college students at eight universities. Health Place 2003;9:1–6. [PubMed: 12609468]

Whitaker DJ, Morrison S, Lindquist C, Hawkins SR, O'Neil JA, Nesius AM, Mathew A, Reese LR. A critical review of interventions for the primary prevention of perpetration of partner violence. Aggress Violent Behav 2006;11:151–166.

Williams RL. A note on robust variance estimation for cluster-correlated data. Biometrics 2000;56:645–646. [PubMed: 10877330]

Zhu L, Gorman DM, Horel S. Alcohol outlet density and violence: a geospatial analysis. Alcohol Alcohol 2004;39:369–375. [PubMed: 15208173]

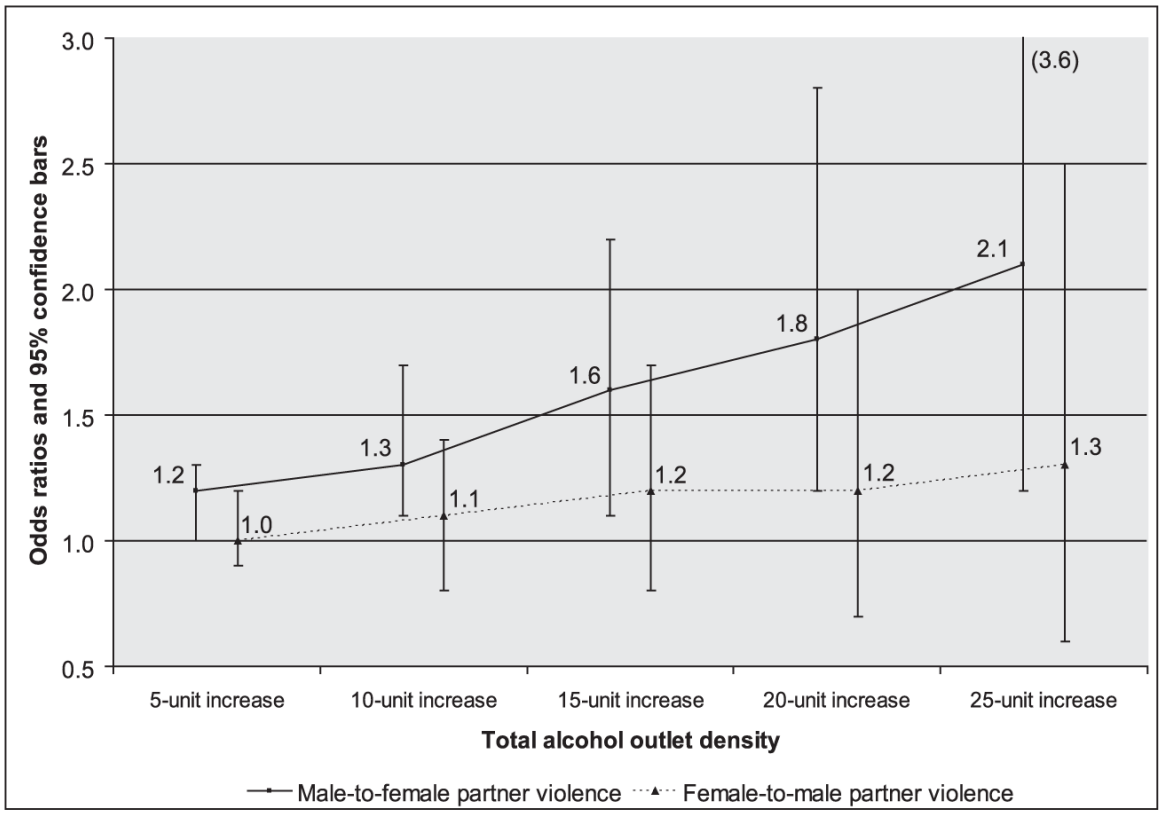

Fig. 1.

Adjusted odds ratios and 95% confidence intervals of associations between total alcohol outlet density and male-to-female partner violence and female-to-male partner violence. (Odds ratios for MFPV were adjusted for male and female age, education level, employment status, and illicit drug use; couple level ethnicity, income, and marital status; and zip code level percent living in poverty and percent living in owner occupied homes. Odds ratios for FMPV were adjusted for the same factors as MFPV and also adjusted for zip code level percent with a high school degree and percent with a college degree.)

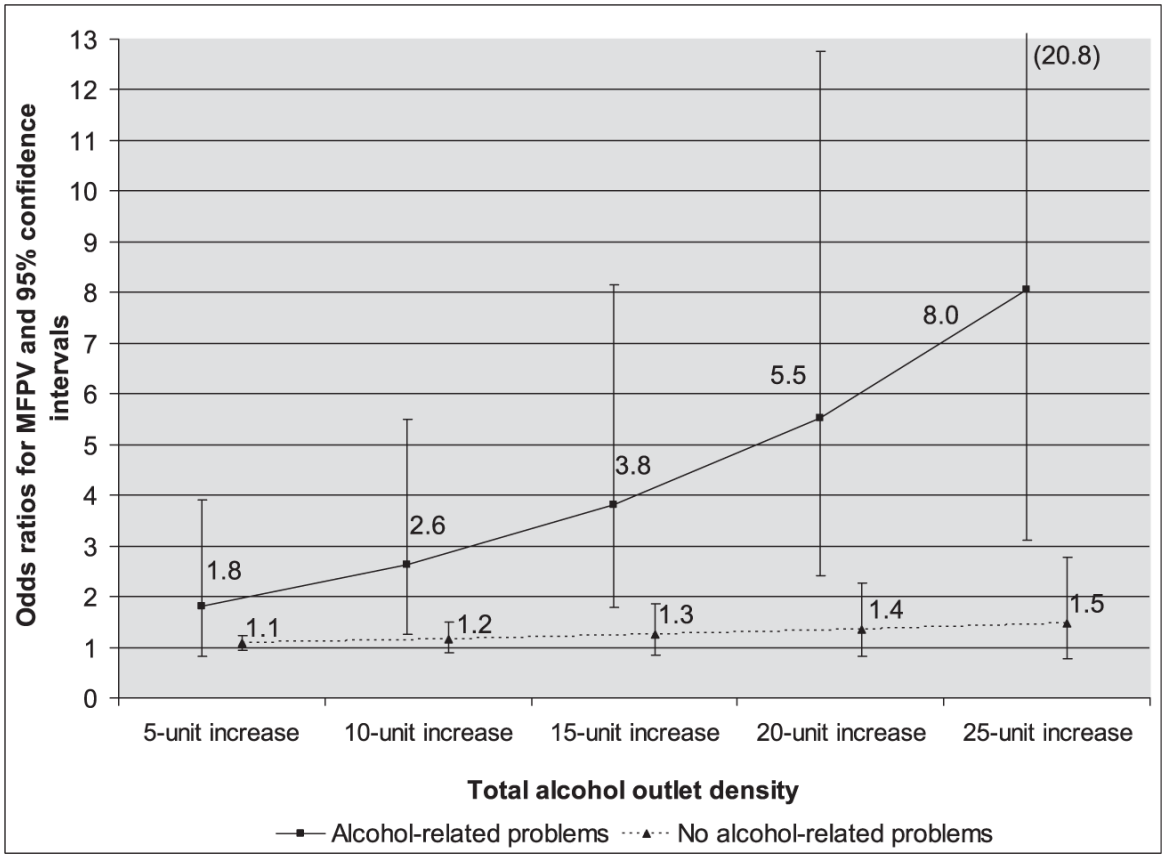

Fig. 2.

Adjusted odds ratios and 95% confidence intervals of associations between alcohol outlet density and male-to-female partner violence among couples who did and did not report having alcohol-related problems across select levels of alcohol outlet density. (Odds ratios were adjusted for male and female age, education level, employment status, and illicit drug use; couple level ethnicity, income, and marital status; and zip code level percent living in poverty and percent living in owner occupied homes.)

Table 1

Individual, Couple, and Zip Code Level Demographic and Behavioral Characteristics Across Intimate Partner Violence Categories

	MFPV	No MFPV	FMPV	No FMPV
Male				
Age (mean in years)	36.8	49.1	37.7	49.6
Education (%)				
<High school	17.8	18.3	19.0	18.1
=High school	43.1	35.9	41.5	35.8
>High school	39.1	45.8	39.5	46.1
Employment status (%)				
Employed	83.8	72.0	80.9	72.0
Retired	2.4	20.2	4.3	20.8
Unemployed/other	13.8	7.8	14.8	7.2
Experienced childhood physical abuse (%)	76.0	63.5	71.3	63.9
Has history of illicit drug use (%)	13.0	4.9	13.1	4.5
Female				
Age (mean in years)	35.0	46.4	35.6	47.0
Education (%)				
<High school	16.0	15.9	17.0	15.6
=High school	39.5	40.3	42.5	39.7
>High school	44.5	43.8	40.5	44.7
Employment status (%)				
Employed	72.8	58.8	67.3	59.3
Homemaker	15.0	25.7	22.4	24.7
Retired	1.5	9.4	1.6	9.8
Unemployed/other	10.7	6.1	8.6	6.3
Experienced childhood physical abuse (%)	65.8	48.6	65.7	47.6
Has history of illicit drug use (%)	7.7	1.4	5.1	1.7
Couple level				
Ethnicity (%)				
White, non-Hispanic	65.7	80.8	66.4	81.5
Black, non-Hispanic	11.0	6.0	11.0	5.8
Hispanic, any race	8.7	6.7	8.2	6.7
Mixed/other, non-Hispanic	14.6	6.5	14.5	6.0
Household income (%)				
<$10,000	10.7	8.3	12.6	7.7
$10 to 19,999	18.8	13.2	19.8	12.7
$20 to 29,999	12.9	17.1	13.2	17.3
$30 to 39,999	18.9	14.3	14.5	15.1
≥$40,000	38.7	47.1	40.0	47.3
Marital status (%)				
Married	77.4	92.0	81.3	92.0
Cohabitating	22.6	8.0	18.7	8.0

	MFPV	No MFPV	FMPV	No FMPV
Positive for binge drinking (%)	67.3	38.9	67.1	37.3
Positive for alcohol related problems (%)	36.4	12.9	31.4	12.8
Zip code level				
Total alcohol outlet density[a]	14.2	12.4	12.2	12.8
On-premise alcohol outlet density[a]	11.9	10.5	10.2	10.9
Off-premise alcohol outlet density[a]	2.9	3.0	3.0	2.9
Living in poverty (%)	13.1	11.6	13.6	11.4
Black (%)	10.6	7.8	11.1	7.5
Hispanic (%)	10.0	7.2	8.9	7.3
Foreign born (%)	7.0	6.2	5.9	6.5
Female-headed households (%)	17.0	14.0	16.7	13.9
Workforce that is unemployed (%)	0.7	0.6	0.7	0.6
High school graduates[b] (%)	75.5	75.4	73.7	75.8
College graduates[b] (%)	20.9	20.2	18.4	20.7
Households making >$75,000 year (%)	9.4	9.7	8.5	10.0
Married (%)	58.9	60.9	59.9	60.8
15 to 29 years of age (%)	22.8	21.9	22.5	22.0
Homes that are owner occupied (%)	53.8	54.1	54.0	54.1
Moved in past 5 years (%)	50.0	48.0	48.7	48.2

Note: (%) denotes weighted proportions.

MFPV, male-to-female partner violence; FMPV, female-to-male partner violence.

[a] Alcohol outlet density is the number of alcohol outlets per 10,000 persons.

[b] Among residents >25 years of age.

Table 2

Unadjusted and Adjusted Associations Between Type of Alcohol Outlet Density and Intimate Partner Violence for a One-Unit Increase in Alcohol Outlet Density

	Unadjusted			Adjusted		
	OR	**95% CI**	***p*-value**	**OR**	**95% CI**	***p*-value**
Male-to-female partner violence[a]						
Total alcohol outlet density	1.015	(0.999, 1.031)	0.06	1.030	(1.009, 1.052)	0.01
On-premise alcohol outlet density	1.014	(0.997, 1.031)	0.11	1.030	(1.009, 1.052)	0.01
Off-premise alcohol outlet density	0.994	(0.935, 1.056)	0.84	1.023	(0.941, 1.113)	0.59
Female-to-male partner violence[a,b]						
Total alcohol outlet density	0.994	(0.972, 1.015)	0.56	1.011	(0.991, 1.039)	0.48
On-premise alcohol outlet density	0.992	(0.969, 1.016)	0.51	1.010	(0.981, 1.042)	0.57
Off-premise alcohol outlet density	1.010	(0.954, 1.069)	0.73	1.054	(0.988, 1.127)	0.11

Note: OR and 95% CI refers to odds ratio and 95% confidence interval.

[a] Adjusted for male and female age, education level, employment status, and illicit drug use; couple level race ethnicity, income, and marital status; and zip code level percent living in poverty and percent living in owner occupied homes.

[b] Also adjusted for zip code level percent with a high school degree and percent with a college education.

Table 3

Adjusted Logistic Regression Model of the Associations Between Total Alcohol Outlet Density and Male-to-Female and Female-to-Male Partner Violence

	MFPV	FMPV
	OR (95% CI)	OR (95% CI)
Total alcohol outlet density		
10-unit increase	1.3 (1.1, 1.7)[a]	1.1 (0.8, 1.4)
Male		
Age		
10-year increase	0.6 (0.4, 0.9)[a]	0.8 (0.5, 1.2)
Education		
<High school	1.5 (0.8, 2.7)	1.6 (0.8, 3.3)
=High school	Referent	Referent
>High school	0.9 (0.5, 1.5)	1.1 (0.8, 1.6)
Employment status		
Employed	Referent	Referent
Retired	0.5 (0.1, 1.9)	0.9 (0.2, 4.0)
Unemployed/other	1.0 (0.5, 2.3)	1.5 (0.9, 2.6)
Has history of illicit drug use		
No	Referent	Referent
Yes	1.4 (0.7, 2.7)	1.9 (0.9, 3.9)
Female		
Age		
10-year increase	0.9 (0.6, 1.5)	0.7 (0.4, 1.1)
Education		
<High school	1.1 (0.5, 2.2)	0.9 (0.5, 1.7)
=High school	Referent	Referent
>High school	0.9 (0.5, 1.5)	0.7 (0.4, 1.3)
Employment status		
Employed	Referent[a]	Referent
Homemaker	0.5 (0.3, 0.8)	0.9 (0.5, 1.6)
Unemployed	1.0 (0.5, 2.0)	0.8 (0.4, 1.5)
Retired/other	1.1 (0.2, 5.9)	0.9 (0.1, 5.5)
Has history of illicit drug use		
No	Referent[a]	Referent
Yes	3.0 (1.0, 8.5)	1.7 (0.5, 5.7)
Couple level		
Ethnicity		
White, non-Hispanic	Referent	Referent[a]
Black, non-Hispanic	1.7 (0.9, 3.0)	1.7 (0.9, 3.2)
Hispanic, any race	0.8 (0.5, 1.4)	0.6 (0.3, 1.1)
Mixed/other, non-Hispanic	1.3 (0.6, 2.8)	1.3 (0.8, 2.3)
Household income		

	MFPV	FMPV
	OR (95% CI)	**OR (95% CI)**
<$10,000	Referent	Referent
$10 to 19,999	1.7 (0.8, 3.3)	1.4 (0.7, 2.6)
$20 to 29,999	0.9 (0.5, 1.9)	0.7 (0.4, 1.3)
$30 to 39,999	1.2 (0.5, 2.8)	0.6 (0.3, 1.3)
≥$40,000	1.0 (0.5, 2.1)	0.8 (0.4, 1.5)
Marital status		
Married	Referent	Referent
Cohabitating	1.3 (0.7, 2.3)	1.2 (0.7, 2.2)
Neighborhood characteristics		
Living in poverty		
10% increase	1.3 (1.0, 1.6)[a]	1.2 (0.9, 1.7)
Living in owner occupied homes		
10% increase	1.2 (1.0, 1.4)[a]	1.3 (1.1, 1.5)[a]
High school graduates		
10% increase		1.0 (0.8, 1.3)
College graduates		
10% increase		1.0 (0.8, 1.2)

[a] p-value < 0.05.