Is the Density of Alcohol Establishments Related to Nonviolent Crime?

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ABSTRACT. Objective: We examined the associations between the density of alcohol establishments and five types of nonviolent crime across urban neighborhoods. **Method:** Data from the city of Minneapolis, MN, in 2009 were aggregated and analyzed at the neighborhood level. We examined the association between alcohol establishment density and five categories of nonviolent crime: vandalism, nuisance crime, public alcohol consumption, driving while intoxicated, and underage alcohol possession/consumption. A Bayesian approach was used for model estimation accounting for spatial auto-correlation and controlling for relevant neighborhood demographics. Models were estimated for total alcohol establishment density and then separately for off-premise establishments (e.g., liquor and convenience stores) and on-premise

establishments (e.g., bars and restaurants). **Results:** We found positive associations between density and each crime category. The association was strongest for public consumption and weakest for vandalism. We estimated that a 3.3%–10.9% increase across crime categories would result from a 20% increase in neighborhood establishment density. Similar results were seen for on- and off-premise establishments, although the strength of the associations was lower for off-premise density. **Conclusions:** Our results indicate that communities should consider the potential increase in nonviolent crime associated with an increase in the number of alcohol establishments within neighborhoods. (*J. Stud. Alcohol Drugs*, 73, 21–25, 2012)

A GROWING BODY OF INTERNATIONAL literature has found significant associations between alcohol establishment density and crime—especially violence-related crime such as assaults and homicide (Livingston, 2008; Livingston et al., 2007; Nielsen and Martinez, 2003; Popova et al., 2009; Reid et al., 2003; Speer et al., 1998). Only a few studies have examined effects of alcohol establishment density on nonviolent crime.

Two studies have assessed the relationship between density of alcohol establishments and vandalism and nuisance crimes. One found a positive association between density and vandalism, public urination, vomiting, and drunkenness near college campuses (Wechsler et al., 2002). The other found a positive association between establishment density and drunkenness but not property damage (Donnelly et al., 2006). A number of studies have examined associations between establishment density and alcohol-related traffic outcomes such as crashes, fatalities, and self-reported drinking and driving, and most found positive associations (Escobedo and Ortiz, 2002; Gruenewald et al., 2002; Scribner et al., 1994; Stout et al., 2000; Treno et al., 2003; 2007). However,

only two studies examined effects of density on arrests for driving while intoxicated—one found a negative association (Smart and Mann, 1998), and the other found no association (Gruenewald et al., 2002).

A few studies found that alcohol establishment density may have an effect on behavior of those younger than age 21, but none specifically examined effects on underage possession/consumption arrests. Densities of off-premise alcohol establishments (but not bars and restaurants) were shown to be positively associated with traffic crash injuries among underage youth in California (Gruenewald et al., 2010), and a positive association was found between establishment density and underage drinking rates (Chaloupka and Wechsler, 1996; Chen et al., 2010).

The few studies assessing effects of density of alcohol establishments on nonviolent crime outcomes have some common limitations. Several did not distinguish effects of different types of establishments, and several did not control for potential spatial autocorrelation, which may lead to the conclusion that there is a relationship between establishment density and crime when, in fact, there is not such a relationship (Lipton and Gruenewald, 2002).

We assessed effects of establishment density on five categories of nonviolent crime (vandalism, nuisance crime, public alcohol consumption, driving while intoxicated, and underage alcohol possession/consumption). We controlled for spatial auto-correlation and analyzed separate effects for density of total establishments, on-premise establishments (e.g., bars and restaurants), and off-premise establishments (e.g., liquor stores).

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Method

This study used data from Minneapolis, MN, with neighborhood used as the geographic unit of analysis. Although smaller geographic units (e.g., census blocks) provide greater statistical power, there is no theoretical or political basis for using these units. We chose neighborhoods as the unit of analysis based on the theory of collective efficacy, which defines *collective efficacy* as “the linkage of mutual trust and the willingness to intervene for the common good” (p. 919) (Sampson et al., 1997). Residents within a neighborhood identify with each other and often unite to shape the development and safety of their neighborhood, and community leaders often represent or work in neighborhoods.

Minneapolis is composed of 87 neighborhoods. We excluded three neighborhoods that were designated by the city as industrial areas and one neighborhood because it recently experienced a 96% decline in population. Thus, 83 Minneapolis neighborhoods were eligible for the current study, ranging in population size from 128 to 15,247 ($M = 4,607$), with the percentage of the neighborhood population that is White ranging from 15.0% to 94.9%.

Alcohol establishments

We obtained a current list of 663 licensed alcohol establishments from the Minneapolis Department of Regulatory Services during fall 2009. We identified 40 duplicates, resulting in a final sample of 623 establishments (503 on-premise establishments and 120 off-premise establishments). Addresses for the alcohol establishments were geocoded, using an address locator in ArcGIS and 2009 street/address data from the Twin Cities Metropolitan Council, and then assigned to neighborhoods. The score (a percentage) of the address locator determined the level of accuracy of where the establishment was placed. All establishments were successfully geocoded, with only 14 addresses receiving a score less than 100%. These 14 addresses were individually evaluated (i.e., searched on Google Maps, Bing Maps, and Yellowpages.com/Whitepages.com) to confirm the addresses and assigned to the correct neighborhood.

We created three alcohol-establishment density measures: (a) density of all establishments, (b) density of on-premise establishments, and (c) density of off-premise establishments. We calculated density as the number of establishments per roadway mile, which presents establishment density in terms of the functional paths people take in their community (Gruenewald et al., 1996; Lipton and Gruenewald, 2002). Roadway miles were calculated using the following rules: (a) eliminating alleys and freeway on/off ramps, (b) assigning an undivided road or highway/freeway that fell on the border of two neighborhoods equally to both neighborhoods, and (c) for roads that crossed a boundary,

assigning the part of the road that fell within a given neighborhood to that neighborhood.

Crime

We obtained crime data for October 1, 2008–September 30, 2009 from the Minneapolis Police Department. These data included Uniform Crime Report Part 1 and Part 2 reported crime. Only primary offenses for each incident were included in the dataset. We achieved a 99% success rate in mapping the crime incidents. We used the coordinates provided by the Minneapolis Police Department, when present, to assign each crime to a neighborhood. Accuracy of these coordinate data was checked by geocoding a subset of the crime incidents using an address locator in ArcGIS and 2009 street/address data from the Twin Cities Metropolitan Council. All coordinates were accurate within 36 yards. Crime incidents that did not include coordinate information were geocoded using the ArcGIS address locator. Crime incidents that fell on neighborhood boundaries (1.04%) were randomly assigned to one of the neighborhoods separated by the boundary. For each of the five crime categories, we estimated raw standardized crime ratios, defined as 100 times the ratio of observed crime counts to the number we would have expected had the crime in question been uniformly distributed across the entire study region.

We included five crime categories: vandalism (range: 7–269; $M = 58$), nuisance crime (range: 0–676; $M = 38$), public alcohol consumption (range: 0–527; $M = 15$), driving while intoxicated (range: 0–155; $M = 12$), and underage alcohol possession/consumption (range: 0–114; $M = 5$).

Neighborhood demographics

We identified potential control variables based on a review of the literature and created an index measuring economic and racial characteristics based on composite measures used in similar studies (e.g., Kikuchi and Desmond, 2010; Morenoff et al., 2001). We selected seven 2000 U.S. Census measures for the index (we obtained all census data from the City of Minneapolis): (a) percentage of female-headed households (number of households with female householder and no husband present and own children younger than age 18 divided by total number of households), (b) percentage of rental housing units (specified renter-occupied units divided by total number of housing units), (c) percentage of families below poverty (number of families below poverty level divided by number of families for whom poverty status is determined), (d) percentage of unemployment (number unemployed in civilian labor force among those age 16 or older divided by number in civilian labor force among those age 16 or older), (e) median household income, (f) median home value, and (g) percentage White (number of Caucasians divided

by total population). We standardized the seven variables with $M = 0$ and $SD = 1$ (missing values for one neighborhood for “percentage of families below poverty” and “median home value” were replaced with mean value of 0). We then summed the seven variables to create the index (index values range from -13.14 to 10.688; α coefficient = .87). In addition to the index, we included two other demographic variables in our analyses: population density (total population divided by total roadway miles) and total persons ages 15–24. Previous studies also controlled for the number or percentage of males; however, in our initial analyses we found little variability in percentage of males across neighborhoods, and thus, we did not control for this variable in our final analyses.

We calculated misalignment between neighborhood boundaries and census block groups with ArcMap spatial analysis tools by calculating the geometry of attribute information for polygons. Excluding industrial areas, the percentage of total misaligned residential areas is less than 1%, suggesting negligible bias in Census estimates because of misalignment.

Analyses

A Bayesian hierarchical inferential approach that accounts for spatial association among neighborhoods was used to model the data. Unlike a frequentist approach that views model parameters as fixed values that can only be estimated

from the data, the Bayesian approach views model parameters as random variables with a distribution that reflects prior knowledge. These prior distributions are then combined with the collected data, resulting in a posterior distribution of all parameter estimates, on which inferences are based. The Bayesian approach is particularly well suited to complex, hierarchical models needed for spatially correlated data (Carlin and Louis, 2009).

Crime counts from each neighborhood were modeled using a Poisson likelihood, in which the expected number of crime incidents in the i^{th} neighborhood is $E_i \exp(\mathbf{x}_i \beta + \theta_i + \varphi_i)$, where E_i is the number of crime incidents we would see in the i^{th} neighborhood if crime were uniformly distributed across the city, calculated by multiplying the number of roadway miles in the neighborhood by the city-wide crime per roadway mile rate. In addition, $\mathbf{x}_i$ denotes the vector of neighborhood-specific covariates, β is a corresponding vector of coefficients, and θ_i represents random (nonspatial) error. By contrast, φ_i are random effects that capture the spatial autocorrelation between the neighborhoods using the conditionally autoregressive model first used in this context by Besag et al. (1991). All models were analyzed using the OpenBUGS software package, Version 3.1.1 (Lunn et al., 2009).

We also computed the percent increase in model-predicted crime associated with a 20% increase in the alcohol establishment density in a neighborhood with average establishment density. Because the densities in our model

TABLE 1. Results of associations between alcohol establishment density and nonviolent crime (estimate [est.] and 95% confidence interval [CI])

Crime	Alcohol establishment density Est. [95% CI]	Population density Est. [95% CI]	Economic/ racial index Est. [95% CI]	Age 15–24 Est. [95% CI]	% increase ^a
Total establishments					
Vandalism	0.26 [0.17, 0.35]	0.20 [0.07, 0.33]	-0.34 [-0.46, -0.21]	0.06 [-0.06, 0.17]	3.30%
Nuisance	0.50 [0.34, 0.67]	0.17 [-0.08, 0.42]	-0.70 [-0.92, -0.47]	0.18 [-0.04, 0.41]	6.40%
Driving while intoxicated	0.48 [0.35, 0.62]	0.05 [-0.15, 0.26]	-0.28 [-0.47, -0.09]	0.17 [0, 0.34]	6.20%
Public consumption	0.83 [0.48, 1.19]	0.62 [0.16, 1.02]	-0.94 [-1.36, -0.54]	0.13 [-0.24, 0.53]	10.90%
Underage possession/consumption	0.40 [0.11, 0.69]	-0.18 [-0.57, 0.23]	-0.38 [-0.74, 0.01]	0.53 [0.15, 0.87]	5.10%
On-premise establishments					
Vandalism	0.25 [0.16, 0.35]	0.20 [0.07, 0.33]	-0.35 [-0.46, -0.23]	0.06 [-0.05, 0.18]	2.80%
Nuisance	0.50 [0.33, 0.68]	0.18 [-0.06, 0.43]	-0.70 [-0.92, -0.49]	0.18 [-0.04, 0.4]	5.60%
Driving while intoxicated	0.47 [0.34, 0.61]	0.07 [-0.14, 0.27]	-0.28 [-0.47, -0.09]	0.15 [-0.02, 0.33]	5.30%
Public consumption	0.83 [0.48, 1.13]	0.59 [0.13, 1.03]	-0.96 [-1.4, -0.52]	0.12 [-0.28, 0.51]	9.50%
Underage possession/consumption	0.38 [0.11, 0.65]	-0.17 [-0.56, 0.23]	-0.39 [-0.75, -0.01]	0.53 [0.18, 0.91]	4.20%
Off-premise establishments					
Vandalism	0.17 [0.07, 0.26]	0.18 [0.03, 0.32]	-0.29 [-0.42, -0.15]	0.07 [-0.06, 0.21]	2.90%
Nuisance	0.21 [0.03, 0.39]	0.14 [-0.15, 0.45]	-0.61 [-0.87, -0.35]	0.19 [-0.08, 0.47]	3.60%
Driving while intoxicated	0.28 [0.11, 0.44]	0.02 [-0.23, 0.26]	-0.16 [-0.38, 0.07]	0.17 [-0.05, 0.39]	4.80%
Public consumption	0.35 [-0.04, 0.73]	0.51 [-0.01, 1.09]	-0.68 [-1.19, -0.2]	0.14 [-0.32, 0.62]	6.00%
Underage possession/consumption	0.35 [0.07, 0.63]	-0.24 [-0.65, 0.19]	-0.28 [-0.65, 0.08]	0.56 [0.16, 0.95]	6.00%

Notes: **Bold** text indicates statistical significance at the $p < .05$ level. Est. [95% CI] columns refer to Bayesian point and 95% CI estimates for the components of the β vector described in the *Analyses* section. ^aPercentage increases corresponding to a 20% increase density in a neighborhood with the average density.

are first standardized to have an *M* of 0 and an *SD* of 1, we computed this percentage as 100 times the quantity:

$$\exp\left(\frac{0.2 \times \text{Mean}(\text{Density})}{\text{SD}(\text{Density})}\right) - 1$$

Results

We found statistically significant positive associations between density of total alcohol establishments and each of the five crime outcomes (Table 1). We estimated that there was a 3.3%–10.9% increase across crime categories resulting from a 20% increase in the alcohol density in a neighborhood with an average density.

Results for density of on-premise alcohol establishments were very similar to those for total alcohol establishment density (Table 1). We observed a statistically significant positive association between on-premise alcohol establishment density and each crime outcome. The estimates of an increase in crime associated with a 20% higher on-premise density show similar patterns as total density across crime categories; however, the estimates for on-premise density are slightly lower.

Associations between off-premise density of alcohol establishments and each crime category were all positive, but the strength of the associations was lower across crime outcomes compared with the observed associations for total alcohol establishment density and on-premise establishment density. The estimated effect of a 20% increase in off-premise density also shows a similar pattern to total and on-premise density across crime categories, but the estimates are lower for three of the five crime categories.

Discussion

This study advances the research literature by using state-of-the-art analytical methods that allow us to control for spatial autocorrelation and by assessing the relationship between density of alcohol establishments and five crime outcomes that have not been studied or have been infrequently evaluated in previous alcohol density studies. We observed a positive association between density of alcohol establishments and several categories of nonviolent crime.

The strongest association was between total establishment density and public consumption. We also found a similarly strong association between public consumption and on-premise density but no association for off-premise density. It is possible that individuals who purchase alcohol at off-premise establishments may consume the alcohol, and thus be arrested for public consumption, in a different neighborhood than the one in which they purchased it, or perhaps they consume in private residences rather than in public.

The associations between density of alcohol establish-

ments and underage possession/consumption were much weaker overall compared with public consumption, but they were significant for total, off-premise, and on-premise density. The significant association for off-premise density for this outcome and not public consumption may be explained by the fact that underage youth can be penalized for simply possessing alcohol as well as for consuming it; hence, youth may purchase alcohol at off-premise establishments and then be arrested after exiting the store or if near the store (Harrison et al., 2000; Wagenaar et al., 1996).

Similar to other studies (Gyimah-Brempong and Racine, 2006; Wechsler et al., 2002), we observed a positive association between establishment density and vandalism. The earlier studies assessed effects of only total alcohol establishment density, but we found that although the associations were stronger for on-premise than off-premise density, the estimated percentage increase in vandalism incidents with a 20% increase in density was almost equal for on- and off-premise establishments.

Patterns of strength of associations for nuisance crime and driving while intoxicated incidents with total, on-premise, and off-premise densities were very similar. However, the associations were stronger for on-premise density than for off-premise density. When individuals purchase alcohol at off-premise establishments, they often consume that alcohol in their home, meaning they would be less likely to drive under the influence of alcohol or be in a public situation in which they would be arrested for a nuisance crime (e.g., disorderly conduct).

Limitations of this study include the cross-sectional design and the fact that it was limited to one metropolitan area. In addition, police arrest data include only offenses for which police were notified and had sufficient evidence to warrant a written report. A limitation of police data is that differential rates across neighborhoods may be influenced by variability in enforcement priorities across these areas. However, this is the best crime data available, and there are no clear measures of enforcement priorities. Last, we did not control for potential edge effects of alcohol establishments located in communities near the borders but outside our study region. However, we believe there should be few edge effects given that most of the surrounding communities are residential areas that do not have a dense distribution of establishments located near the borders.

Positive associations between alcohol establishment density and a wide range of crimes have been consistently found across many studies using different methodologies. Future studies should assess longitudinal effects of changes in establishment density and whether neighborhood characteristics can modify these relationships. Results from this study and others suggest that communities should consider the potential economic and societal costs of increasing the number of alcohol establishments within neighborhoods.

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