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The Neighborhood Alcohol Environment and At-Risk Drinking among African Americans

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Abstract

Background—Our objective was to examine whether components of the neighborhood alcohol environment—liquor store, on-premise outlet, convenience store, and supermarket densities—are positively associated with at-risk alcohol consumption among African American drinkers.

Methods—Multilevel cross-sectional sample of 321 African American women and men ages 21 to 65 years recruited from April 2002 to May 2003 from three community-based healthcare clinics in New Orleans, Louisiana, U.S.

Results—The alcohol environment had a significant impact on at-risk alcohol consumption among African American drinkers, specifically liquor store density (adjusted OR = 3.11, 95% CI = 1.87, 11.07). Furthermore, the influence of the alcohol environment was much stronger for African American female drinkers (adjusted OR = 6.96, 95% CI = 1.38, 35.08).

Conclusions—Treatment and prevention programs should take into account the physical environment, and the concentration of outlets in minority neighborhoods must be addressed as it poses potential health risks to the residents of these neighborhoods.

Introduction

In ecologic studies at the neighborhood level alcohol outlet density has been shown to be strongly associated with both alcohol consumption (Gruenewald, Ponicki, & Holder, 1993; Scribner, Cohen, & Fisher, 2000) and numerous alcohol related outcomes including fatal and injury traffic crashes (Scribner, MacKinnon, & Dwyer, 1994), drunk driving offenses (Gruenewald, Johnson, Millar, & Mitchell, 2000; MacKinnon, Scribner, & Taft, 1995; Treno, Gruenewald, & Ponicki, 1996), cirrhosis mortality (Gruenewald & Ponicki, 1995; MacKinnon, Scribner, & Taft, 1995), assaultive violence (Gorman, Speer, Gruenewald, & Labouvie, 2001; Scribner, Cohen, & Kaplan, 1999; Scribner, MacKinnon, & Dwyer, 1995), sexually transmitted diseases (Cohen et al., 2006; Scribner, Cohen, & Farley, 1998), and liquor law violations (MacKinnon, Scribner, & Taft, 1995). Multilevel studies have shown that the effect of alcohol outlets on health outcomes may be independent of individual level risk factors (Scribner, Cohen, & Fisher, 2000; Theall et al., 2009).

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Neighborhood alcohol outlet density may be associated with individual alcohol consumption by exposing neighborhood residents to cues related to alcohol consumption more frequently and by providing residents with high levels of alcohol availability. Certain alcohol outlets may also pose a situational risk in the neighborhood environment since they are often associated with other high-risk behavior such as the use and exchange of other drugs (Scribner, MacKinnon, & Dwyer, 1995). Alcohol outlets are also associated with more social disorder, which may be linked to various poor health outcomes (Cohen et al., 2000). Specifically, a problem off-premise alcohol outlet in a neighborhood may represent a spatial focus for incivilities associated with physical (e.g., graffiti, liquor advertising, trash) and social (e.g., loitering, drug sales, prostitution, altercations) disorder (Scribner et al., 2007). Consequently, the presence off-premise alcohol outlets may hinder the expansion of a positive underlying neighborhood social network as the “eyes on the street” (Jacobs, 1961) and “defensible space” (Newman, 1972) are reduced and therefore the potential for social capital development (Scribner et al., 2007; Theall et al., 2009).

Despite evidence for alcohol outlets to exert a contextual effect on drinking, violence, mortality and other health outcomes, and social capital formation at the neighborhood level, the relationship between the alcohol environment and individual consumption has not been fully examined among specific minority groups. However, there is growing evidence that the contextual effects observed pertain to specific types of outlets among various types of populations (low versus high SES, white versus black). Given the level of segregation in the U.S., minority groups may be experiencing the most detrimental influences of alcohol outlets (LaVeist et al., 2008) since several studies have empirically demonstrated high concentrations of alcohol establishments in minority and lower-income neighborhoods (Bluthenthal et al., 2008; Gorman & Speer, 1997; LaVeist & Wallace, 2000; Romley, Cohen, Ringel, & Sturm, 2007). Furthermore, the amount physical shelf space devoted to alcohol is higher in minority and low-income neighborhoods (Bluthenthal et al., 2008). LaVeist and colleagues (2000) found that, compared with other neighborhoods, low-income segregated African-American communities in Baltimore, Maryland, U.S. had eight times as many liquor stores per capita (LaVeist & Wallace, 2000).

Not only are certain alcohol establishments concentrated in many African American communities in the U.S., but the drinking style of African Americans may have a greater impact on negative health outcomes (Rehm, 2000) given that it is characterized by a pattern of increased heavy drinking occasions compared with Caucasians (Dawson, 1998; Sempos, Rehm, Wu, Crespo, & Trevisan, 2003). Although African Americans consume less than their white counterparts on average (Jones-Webb, Snowden, Herd, Short, & Hannan, 1997; Kandel, Chen, Warner, Kessler, & Grant, 1997), research has shown that they may have a higher prevalence of early morning drinking (Dawson, 1998). Furthermore, they may drink more heavily throughout the life course as compared to Caucasians, who tend to reduce alcohol consumption as they age (Braun, Hannan, Wolfson, Jones-Webb, & Sidney, 2000; Caetano & Clark, 1998), although some have shown that this may not be the case (Sloan, Malone, Kertesz, Wang, & Costanzo, 2009).

There is also a need to examine the heterogeneous impact of the neighborhood alcohol environment according to gender or sex. While few studies have reported community or neighborhood differences across sexes, a growing body of evidence suggests that neighborhood social and built environments can and do affect men and women differently (Bird & Rieker, 1999; Cubbin, Hadden, & Winkleby, 2000; Do et al., 2007; Macintyre, Hunt, & Sweeting, 1996; Molinari, Ahern, & Hendryx, 1998). Males and females differ in their response to stress (Ross, 2000; Taylor, Repetti, & Seeman, 1997) and are also differently affected by social control processes (Ramirez-Valles, Zimmerman, & Juarez, 2002). In impoverished neighborhoods with the potential for low social control, greater

disorder and less social capital, among women who drink, greater availability of alcohol in the neighborhood may therefore influence the level of consumption or problem drinking compared to their male counterparts, among whom there is greater drinking and perhaps less variability in consumption patterns compared to women. Among both male and female drinkers, however, the type of venue where alcohol may be purchased may also play a role in the level of consumption.

The objective of this study was to examine whether the neighborhood alcohol environment and different aspects of this environment— liquor store, on-premise outlet, convenience store, and supermarket densities—are positively associated with at-risk alcohol consumption among a sample of African Americans and whether this association was moderated by sex. We consider the impact of the neighborhood alcohol environment in the context of a set of individual-level risk and resource variables that may be important to the well-being of African Americans (Dressler, 1993) and may influence alcohol consumption levels.

Materials and Methods

Study Population

The current study is based on a baseline sample of 321 African American women and men who were part of a pharmacist-delivered intervention to reduce risky alcohol consumption. Respondents were recruited from April 2002 to May 2003 from three community-based healthcare clinics in New Orleans, Louisiana, U.S. All participating clinics were reported to predominantly serve poor African American; one site also reported a significant transient clientele. All respondents had used alcohol within 90 days prior to completing individual surveys. The details of the study procedures have been previous reported (Pillifant, Hinton, Pharm, & Kishore, 2004). The study was conducted at three community based healthcare centers as a randomized, pre-test/ post-test design consisting of a control and an experiment group. An alcohol use profile on each participant was developed using CAGE and AUDIT, with men having higher scores than women. The screening and interviewing process occurred in the waiting areas of each site. Once patients had entered the site they were approached individually and were handed a brochure, which gave basic information about the study including the fact that should they qualify and enroll, they have the right to withdraw from the study at any time. The patient was then orally solicited, which contained a summary of the brochure. The oral solicitation also explained the risks associated with participating so that the patient could make an informed decision about participation. Respondents who agreed to participate in the study and were enrolled were similar to those clinic patients who refused based on available demographic data.

Once the respondent had qualified to take the survey and had signed the informed consent, he or she was asked to provide primary contact information as well as secondary contact information. After these two sheets had been filled out, the interviewer proceeded with the quantitative questionnaire.

Data Sources and Measures

Individual-Level Data—Individual level data were obtained from the individual surveys that were administered at baseline of a larger longitudinal study. Data collection utilized a 36 question survey which was embedded with Alcohol Use Disorder Identification Test (AUDIT) questions throughout. The primary outcome measure, at-risk drinking classified respondents based on an AUDIT score of > 7. The AUDIT has been shown to be reliable and valid instrument to identify at-risk drinkers (Daeppen, Yersin, Landry, Pécoud, & Decrey, 2000). The quantitative survey also included items that may be associated with the level of alcohol use and/or the neighborhood alcohol environment such as

sociodemographic, social support, information on alcohol-related behavior at the participant's place of work, alcohol and social settings, and the participant's family history of alcohol and mental health problems.

Family history included the number of family members with substance-use or psychiatric health conditions. Indices created included the respondent's ability to resist alcohol in social situations and social support. Resistance score included six summed dichotomous items on ability to resist alcohol in a variety of settings and situations ("Do you often find it difficult to resist alcohol..."): when out to lunch or dinner, when at a party or bar/club, when wanting to feel more confident, when someone offers a drink, when friends or spouse are drinking, and when bored, upset or sad (Cronbach's alpha=0.91). Social support included six summed dichotomous items on how close respondents felt to their: mother, father, siblings, spouse/companion, children, and friends (Cronbach's alpha=0.87). The level of isolation was also considered and defined as isolated (yes/no) if the respondent indicated that she/he spends most of their time alone versus with others (e.g., family, friends).

All unique address listings for survey respondents and alcohol outlets were geo-coded and mapped to the 2000 Census tract areas, and individual data sources were matched by census tract. One hundred percent of addresses were matched using Arcview GIS software (Environmental Systems Research Institute, ESRI, Inc, Redlands, CA) along with Louisiana TIGER street files from the 2000 Census. Of the 321 respondents, 19 did not provide residential address information and were excluded from the multilevel analyses. Participants were from 143 census tracts or neighborhoods in the New Orleans area (average number of residents per tract = 1,015; min=52, max=5,588).

Neighborhood-Level Data—As with individual-level data, data at the neighborhood level also included additional measures such as markers of social capital, crime, and sociodemographic characteristics that are associated with the neighborhood alcohol environment and potentially individual level consumption. Measures of the neighborhood alcohol environment included: off-premise alcohol data—specifically, liquor store density, convenience store density, and supermarket density—as well as on-premise outlet density, which included bars/pubs, clubs and restaurants with on-site consumption. All measures were calculated as the number of establishments per 1,000 residents in the census tract. Alternative measures of density were also calculated (e.g., establishments per roadway mile) and examined.

Neighborhood alcohol data was based on ata on North American Industry Classification System (NAICS) codes provided by InfoUSA and obtained from ESRI Inc. NAICS is the Federal U.S. standard for classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy. InfoUSA offers commercial databases on businesses with information regarding business openings and closings, updated on a weekly basis. Selected characteristics of the businesses are verified monthly by telephone interviews and Standard Industrial Classification (SIC) codes are assigned to each business. SIC were supplemented with codes with an additional 2-digit number developed by InfoUSA to further detail types of businesses. SIC codes were used to classify off- and on-premise outlets used for calculation of the neighborhood alcohol environment. While little research exists on the ability of NAICS codes to distinguish between types of establishments, a sensitivity analysis of establishment names reveals distinct classification. What may be more difficult is classifying the type of supermarket or convenience stores. We did not further classify supermarkets given our interest in that one type of potential off-premise outlet, although further classification may be of interest (Kaufman, 1999) if supermarkets impact drinking levels among this sample.

Also obtained from ESRI were data on crime risk for each neighborhood. Crime risk was based on a series of standardized indexes for a range of serious crimes against both persons and property based on reporting categories used by the FBI in its Uniform Crime Report (UCR). The total crime risk index, which includes murder, rape, robbery, assault, burglary, theft, and motor vehicle theft, was utilized in this study.

Neighborhood-level socio-demographic characteristics were obtained from the 2000 U.S. Census and included: percentage White, Black, and Hispanic, percentage male, percentage married, percentage of female heads of household, percentage with less than a high school education, percentage with a college degree or higher, percentage below the Federal poverty level (for U.S. 2000 Census), unemployment rate, percentage of vacant homes, an index of socioeconomic position, and an index of endogenous social organization. Socioeconomic position was measured using a Z-score standardized index of % < high school, unemployed, < poverty, working class, median household income (Cronbach's alpha = 0.82) (Krieger, Chen, Waterman, Rehkopf, & Subramanian, 2005).

As a marker for social capital, endogenous social organization examined specific aspects of neighborhood structure that may influence the development of social networks and organizations and, in turn, social capital in a community (Metro Chicago Information Center, 2005; Sampson, 2003; Sampson, Morenoff, & Earls, 1999; Sampson, Raudenbush, & Earls, 1997). The index included two different sub-components: *interaction potential and stability*. These were modeled from the Metropolitan Information Center's Community Vitality Index (Metro Chicago Information Center, 2005), and have been used by others to examine neighborhood structure conducive to the development of positive consequences of social capital, namely social control, collective efficacy and lower neighborhood crime rates (Bursik, 1988; Sampson, 2003; Sampson, Morenoff, & Earls, 1999; Sampson, Raudenbush, & Earls, 1997). The scale demonstrated moderate reliability in this sample (Cronbach's alpha = 0.74). *Interaction potential* included: (1) neighbor interaction, defined as the percentage of households that are not linguistically isolated (assuming that a common language is vital to a community's capacity to participate fully in the larger social and economic structure); (2) social support, defined as the percentage of households with more than one person; and (3) at home, measured as the percentage of households with one or more adults not in the labor force (with the assumption that these households are ones where someone may have more time to invest in building relationships in the community). *Stability* included: (1) mobility, defined as the percentage of all households that reported that they moved in the past five years, reverse coded (assuming that neighborhood structure contributes to neighborhood connectedness, which may increase social capital); and (2) immigration, measured as the percentage of foreign-born residents who entered the U.S. and their specific census tract within five years of the 2000 U.S. Census, also reverse coded (assuming immigration results in significant social and cultural adjustments that may hamper development of social cohesion).

Statistical Analyses

Descriptive/univariate, bivariate, and multivariate analyses were performed. SAS version 9 was used for all analyses, including PROC LOGISTIC and PROC CORR for bivariate associations with at-risk drinking and PROC MIXED and GLIMMIX for hierarchical models. Two-level hierarchical logistic regression models, with individuals (first level, n=302) nested within census tracts (second level, n=143) were used to examine the contextual effect of the alcohol environment on at-risk drinking. Such models allow for estimates of variance components at both the individual- and neighborhood-level (Bryk & Raudenbush, 1992; Snijders & Boskers, 1999). Partitioning variance in this way accounts for the variance in individual-level outcomes that can be attributed to differences between neighborhoods, expressed as the intraclass correlation coefficient (ICC). To examine the

extent of clustering in alcohol consumption measures based on unconditional means models (which is a function of the neighborhood-level random intercept and used to obtain the amount of clustering in outcomes within neighborhood), we utilized PROC MIXED for linear outcomes. In this case, the ICC was calculated as:

$$\frac{V_{neighborhood}}{V_{neighborhood}+V_{individual}}$$

where $V_{neighborhood}$ = variance between neighborhoods and $V_{individual}$ = variance within neighborhoods or between individuals. For the primary outcome (at-risk drinking), which is dichotomous or binary in nature, the ICC was calculated by following the formula of Snijders based on an underlying continuous variable with $V_{individual} = \Pi^2 / 3$ (Snijders & Boskers, 1999). However, the pseudo ICC for non-linear models may not be appropriate and therefore we also calculated and examined the Median Odds Ratio (MOR) as described by Merlo and colleagues (Merlo et al., 2006).

The following multilevel logistic regression models were examined: (1) crude bivariate multi-level models including all individual- and neighborhood-level measures to examine their crude association with at-risk drinking—paying particular attention to the relationship between the alcohol environment and at-risk consumption; (2) for models with a significant association between alcohol environment measures and at-risk drinking, potential confounders and/or other predictors of at-risk consumption were included in the model; and (3) the cross-level interaction or effect modification between alcohol environment measures and sex were examined, as well as interaction between % African American (neighborhood composition) and the alcohol environment. All of the individual-level variables were centered at their respective means.

Results

Characteristics of respondents, overall and by at-risk drinking status, are presented in Table 1. Approximately 23% of participants were classified as at-risk drinkers based on their AUDIT score. The average AUDIT score among the whole sample was 5.18 (± 5.45). The majority of the sample was female (71.3%), had less than a high school education (72.6%), had a total household income in last year of less than $20,000 (84.1%), were affiliated with one or more religious organizations (96.0%), and had never received treatment for alcohol or drug problems (91.3%). Ages ranged from 21 to 65 (mean=42.29 ± 12.91). Approximately one-fourth of the sample indicated they were in a stressful living situation and 16.2% said they spend most of their time alone. The mean number of family members with a history of substance use and/or mental health problems was 1.7 (± 2.3).

Comparing the likelihood of being classified as an at-risk drinker by socio-demographic and alcohol-related characteristics revealed that women (crude OR = 0.47, 95% CI = 0.27, 0.81), those with greater resistance scores (crude OR = 0.53, 95% CI = 0.45, 0.63), and those with more social support (crude OR = 0.81, 95% CI = 0.69, 0.95) were significantly less likely to be at-risk drinkers. Those respondents with less than a high school education (crude OR = 2.52, 95% CI = 1.46, 4.36), who had ever been treated for drug or alcohol use (crude OR = 8.93, 95% CI = 3.83, 20.80), who were more isolated (crude OR = 2.99, 95% CI = 1.60, 5.59), and who had a greater number of family members with a substance use and/or mental health problem (crude OR = 1.25, 95% CI = 1.12, 1.40) were significantly more likely to be at-risk drinkers (Table 1).

Overall AUDIT score exhibited meaningful clustering at the neighborhood level, as shown in Figure 1, with an ICC of 3.13%. This finding suggests that some of the variance in this individual drinking measure may be explained by neighborhood-level factors such as the alcohol environment or approximately 3% of the variance in AUDIT potentially attributable to neighborhood factors. Furthermore, this difference varied by gender, with a significant ($p < 0.05$) difference between female (4.03%) and male (2.45%) ICCs.

Characteristics of respondent's neighborhoods are presented in Table 2. The proportion of African Americans was high across neighborhoods (mean=77.41%) and on average, approximately half of the neighborhoods were male residents and half had a female as head of household. Mean percentage below poverty was substantial—33.05%--as was the average unemployment rate (12.96%). Neighborhoods had an average of 0.09 liquor stores per 1000 (range = 0 to 6.16), 1.96 on-premise outlets per 1000 (range = 0 to 70.89), 0.41 convenience stores per 1000 (range = 0 to 4.27), and 1.26 supermarkets per 1000 (range = 0 to 8.21).

Of all neighborhood factors considered, only percentage married, percentage of vacant homes, endogenous social organization, and liquor store density per 1000 and supermarket density per 1000 were significantly associated with at-risk drinking based on crude correlations. These associations were mirrored in crude multilevel regression models, however, with the likelihood of being an at-risk drinker more than twice as high for respondents who live in neighborhoods with greater liquor store density (crude OR = 2.17, 95% CI = 1.86, 5.44) and 35% higher for those living in neighborhoods with greater supermarket density (crude OR = 1.35, 95% CI = 1.18, 1.65).

With respect to other neighborhood conditions, we did not observe associations between many neighborhood factors and at-risk drinking among this sample. The percent of population married and endogenous social organization were inversely associated with at-risk drinking, while the percent of vacant homes was positively associated with at-risk consumption.

Because liquor store density continued to be associated with at-risk drinking in multivariate models, the final models presented in Table 3 include only liquor store density as the primary alcohol environment variable. Supermarket density did not remain associated with drinking after taking into account sex, education, alcohol resistance score, family history and social support (adjusted OR = 1.10, 95% CI = 0.89, 1.72).

Model 1 in Table 3 presents the crude association between liquor store density and at-risk consumption mentioned above. While a substantial proportion of the clustering of at-risk drinking by neighborhood was explained when we added liquor store density to an empty model (ICC=4.29% to 3.87%), significant clustering still remained.

Model 2 in Table 3 presents the final multivariate multilevel logistic model that includes additional individual- and neighborhood/tract-level predictors of at-risk drinking. As shown, even after taking into account sex, education, isolation, alcohol resistance score, family history, vacant homes, and social organization, the likelihood of being an at-risk drinker increases more than three times for each additional liquor store per 1000 persons (adjusted OR = 3.11, 95% CI = 1.87, 11.07). With the exception of family history and percentage of vacant homes, the remaining predictors in the model retained their association with at-risk drinking as seen in crude bivariate analyses.

To determine if the relationship between liquor store density and at-risk consumption differed according to sex, we ran the same model but included a two-way, cross-level interaction term between sex and liquor store density. The results of this model are shown in Model 3 of Table 3 and suggest a strong interaction between liquor store density and sex.

Further stratification by sex revealed a strong and significant association between liquor store density and at-risk drinking among women, even after controlling for all other covariates presented in Model 3 (adjusted OR = 6.96, 95% CI = 1.38, 35.08). The same relationship did not hold up in the same analysis among only men in the sample (adjusted OR = 1.53, 95% CI = 0.62, 3.80).

Discussion

The neighborhood environment increasingly is being recognized as a key component of individual health. While studies have demonstrated the concentration of alcohol establishments (particularly liquor stores) in minority neighborhoods (Bluthenthal et al., 2008; Gorman & Speer, 1997; T. A. LaVeist & Wallace, 2000; Romley, Cohen, Ringel, & Sturm, 2007), few researchers have examined the impact of alcohol establishments on drinking among these groups. Results of this study suggest that a concentration of liquor stores in the neighborhood environment may increase the likelihood of at-risk drinking among African American drinkers, and these associations may be heterogeneous with respect to sex.

Key findings indicate that the alcohol environment may greatly impact at-risk alcohol consumption among African American drinkers. However, this effect may be only for liquor stores, or strongest for this type of alcohol environment as it was the only physical measure of the neighborhood alcohol environment that remained positively and significantly associated with at-risk consumption among respondents in this sample. Furthermore, results suggest that the influence of liquor outlets may be much stronger for African American female drinkers, an observation that occurred both in the stratified multivariate analyses and the crude ICC estimates. With increased clustering indicative of a stronger area-based influence, results suggest that, in the present sample, the neighborhood influence on at-risk drinking as well as the quantity and frequency of consumption is stronger for women than men. This may be due to differential coping among women who do drink. For example, in high crime areas, women may feel more vulnerable to crime which may lead to greater psychological distress. Sundquist and colleagues (2006) have observed higher rates of coronary heart disease among women compared to men living in high crime neighborhoods (Sundquist et al., 2006).

Fear of neighborhood environment, including fear of crime and victimization, is a severe individual- and community-level problem that may influence how freely people move about the places where they reside (Liska, Sanchirico, & Reed, 1988).

While a number of neighborhood characteristics were examined in this analysis, endogenous social organization or a marker for the potential for social capital formation and the percentage of vacant homes were also associated with at-risk consumption. The percent of vacant homes may be a marker for social disorder, linked to both alcohol consumption and alcohol outlet density, as have social capital indicators. The hypothesized mechanism through which alcohol outlets in a neighborhood may decrease the amount of positive social capital is through decreased positive social network expansion. As potential markers for neighborhood social and physical disorder (Deborah A. Cohen, Inagami, & Finch, in press; Sampson & Raudenbush, 1999; Scribner et al., 2007; Scribner, Cohen, & Fisher, 2000), the presence of liquor stores in a neighborhood may have both direct and indirect effects on resident's perception of safety and ability to form constructive social networks. In neighborhoods perceived as being unsafe, residents may be less likely to spend time outdoors and to network in a way that may build positive social capital, given that residents may have to compete with the social networks often associated with liquor outlets.

Even after accounting for potential social capital and vacant housing, as well as individual level factors that may be associated with at-risk consumption such as social isolation and a family history of substance use, liquor store density within a neighborhood was associated with at-risk drinking among respondents in our sample. While other establishments that provide alcohol have been associated drinking in previous studies, in this sample of drinkers, liquor stores are a salient part of the physical and social environment that may increased the likelihood of hazardous consumption among African American drinkers. Overconcentration of liquor stores in predominantly African American neighborhoods in the U.S. must be addressed.

Limitations of this study include a cross-sectional design, self-reported alcohol consumption and other individual-level covariates which may increase social desirability and recall biases. Furthermore, measures of the alcohol environment were based on InfoUSA data, which may be an underestimate of the true physical alcohol environment in the neighborhood (D. Cohen, Schonlau, Farley, & Bluthenthal, 2009). The possibility of structural confounding is also a limitation, i.e., drinkers may be attracted to neighborhoods with many liquor stores rather than the liquor stores contributing to the increased drinking.

While a number of measures of the alcohol environment were considered, they included only density measures and therefore did not account for differences in the availability by outlet type (e.g., ratio of liquor stores to supermarkets), the impact of alcohol advertising and promotion within or near outlets, or alcohol pricing (Bluthenthal et al., 2008). As an additional sensitivity analysis we calculated a per roadway mile measure and compared to the per capita measure. Results were similar, which was expected given the more urban nature of the sampled tracts.

In conclusion, the alcohol environment and, specifically, liquor store density may play a significant role in determining drinking level among African Americans who consume alcohol, particularly for women. Treatment and prevention programs for alcohol abuse and dependence should take into account the patient's physical environment not only for prevention but also for relapse. Most importantly, however, the concentration of outlets in minority populations must be addressed through policy as it poses numerous health risks to the residents of these neighborhoods.

Acknowledgments

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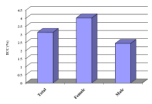

Figure 1. Clustering of AUDIT Score by Neighborhood: Overall and by Sex

Note. The intraclass correlation coefficient (ICC) represents the amount of clustering of AUDIT scores by neighborhood (census tract) or the amount of variance in AUDIT score that may be attributable to neighborhood. The ICC is calculated as:

$$\frac{V_{neighborhood}}{V_{neighborhood}+V_{individual}}$$

where $V_{neighborhood}$ = variance between neighborhoods and $V_{individual}$ = variance within neighborhoods or between individuals. Overall the amount of clustering in AUDIT scores was 3.13%, or approximately 3% of the variance in AUDIT potentially attributable to neighborhood factors. Furthermore, this difference varied by gender, with a significant ($p < 0.05$) difference between female (4.03%) and male (2.45%) ICCs.

Table 1

Sociodemographic, Family, Work, and Alcohol-Related Characteristics of Participants According to At-Risk Drinking Status (N= 321)

	N (%) or Mean (s.d.)			
	Medium to High Risk Drinker N=75	**Low Risk Drinker N=246**	**Total N=321**	**Crude Odds Ratio (95% Confidence Interval)**
Gender				
Female	44 (58.7%)	185 (75.2%)	229 (71.3%)	**0.47 (0.27, 0.81)**
Male (referent)	31 (41.3%)	61 (21.8%)	92 (28.7%)	1.00
Age				
21-30	16 (21.3%)	56 (22.8%)	72 (22.4%)	1.00
31-40	12 (16.0%)	51 (20.7%)	63 (19.6%)	0.82 (0.36, 1.91)
41-50	27 (36.0%)	61 (24.8%)	88 (27.4%)	1.55 (0.76, 3.17)
51-60	11 (14.7%)	58 (23.6%)	69 (21.5%)	0.66 (0.28, 1.56)
61 +	9 (12.0%)	20 (8.1%)	29 (9.0%)	1.58 (0.60, 4.13)
Education				
< High School	43(13.4%)	190 (77.2%)	233 (72.6%)	**2.52 (1.46, 4.36)**
High school graduate / GED or more	32(42.7%)	56 (22.8%)	88 (27.4%)	1.00
Total household income in last year				
Less than $20,000	68 (90.7%)	202 (82.1%)	270 (84.1%)	2.12 (0.91, 4.92)
$20,000 or more	7 (9.3%)	44 (17.9%)	51 (15.9%)	1.00
Religious Affiliation				
Affiliated with one or more religion(s)	73 (97.3%)	2 35 (95.5%)	308 (96.0%)	1.71 (0.37, 7.89)
Non-affiliated	2 (2.7%)	11 (4.5%)	13 (4.1%)	1.00
In a Stressful Living Situation				
Either single-parent or living in an unstable situation	13 (17.3%)	70 (28.5%)	83 (25.9%)	0.53 (0.28, 1.02)
Not in a stressful living situation	62 (82.7%)	176 (71.5%)	238 (74.1%)	1.00
Isolated				
Spends most of the time alone	22 (29.3%)	30 (12.2%)	52 (16.2%)	**2.99 (1.60, 5.59)**
Spends most of the time with others	53 (70.7%)	216 (87.8%)	269 (83.8%)	1.00
Resist Alcohol Score (range=0-6)	0.8 (1.2)	2.5 (2.0)	1.2 (1.6)	**0.53 (0.45, 0.63)**
Social Support (range=0-6)	3.9 (1.5)	4.6 (1.5)	4.3 (1.5)	**0.81 (0.69, 0.95)**
Number of Dependents	1.7 (2.0)	1.7 (1.7)	1.7 (1.8)	0.99 (0.86, 1.15)
Number of Family Members with Substance-Related or Psychiatric Health Conditions	2.7 (2.8)	1.4 (2.0)	1.7 (2.3)	**1.25 (1.12, 1.40)**
Longest Full Time Job (years)	7.9 (7.7)	9.1 (8.2)	8.3 (8.1)	0.98 (0.95, 1.01)

Note. Values based on non-missing responses. Percentages according to drinking status represent column percentage. OR=1.00 corresponds to referent group.

Table 2

Characteristics of Respondent's Neighborhoods and Association with Median-High Risk Drinking (N=302)

	Mean	SD	Range	Correlation with Median to High Risk Drinking
Mean % African American	77.41	24.15	3.74-99.41	-0.029
Mean % White	18.95	22.10	0.09- 92.95	0.017
Mean % male	46.31	4.07	30.83- 68.15	-0.002
Mean % married	29.89	11.34	4.35 -58.54	**-0.114** ‡
Mean % female head of household	43.12	14.59	5.37- 84.62	0.014
Mean % with less than high school education	32.27	13.13	5.35- 68.82	0.046
Mean % with college degree / college graduate	16.13	12.97	0- 59.48	-0.019
Mean % below poverty	33.05	16.72	3.96- 84.20	0.084
Mean SEP index[a]	2.12	2.86	-3.19-1 0.97	0.065
Community poverty	173.93	19.13	113.24- 228.83	0.071
Mean unemployment rate	12.96	8.82	1.83- 53.20	0.049
Mean % vacant homes	12.45	7.07	2.31-41.92	**0.093** *
Mean neighborhood structure index score / endogenous social organization	235.78	35.42	117.21-313.35	**-0.099** *
Off-premise outlet density per capita per 1000	0.087	0.48	0- 6.16	**0.148** ‡
On-premise outlet density per capita per 1000	1.96	5.50	0-70.89	0.074
Convenience store density per capita per 1000	0.41	0.82098	0- 4.27	0.030
Supermarket density per capita per 1000	1.26	1.28801	0- 8.21	**0.184** †
Mean total crime risk	345.59	161.29	9.50 -791.50	0.055

Note. P-value:

‡ < 0.05

† < 0.01

* < 0.10.

[a] SEP = Socioeconomic Position (index of % < high school, unemployed, < poverty, working class, median household income).

Table 3

Final Multilevel Models – Association between Alcohol Environments and At-Risk Alcohol Consumption (N=143 neighborhoods/tracts, N=302 individuals)

Variables	Adjusted Odds Ratio (95% Confidence Interval)		
	Model 1: Liquor Store Density Only	**Model 2: Liquor Store Density and Individual and Group-level Covariates**	**Model 3: Cross-Level Interaction**
Individual-Level Variables			
Female[a]		0.45 (0.20, 1.05)	0.39 (0.17, 0.59)
Less than high school education[a]		3.18 (1.41, 7.16)	3.46 (1.51, 7.93)
Isolated[a]		2.88 (1.06, 7.83)	2.92 (1.06, 8.01)
Alcohol resistance score		1.96 (1.55, 2.48)	1.99 (1.56, 2.54)
Number of family members with substance use and/or mental health problem		1.12 (0.95, 1.32)	1.12 (0.95, 1.35)
Tract-Level Variables			
Liquor store density per 1000	**2.17 (1.86, 5.44)**	**3.11 (1.87, 11.07)**	1.38 (1.10, 1.92)
% Vacant homes		0.99 (0.96, 2.89)	1.01 (0.94, 1.06)
Neighborhood structure index score / endogenous social organization (1990)		0.98 (0.97, 1.00)	0.99 (0.98, 1.05)
Cross-Level and Tract-Level Interactions			
Liquor store density × female sex			**5.33 (1.08, 28.69)**
ICC [b]	3.87%	2.64%	2.62%
MOR [b]	1.41	1.12	1.09

[a] Referent categories: male sex, high school graduate/GED or higher, not isolated/spends time with friends and family.

[b] ICC=Intraclass correlation coefficient (with individual-level variance calculated using the formula of Snijders based on an underlying continuous variable with $V_{iindividual} = \Pi^2 / 3$ (Snijders and Bosker, 1999). Because of limitations of the ICC for non-linear outcomes, the Median Odds Ratio (MOR) (Merlo et al., 2004) was also calculated as $\exp[0.95(\sqrt{V}_{neighborhood})]$.