Article

Alcohol Outlets and Neighborhood Crime: A Longitudinal Analysis

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Abstract

This article examines the relationship between the number of alcohol outlets in block groups and the number of incidents of street crimes in Norfolk, Virginia. Cross-sectional and longitudinal panel designs are used to explore the relationship. Results were corrected for spatial autocorrelation and controlled for variation in size of population, socioeconomic disadvantage, and a dummy variable for being the downtown area. The cross-sectional analysis revealed a strong relationship between the number of alcohol outlets and the number of street crimes for on-premises and off-premises outlets. A panel design was then used to examine the effects of newly established outlets on the change in the number of street crime events over three periods. All three panels showed significant relationships between the number of alcohol outlets and the number of street crime events controlling for prior levels of crime, socioeconomic disadvantage, population size, and a spatial lag.

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Introduction

The United States launched its first attempts to control the availability of alcohol in the early 19th century through the temperance movements. These efforts, aimed at reducing the consumption of alcohol, began in the 1820s and represented the first major public efforts to control drug use of any type in the United States (Mills, 1943; Nusbaumer & Reiling, 2007). The members of the temperance movements believed that alcohol consumption was the cause of many, or even most, of the social problems of the day and that controlling or eliminating the availability of alcohol would reduce the amount and seriousness of these problems (Heath, 1989). Through time, more modern temperance movements continue to focus on the dangers of the availability of a variety of drugs, with the emphasis no longer as much on alcohol as other drugs. However, social scientists continue to seek to provide careful examinations of the links between alcohol accessibility and violent crimes. This article joins in this endeavor.

Although the causal nature of the relationship is debated, a clear link between alcohol consumption and criminal behavior is solidly established in social science literature (see Parker & Auerhahn, 1998; Sumner & Parker, 1995, for very different interpretations of the literature). Over time, the research has been advanced by the developments in sophisticated mapping technology, which have accompanied the growth of investigations into the relationship between variation in supplies of alcohol, such as bars and convenience stores that are located in geographical areas, and variation in crime, including violence and other forms of social disorder. Regardless of the year, the location the research was conducted, or the sophistication of the mapping technology used, however, the connection between alcohol availability and crime has been demonstrated most often through cross-sectional correlation. Our article follows the trail of research into the effects of alcohol availability in geographical space by examining the relationship between the number of alcohol outlets, offering on- and off-premises consumption, in census block groups in Norfolk, Virginia. We move beyond cross-sectional studies by looking at the effects of the introduction of alcohol outlets over three time waves with stringent controls, including prior measures of crime.

Literature Review

Over time, researchers have used a variety of measures and techniques to explore the relationship between alcohol and crime. Thus far, cross-sectional studies are the most common. They vary in the measure of alcohol availability

they use with variation in price and density of outlets commonly used. Less frequent are longitudinal studies that allow examination of change and a stronger test of a causal relationship.

Variation in Price As a Measure of Availability

Researchers have studied the effects of alcohol availability on a number of different criminal outcomes. The basic assumption of these studies is that as the price of alcohol increases, residents' ability to purchase alcohol decreases and consumption will decrease. In an early study, regression analysis showed increases in the state beer tax, which raises the amount one spends to buy a beer, were associated with a decrease in homicides, rapes, assaults, and robberies (Cook & Moore, 1993). In addition, Grossman and Markowitz (1999) have examined the effect of price of alcohol on a variety of violent outcomes. They determined that the price of alcohol was inversely correlated with the amount of violence on college campuses. Considering the reverse of increased prices, Markowitz (2000) showed that as alcohol became more accessible due to lower prices in an area, physical fights increased among teenagers. In addition, lower prices per ounce of alcohol have been associated with higher rates of "wife abuse" (Markowitz, 2000), domestic child abuse (Markowitz & Grossman, 1998), and violent behavior (Chaloupka, Grossman, & Saffer, 2002).

Alcohol Outlet Density: Cross-Sectional Studies

Using a more direct measure of accessibility, research has also looked at the presence of alcohol outlets or the density of alcohol outlets and its relationship with crime, in particular violent crimes. The research linking alcohol availability with various types of violent and disorderly offenses is profuse and has been conducted in a wide variety of locations. Over the past 40 years or so, studies have examined the relationship between alcohol availability and crime by examining the correlation between the presence or number of alcohol outlets in areas such as blocks, block groups, and census tract and crime across a wide range of cities and time points. For example, studies have examined the relationship across block groups in Cleveland in 1970 (Roncek, Bell, & Francik, 1981) and from 1979 to 1981 (Roncek & Maier, 1991) and San Diego in 1970 (Roncek & Pravatiner, 1989). In addition, block groups have been used as proxies for neighborhoods in the search for a relationship between alcohol outlet and crime in Camden, New Jersey, in 1990 (Gorman, Speer, & Gruenewald, 2001), in Baton Rouge in 1992 (Costanza, Bankston,

& Shihadeh, 2001), and in a "Northern California City" in 2000 (Freisthler, Needell, & Gruenewald, 2005). At an even higher level of aggregation, census tracts have most commonly been used as a unit of analysis expected to be relatively good representations of neighborhoods. A relationship between alcohol outlets and crime has been examined at this level in Austin and San Antonio in 2000 and 2002 (Zhu, Gorman, & Horel, 2004), in Houston in 2000 (Gorman, Li, & Horel, 2005), in Kansas City in 1995 (R. J. Reid, Hughey, & Peterson, 2003), in Detroit in 1992 (Gyimah-Brempong, 2001), in New Orleans in 1994-1995 (Scribner, Cohen, & Kaplan, 1999), and in Columbus, Ohio, in 1990 (Peterson, Krivo, & Harris, 2000).

Speer, Gorman, Labouvie, and Ontkush (1998) published one of the few studies that has looked at the relationship between alcohol outlets and crime at multiple levels of analysis (block groups and census tracts). The study site was Newark, New Jersey (summers of 1993 and 1994). They found that alcohol outlet density was predictive of violent crime at both levels of analysis. In fact, they report that density of alcohol outlets at the census block group level had more effect on violence crime rates than any demographic characteristic that they measured at the block group or census tract level (Speer et al., 1998).

A variety of types of violent crimes have been linked to alcohol availability, including index crimes, separately and as indexes (Gyimah-Brempong, 2001; Peterson et al., 2000; Roncek & Maier, 1991), homicide (Gyimah-Brempong, 2001; Parker, 1995; Parker & Cartmill, 1998; Parker & Rebhun, 1995; Scribner et al., 1999), youth homicide (Parker & Rebhun, 1995), assault (Gruenewald, Freisthler, Remer, LaScala, & Treno, 2006), assaultive violence (R. J. Reid et al., 2003), child abuse and neglect (Freisthler, 2004; Freisthler et al., 2005), gang-related violence (Parker, Luther, & Murphy, 2007), college campus rape rates (Scribner, Mason, Simonsen, & Dejong, 2010), and gunshot victimization (Branas, Culhane, Richmond, & Wiebe, 2008).

All the studies above have shown positive correlations between the presence and the density of outlets on crimes of violence. All of these studies are cross-sectional studies with statistical controls for a variety of potentially confounding variables. None of them, however, provides longitudinal data or controls for prior crime. These are problems for drawing conclusions about the relationship between alcohol availability and crime. The researchers exploring this relationship generally argue that it is the availability of alcohol that leads to the higher crime rates. The reverse is also possible; however, it could be that areas where crime rates are high have high levels of alcohol availability because of the high stress involved in living in a high crime area. Longitudinal research would help address the issue of causal direction.

Longitudinal Research

The vast majority of aggregate-level research on alcohol availability and crime has been cross-sectional in nature. However, a few studies have examined the relationship over time. For example, a natural experiment resulted in Norway when alcohol availability was reduced as the result of a labor strike by the employers of the state wine and distribution system, which prevented deliveries to retail markets. A reduction in consumption and a concomitant reduction in domestic and general violence were observed after the inception of the strike (Hauge, 1988).

Norstrom-Thor published two times series analyses with national level Swedish data. The first examined the effects of on-premise sales of beer and spirits and retail sales of spirits on assaults and homicide rates between 1956 and 1994 (Norstrom, 1998). Alcohol sales explained 40% of the variation in assault rates and 50% of the variance in homicide rates. In the second study, he examined the effect of outlet density on crimes of violence investigated by the police and convictions for violence between 1960 and 1995. Outlet density was significantly related to violent crimes investigated by the police but was unrelated to convictions (Norstrom, 2000).

Two studies examined longitudinal data in the United States. The first study by Cook and Moore (1993) used a pooled-cross-sectional design with 48 contiguous states as the unit of analysis for the years 1979 to 1988 (total $n = 480$). The amount of beer taxes that varied by state and changed considerably over time was their measure of alcohol availability. They found negative relationships between beer taxes and homicide, assault, rape, and robbery. In a second study, Parker and Rebhun (1995) examined the relationship between alcohol availability (number of liquor stores per 1,000 population) and homicide across 256 U.S. cities in 1960, 1970, and 1980. For the 1970 and 1980 models, homicides rates from the prior decade were used as controls. They found a direct relationship between alcohol availability and homicide, but only in 1970. Interestingly, they found that alcohol availability interacted with "poverty," "young age structure," and "low social bonds" in certain years suggesting that certain characteristics of cities may exaggerate the effect of alcohol availability on homicide.

These studies suggest that alcohol availability may affect crime over time at the city, state, and national levels. Although researchers have lamented the cross-sectional nature of their analyses in neighborhood-levels studies (e.g., Gorman et al., 2005; R. J. Reid et al., 2003), to our knowledge only one study has examined the longitudinal effect of alcohol availability on crime at a unit of analysis that comes close to the neighborhood level.

Gruenewald and Remer (2006) conducted a study examining the effect of alcohol outlet density on assaults across 581 California zip codes over 6 years controlling for several sociodemographic controls, including prior levels of crime. The authors examined three types of outlets: bars, restaurants, and off-premise alcohol outlets. Both bars and off-premise alcohol outlets were positively related to assaults, whereas restaurants were negatively associated with assaults.

The smaller level of aggregation in this study was an important step for studies that use longitudinal analyses to develop a better understanding of the causal link between alcohol outlet density and violent crime. However, postal zip codes are problematic units of analysis if one is attempting to approximate a neighborhood level. Zip codes often include several resident-defined neighborhoods, block groups, and census tracts. The goal of the current article is a longitudinal analysis with a better approximation of neighborhood as the unit of analysis and controls for prior crime. However, before these analyses are presented, we briefly discuss why a relationship between alcohol and violent behavior might be expected.

Understanding the Relationship Between Alcohol Use and Violent Behavior

Although the correlation between alcohol and violent crime is well known, the mechanisms linking them are not well understood. It appears that the linkages involve the social-psychological characteristics of the consumer, the effects of alcohol on biochemistry, and the social context of crime. Using data from the national Longitudinal Study of Adolescent Health, Felson, Teasdale, and Burchfield (2008) found that, among teenagers, drinking alcohol was causally implicated in fighting and that drinkers who commit violence were more likely to commit violence while sober than nondrinkers. This suggests that violence produced by intoxication often comes from those drinkers already predisposed to violence. This supports Dilulio (1995) who stated that, "alcohol is a multiplier of crime," that is, alcohol may increase violence among those already predisposed to violence (p. 5).

Several additional explanations have been postulated for the effects of alcohol consumption on violent behavior (Collins, 1981; Roizen, 1993). Perhaps the most often explanation offered is some version of the disinhibition hypothesis (e.g., Shuntich & Taylor, 1972; Vikkunen, 1994). In effect, this explanation suggests that alcohol weakens internal controls that normally come into play when not drinking. Also, the heightened arousal hypothesis has been suggested (Boyatzis, 1983) which argues that alcohol consumption

can lead to increased arousal and aggression. Both of these explanations involve hypotheses regarding the effects of the chemical alcohol on the brain. The time-out hypothesis (Orcutt, 1975) suggests, alternatively, that it is the drinking setting that signals a different set of norms than nondrinking settings (Alaniz, Cartmill, & Parker, 1998; Clairmond & Magill, 1974). These authors contend that the norms in drinking places are less restrictive on behavior allowing actors in the drinking setting to act in ways that may be aggressive and provocative to others.

Parker and colleagues have argued that understanding the higher rates of violence emerging from alcohol consumption requires an analysis of both the disinhibiting chemical effects and the interaction that takes place when drinkers or drinkers and others come together—the selective disinhibition approach. This approach specifies the ways in which norms prohibiting violence are overridden when social actors become intoxicated (Parker, 1993; Parker, 1995; Parker & Rebhun, 1995). The key elements coming to play are located in the structure of the social situation. These elements interact with intoxication leading to the suspension of norms that control behavior. Perhaps this provides an explanation for conclusions like those of Spunt, Goldstein, Brownstein, Fendrich, and Langley (1994) who reported that interviews with 268 prison inmates incarcerated for homicide determined that the substance most likely to be used by homicide offenders on a regular basis as well as during the 24 hr directly preceding the crime was, overwhelmingly, alcohol.

Method

The large majority of research studies on alcohol availability and crime are conducted within a cross-sectional framework with statistical controls. Here, we also include a cross-sectional analysis of alcohol outlets and street crimes. We specifically look at the relation of establishments selling alcohol for "on-premises" consumption and those that sell only alcohol for "off-premises" consumption. This analysis is followed by a longitudinal analysis of outlets and street crime using three panel waves. Each panel includes all the establishments that were introduced during the 3-year period. The number of street crime events in the final year of the 3-year period is compared with the number of crimes in the year prior to the introduction of the outlets.

Norfolk, Virginia

The city of Norfolk, Virginia, was selected because all the authors reside in the city of Norfolk. This affords benefit of personal knowledge of the

character of the neighborhoods and many of the alcohol outlets included in the study. The authors have also have had discussions with the zoning department regarding the establishment of commercial and residential zoning. In addition, the authors have tracked the licensing of alcohol outlets and crime for a number of years. Some of that knowledge is displayed in this article to help account for unanticipated findings. This advantage is illustrated on the analysis of neighborhoods that departed from expected directions.

Norfolk is not a particularly unusual city. It is located in about the middle of the East Coast. The city is an active working port with a population of 242,803 in 2010. It comprised 47.1% Whites, 43.1% African Americans, 6.6% Hispanics, and 3.3% Asians. In many respects, it has the characteristics of an average to moderately large size city, but in some respects, because it is embedded with other smaller cities in the larger metropolitan complex of Hampton Roads (population of 1,656,718 in 2010), it has features of a larger metropolitan city.

Unit of Analysis: Census Block Groups

We used U.S. Census 2000 block groups as our units of analysis. Smaller division into blocks would have resulted in too many errors in classifying both crimes and alcohol outlets that reside on the streets bordering the blocks. However, the larger census tracts would reduce the number of units considered for the analysis and involve less precise measures of demographic features of the environment of the outlets. We use 183 block groups out of a total of 188 in the city of Norfolk, Virginia. Two block groups were omitted because the populations were less than four residents and three were not included because they were part of a large naval base with an unstable population. The populations in the naval base block groups are quite large but do not provide an accurate estimate of the population at any given time. This is because many residents of the base are located on large ships that may or may not be in port at any given time. Another reason for not including the block groups in the naval base is that many of the offenses that might normally be reported to the Norfolk Police Department are instead handled by the military police and are thus not recorded in our data.

Measures

Dependent variable. We obtained the crimes-known-to-the-police data from the Norfolk Police Department for the years from 1999 to 2009. Crime

events considered in this article are *street crimes*, including homicide, aggravated assault, simple assault, rape, and robbery to individuals. We located the crime events in the block groups by geo-coding the addresses for the crimes using ESRI ArcGIS. We were often able to manually insert crime events listed for streets not appearing on the map in the appropriate block groups. In all, less than 3% of the events in the police files were omitted because addresses could not be matched to the U.S. street maps established by the census tiger maps for the year 2000.

Independent variables. Our key independent variable is the number of alcohol outlets. We obtained a listing of all licensed alcohol establishments located in Norfolk, Virginia, from the Virginia Alcohol Control Board. For the cross-sectional analyses, we included all establishments licensed by the state to sell wine or beer either on the premises or off premises in 2008. For the longitudinal, we collected information on changes in alcohol outlets from 2000-2002, 2003-2005, and 2006-2008 described below. We excluded large private clubs, hotels, and catering services. Many of the "on-premises" outlets included in our study are restaurants principally known for serving food, although most of these restaurants also include separate bar areas catering to customers who visit for drinks without ordering meals. Our listing also includes alcohol outlets such as grocery and convenience stores that sell beer and wine for off-premises-only consumption. In addition, we have also included the state liquor stores. Virginia does not have private liquor stores, only state-owned stores are authorized to sell bottled liquor for off-premises use. However, restaurants and bars may obtain licenses to sell liquor by the drink for consumption on their premises. The cross-sectional analysis used outlets in Norfolk in 2008. During the time period, there were 271 outlets suitable for our research in the city of Norfolk. We examined the effects of both "on premises" and "off premises" each on street crime rates for the cross-sectional analysis. For the longitudinal analyses, we only had to add in the changes in the total number of alcohol outlets for the years examined.

Control variables included population estimates for the block groups from the 2000 census. This variable was used to control for the variation in resident population across the block groups. A composite measure of socioeconomic disadvantage was also created to control for variation in socioeconomic features of the block groups. To reduce of the risk of high multicollinearity, the six variables representing levels of socioeconomic status were combined using principal components factor analysis (see Sampson, Raudenbush, & Earls, 1997). The six measures used to capture socioeconomic disadvantage, and their factor scores, are median family income (–0.859), percentage of female-headed families (0.807), percentage of person above age 25 with a college degree

Table 1. Descriptive Statistics (n = 183).

	M	SD	Minimum	Maximum
Cross-sectional analyses				
Street crime 2008	21.74	14.80	0.00	113.00
Socioeconomic disadvantage	0.00	0.99	−2.41	2.77
Population size	1,153.48	482.59	339.00	3,824.00
Alcohol outlets 2008	1.85	4.22	0.00	42.00
On-premise outlets 2008	1.73	4.22	0.00	41.00
Off-premise outlets 2008	1.36	1.45	0.00	7.00
Variables added in longitudinal analyses				
Street crime 1999	17.65	12.15	0.00	64.00
Street crime 2002	19.32	15.66	0.00	92.00
Street crime 2005	21.77	18.18	0.00	114.00
Street crime 2008	21.74	17.80	1.00	113.00
Δ Alcohol outlets 2000-2002	0.48	1.14	0.00	11.00
Δ Alcohol outlets 2003-2005	0.20	0.75	0.00	7.00
Δ Alcohol outlets 2006-2008	0.36	1.37	0.00	1.37

(–0.638), unemployment rate (0.641), percentage of under poverty level (0.867), and percentage of owner occupied homes (–0.706). The socioeconomic factor explained 57.63% of the variance across the set of six measures.

Finally, two block groups comprising the downtown area of Norfolk are distinctly different from the other areas of the city. The largest concentration of bars, restaurants, and music venues as well as the hockey rink are located in these two block groups. There is also a community college, many commercial firms, hotels, a nautical museum, a large shopping mall, and a waterfront area that hosts a variety of festivals during the summers. Most of the festivals include multiple vendors selling beer and wine. Given all these attractions, it was impossible to know the size of the population present in the downtown area at any given time. Thus, we created a dummy variable indicating if the block groups were one of the two downtown block groups to control for this area. Table 1 provides descriptive statistics for the sample.

The mean number of street crimes varied considerably over the block groups and rose slightly over the study period. The number of alcohol outlets also varied considerably across block groups in 2008 with far more variation in on-premise than off-premise establishments. Change in the number of alcohol establishments was relatively small with the largest change occurring in the 2000-2002 time period.

Statistical Technique

For the cross-sectional analyses, we focus on the year 2008 and include a disaggregated analysis, including all alcohol outlets, on-premise outlets, and off-premise outlets. The basic model for the longitudinal analysis was to regress the incidence of crime in the last year of the establishment period for the alcohol outlets on the number of alcohol outlets in each block group while controlling for variation in population, socioeconomic disadvantage, and number of crime events for the year preceding the establishment of the outlets across the block groups. This procedure allowed us to determine the effects of outlets on the change in crime events over the period. This procedure was repeated for each of the three periods, 2000-2002, 2003-2005, and 2006-2008. The basic model for the analysis involved the regression of the of crime events (street violence) in the last year of the establishment period for the alcohol outlets. We also controlled for population size, socioeconomic disadvantage, and for the downtown block groups. All models include a control for a spatial lag to correct for spatial autocorrelation which turned out to be quite high in this study, as it has been in other studies of this nature (e.g., Gorman et al., 2005; Zhu et al., 2004).

Results

Cross-Sectional Analyses

First, we examined a cross-sectional analysis of Norfolk for 2008 (Table 2). The first model of this analysis shows that the total number of alcohol outlets in a block group is strongly related to the number of violent street crime events controlling for socioeconomic disadvantage, population size, and the spatial lag. As expected, the size of the population, socioeconomic disadvantage, and the spatial lag are also positively correlated with the number of street crimes. The downtown factor is unrelated to street crimes perhaps due to lack of variation (only two cases).

To determine the block groups in which the number of outlets most over-predicts street crimes and the ones in which street crime are most underpredicted, we examined the features of the four block groups with the highest positive residual values and the four with the highest negative residual values. The overpredicting block groups consisted of two areas in Norfolk. The first is an area containing several middle-price restaurants, many of them specialize in international menus, Thai, Bolivian, Mexican, Japanese, and so on. Most of these establishments serve alcoholic beverages and most close

Table 2. Effects of Alcohol Outlets on Street Crime (2008) Controlling for Population Size, Socioeconomic Disadvantage, and Spatial Autocorrelation.

	b (SE)	b (SE)	b (SE)	b (SE)
Spatial lag	.389 (.389)**	.498 (.069)**	.470 (.075)**	4.69 (.070)**
Constant	.262 (2.624)	.974 (2.687)	.641 (2.844)	.856 (2.692)
Population size	.008 (.002)**	6.631 (.952)**	6.076 (.989)**	6.561 (.946)**
Socioeconomic disadvantage	6.853 (.912)**	.005 (.002)**	.005 (.002)**	.005 (.002)**
Alcohol outlets	1.747 (.255)**			
On-premise outlets		1.905 (.314)**		1.365 (.757)**
Off-premise outlets			3.107 (.660)**	1.541 (3.73)
Downtown	9.985 (10.264)	−3.760 (12.538)	47.428 (9.153)**	5.287 (13.359)
R^2	.544	.553	.520	.561

*$p < .05$. **$p < .01$.

after the dinner service. In addition, they attract clients who are chiefly interested in the food rather than the drinks. The other overpredicted area contains a number of "quality" seafood restaurants arranged along the Chesapeake Bay. Also in this area are some dock-side convenience stores catering to the boats that arrive for gas, food, and fishing bait. The primary residential area and surrounding boat docks located in this area cater to a "well-to-do" population that arrest data indicates is unlikely to engage in street crimes. Consequently, both of these areas have a sizable number of alcohol outlets but a low volume of street crimes resulting in overpredictions.

The four block groups that were most underpredicted (those that exhibited the highest residuals) included three block groups consisting of multiple subsidized housing projects providing residences for very-low-income families. The other block group is an area notorious in the city as an area of frequent drug activities and dealers. None of these block groups contain bars or restaurants serving as alcohol outlets. However, because of the higher concentrations of economic disadvantage in three of the block groups, and the entrenchment of criminal activity as an outgrowth of drug dealing in the other, there are elevated level of street crimes.

We did a separate analysis of the outlets that provided alcohol on the premises, presented as the second model in Table 1. The on-premises locations can sell liquor as well as beer and wine. We hypothesized that there would be a stronger relationship between the number of on-premises outlets and crime as the consumption would occur in the block groups where the alcohol was sold and consumed. The purchasers of the off-premises alcohol

must consume it at another location that may or may not be within the boundaries of the block group where it was purchased. The on-premises outlets are significantly related to the number of street crime events controlling for other variables in the model. The third model in Table 2 includes the number of off-premise alcohol outlets and it too is significant and positive.

One salient difference between the models displayed in Table 1 is that the downtown variable is significantly related to the number of street crimes when using the off-premises measure unlike the analyses of total outlets and on-premises outlets. Because the highest concentration of on-premises outlets is located in the downtown area, the downtown variable was a stand-in for on-premises outlets. To determine this and to directly compare the effects of on- and off-premises outlets, we entered both in the analysis along with the downtown variable, in the fourth model in Table 2. This model shows that, when controlling for the on-premises outlets, the off-premises locations are not statistically significant. The on-premises outlets, however, remain significantly correlated with the number of street crime events confirming our hypothesis that on-premise outlets would have the stronger effect. The table also reveals that the downtown variable is not significant when the on-premises outlets are added to the model with the off-premises locations. This indicates that the downtown variable was an indicator of on-premises outlets.

Thus far, the analysis has supported findings from other cross-sectional studies of alcohol availability and crime. There is a problem, however, with reliance on cross-sectional studies. It is entirely possible that neighborhoods that already have higher crime rates also attract more bars and other alcohol outlets producing a correlation between crime and the locations of bars and alcohol outlets. Perhaps communities in which there is more poverty and joblessness also have more crime as well as more drug and alcohol use. In these cases, bars, drug dealers, and criminal activities would be symptoms of disadvantaged neighborhoods rather than causes of increased crime rates. It is for these reasons that we conducted the panel analysis as described below.

Longitudinal Panel Analyses

The panel analysis involves the examination of the effects of alcohol outlets for three waves of data. Each of the regression equations included all the alcohol outlets that began in Norfolk during the specified 3-year period, 2000-2002, 2003-2005, and 2006-2008. We also subtracted the number of outlets that closed during the time period to arrive at the net number of outlets. The number of crime events for the last year of the panel was regressed on number of crime events occurring in the year prior to the study period

Table 3. Longitudinal Panel Models of the Effect of Change in Alcohol Outlet Density on Street Crime, Controlling for Prior Street Crime, Population Size, Socioeconomic Disadvantage, and Spatial Autocorrelation.

	2000-2002	2003-2005	2006-2008
	b (SE)	b (SE)	b (SE)
Spatial lag	.240 (.065)**	.166 (.617)**	.222 (.556)**
Constant	−.715 (.059)	−1.916 (2.055)	.642 (1.912)
Prior street crime	.737 (.059)**	.826 (.054)**	.733 (.047)**
Population size	.001 (.001)	.003 (.001)*	−.001 (.619)
Socioeconomic disadvantage	.153 (.735)*	1.753 (.766)*	.575 (.438)
Alcohol outlets	1.679 (.666)*	3.455 (1.130)**	2.728 (.771)**
Downtown	8.539 (6.817)	.976 (8.292)	−.350 (6.882)
R^2	.769	.798	.815

*$p < .05$. **$p < .01$.

(i.e., change in the number of outlets) along with the control variables discussed earlier. The inclusion of the number of crime events in the year prior to the estimated change in alcohol outlets provides a much more rigorous test of the alcohol outlet–street crime relationship than past studies at the neighborhood level.

Table 3 confirms that the net addition of new alcohol outlets during each of the 2000-2002, 2003-2005, and 2006-2008 periods was significantly associated with an increased number of street crimes. Each new additional outlet increased the number of street crimes by approximately two per block group during the first period, three and one-half during the second, and two and one-half during the 2006-2008 periods. During all three periods examined, socioeconomic disadvantage, population size, and the spatial lag were all also statistically significant. The downtown variable was not significant in any of the equations.

Discussion

When we initially looked at the cross-sectional effects of the number of alcohol outlets per block group in Norfolk, we found statistically significant, positive, effects on street crimes. This finding was consistent across the combination of all types of outlets, on-premises and off-premises outlets separately. These findings remained even when we controlled for socioeconomic

disadvantage, population size, the downtown block groups, and a spatial lag. These positive results echo most of the cross-sectional research that has been conducted in the past. Branas, Elliott, Richmond, Culhane, and Wiebe (2009), for example, discovered that the risk of being in an area of high off-premises alcohol outlets doubles the risk of being a victim of a gunshot assault but areas high in "on-premises" alcohol outlet did not elevate the risk of gun assaults.

Although we found significant relationships between off-premises outlets as well, it was not a surprise to find a significant and even stronger relationship between the number of on-premises outlets and street violence events. On-premise sites often bring together alcohol, young people, especially males, and create situations ripe for violence. It is our contention that these results suggest that that the higher number of outlets increases the number of potential offenders and/or victims in the block group. This would be especially true when there are a number of on-premises outlets—what Livingston, Chikritzhs, and Room (2007) refer to as "bunching." They argue that the clustering of on-premise outlets, "is likely to increase competition (not a good thing in alcohol markets from a health or order perspective), make server intervention more difficult and encourage disruptive strolling from pub to pub, increasing the likelihood of violence" (Livingston et al., 2007, p. 564). Most research suggests that alcohol has the tendency to lower inhibitions. In areas where there are many people who have lowered inhibitions against aggressive behavior or lower inhibitions against taking safety precautions, both the number of potential offenders and victims increases. As a test of the "bunching" or concentration hypothesis, we drew 100 meter buffers around each of the on-premise liquor outlets and counted the number of outlets and number of street crimes. A scatterplot is presented in Figure 1 showing the robust correlation ($r = .61$) between the two variables sharing 37% of the variance across items.

The examination of before–after measures of street crimes when alcohol outlets were newly established and old ones removed from each block group enabled us to understand the change in levels of street crime that could be attributable to actual change in the number of outlets in each block group. The results indicated that the change in the number of outlets in block groups is consistently and positively related to the change in street crimes. This is evident controlling for prior levels of crime, population size, socioeconomic disadvantage, and the downtown block groups. Our analysis extends the validity of most of the research on alcohol availability and street crime by providing a much more rigorous test of the relationship.

Some research suggests that alcohol outlets interact with other neighborhood characteristics such as socioeconomic disadvantage to affect crime
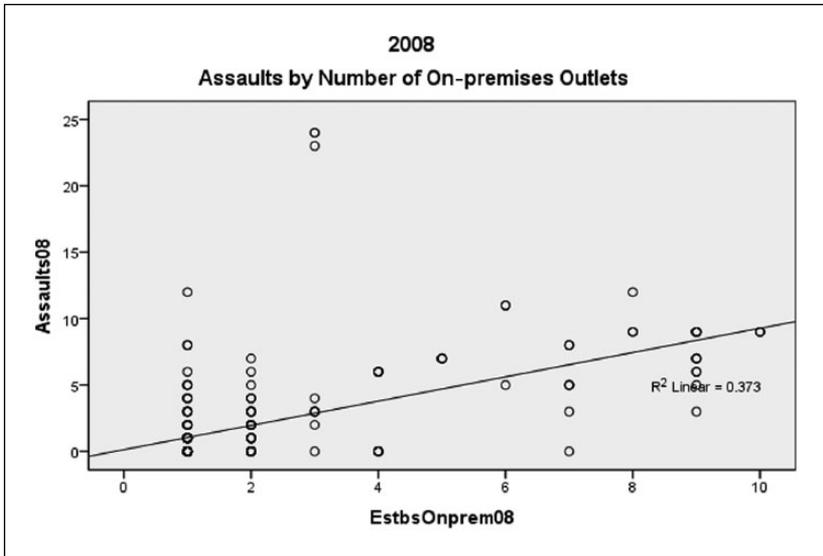
Figure 1. Scatterplot of the number of establishment and the number of street crimes.

across various geographic areas (Alaniz, 1998; Gruenewald et al., 2006; Komro, Tobler, Maldonado-Molina, & Perry, 2010; Parker & Rebhun, 1995; Peterson et al., 2000). We examined the interaction effects of the number of outlets and level of socioeconomic disadvantage on street crimes (analyses not presented) but did not find the expected interactions in any of the models. We expect the lack of detected interaction effects may be the result of the relatively small sample size and the already relatively large direct effects which explained between 50% to over 80% of the variation in street crimes across models. More research is clearly warranted in this direction.

The similarity of the results of this study to others conducted in other cities suggests that there is nothing about the city of Norfolk that is particularly unique with respect to the content of this study or that would bias the results of our study. For example, in this article, we cite studies done in several cities such as Cleveland (Roncek & Maier, 1991); San Diego (Roncek & Pravatiner, 1989); Camden, New Jersey (Gorman et al., 2001); and Baton Rouge (Costanza et al., 2001) among others. Our results are consistent with all these in the finding that higher levels of alcohol availability produce higher levels of violent crime. This correspondence suggests that the results that we

obtained are not the result of a city that is unique in the sense of the relation of alcohol availability to crime. Alternatively, Norfolk has an area that is unique with respect to the concentration of alcohol outlets and entertainment venues, but we controlled for these downtown block groups in the analysis to prevent them from biasing the results.

In addition, we created a dummy variable which was coded for the presence or absence of outlets to determine if the locations of alcohol outlets had elevated crime events because of selective placement in neighborhoods conducive to crime. We examined the relationship between this variable and variables often found to be more conducive to crime. When the dummy variable was run separately with our socioeconomic disadvantage variable (and then separately for poverty level, medium family income, and an indicator of the percentage of vacant dwellings), the relationships with all these variables were not significant. However, the presence of outlets was significantly related to variation in neighborhood population and the percentage of female-headed households. The relationship with female-headed households was statistically significant but negative showing that the outlets were more likely located in block groups with lower percentages of female-headed households. The relationship with population was expected as these outlets were more likely to be placed in neighborhoods with more potential customers, and we suspect that is not unique to Norfolk. Furthermore, we controlled for the independent effects of population size in all our models.

We do not have data on the connection between the location of the alcohol purchase and the offense. Alcohol could be purchased in one block group and result in an offense in another. This speculation is consistent with the large positive and statistically significant spatial lag coefficients showing that areas adjacent to high crime areas also tend to have high levels of street crime. We also do not know what proportion of the offenses reported in this article was alcohol related. Future research should attempt to disaggregate offenses that are alcohol related and ones that are not. In fact, research should also disaggregate types of violent crimes. Although alcohol outlet density has been associated with a number of different crimes, understanding the relationships across different types of crime would provide fodder for both theory and practice. Related to this, although some research, including this study, recognizes that there is tremendous variation in the nature of outlets, and have disaggregated outlets by bars and taverns, on- and off-premise outlets, and so on, clearly "a bar is not a bar is not a bar." As Livingston et al. (2007) noted, "in most published studies both a small bar and a sprawling multi-level nightclub would be counted as one on-premise license" (p. 562). Obviously, different types of establishments will attract different types of people. Some

establishments are probably more likely to facilitate or tolerate violence than others, whereas some types of people are more likely to engage in violence than others and are attracted to certain types of outlets. Future research should seriously consider these issues.

In conclusion, our results suggest a relatively strong cross-sectional relationship between the presence of alcohol outlet and crime. Furthermore, our more rigorous longitudinal analyses looking at change in the number of alcohol outlets controlling for prior crime strengthens, but does not prove, the notion that the relationship is causal. Furthering prior research, alcohol availability would appear to be one of the stronger structural characteristics affecting crime at the neighborhood level. Future research should (a) continue to pursue longitudinal analyses of alcohol availability at the neighborhood level, (b) disaggregate types of crime and violence associated with increased (or decreased) alcohol outlets, (c) examine the contexts where alcohol outlets are most likely to promote crime (i.e., interaction effects), and (d) seriously consider the nature of establishments that appear to promote or tolerate crime, violence, and other forms social and physical disorder. Only after clearly disentangling these issues will solid policy recommendations be forthcoming.

Declaration of Conflicting Interests

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