HHS Public Access

Author manuscript

J Community Psychol. Author manuscript; available in PMC 2016 September 01.

Published in final edited form as:

J Community Psychol. 2016 September ; 44(7): 819–832. doi:10.1002/jcop.21802.

Alcohol Outlets and Substance Use among High Schoolers

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Abstract

Few studies have considered the potential role of the built environment in increasing adolescent substance use. The current study explored the relationship between alcohol outlets, a potential malleable component of the neighborhood environment, and adolescent behavioral outcomes. Specifically, we investigated the relationship between alcohol outlet density, perceived alcohol, tobacco, and marijuana availability (ATOD), perception of substance use as a problem at the school, and self-reported ATOD use. Data come from Maryland Safe and Supportive Schools (MDS[3]) Initiative, a statewide project focused on measuring and improving school climate. The sample includes 25,308 adolescents from 58 high schools (9th–12th grade) across 12 counties. Multi-level path models indicated a positive relationship between the count of alcohol outlets and perceived availability of ATOD among girls but not boys. Perceived availability was associated with increased ATOD use at both the individual- and school-level, as well as other students' ATOD use. Findings provide support for the potential role of the built environment in adolescent risk for substance use, particularly among girls.

Keywords

Alcohol outlets; Substance use; Environment; Policy

Delaying onset of substance use can prevent subsequent substance use problems. For example, Grant and Dawson (1997) examined age of onset for alcohol use using a national study and found that rates of lifetime alcohol abuse decreased from 11% for individuals initiating alcohol use at 16 years of age or below to 4% among individuals who initiated alcohol use at ages 20 or above. While there are many factors associated with early alcohol initiation (e.g. gender, parental drinking; Hawkins et al., 2007), preventing opportunities to use alcohol, tobacco, and other drugs may delay initiation of substance use and later problem use (Crum et al., 1996; Wagner & Anthony, 2002).

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Alcohol is commonly obtained from peer sources and parents during early adolescence (Hearst et al., 2007; Wagenaar et al., 1993). By middle to late adolescence, commercial sources, such as packaged goods stores and convenience stores that sell alcohol, become an important source of alcohol acquisition (Wagenaar et al., 1993; Wagenaar et al., 1996). Commercial sources continue to serve as a source of alcohol and tobacco for underage individuals despite minimum age purchasing laws (Harrison et al., 2000; Wagenaar et al., 1996). The Substance Abuse and Mental Health Services Administration (SAMSHA) estimated that nationally 8.7% of underage drinkers purchased their own alcohol (SAMSHA, 2012). Underage alcohol purchases from commercial sources are more likely among female buyers and at convenience stores that sell alcohol products (Wagenaar et al., 1993).

Alcohol outlets are not only a source of alcohol but they are also locations of tobacco sales and drug markets (Kuntsche et al., 2008; McCord & Ratcliffe, 2007; Milam et al., 2013; Theall et al., 2011; Widome et al., 2013). Stillman et al. (2014) studied the sale of loose cigarettes in urban areas and found that the majority of adolescents reported that single cigarettes were available outside bars/clubs; additionally, many liquor stores (i.e. off-premise alcohol outlets) also sell tobacco. Other studies have found that liquor stores have more point-of-sale tobacco advertising than tobacco outlets, convenience stores, and gas stations (Widome et al., 2013). McCord and Ratcliffe (2007) found that alcohol outlets were associated with locations of drug markets; this was further supported in a study of alcohol outlets and violent crime (Jennings et al., 2014). In addition to the association between alcohol outlets and substance availability, these facilities are also associated with violent crime and neighborhood incivility (Franklin et al., 2010; Jennings et al., 2014; Speer et al., 1998)

While research on the relationship between alcohol outlets and substance use among high school students is lacking, a number of investigations focusing on this relationship for college students have found that increased alcohol outlet density is associated with increased alcohol consumption including heavy and binge drinking (Kypri et al., 2008; Scribner et al., 2007; Weitzman et al., 2003). However, the findings on school-aged youth has been mixed, with some studies reporting finding no association between density or proximity of alcohol outlets and student substance use (e.g., Pasch et al., 2009b), and others documenting an association between the presence of alcohol outlets on the route to and from school and opportunities to use alcohol, tobacco, and other drugs (ATOD) among elementary school students (Milam et al., 2013).

Although some studies have identified certain environmental factors, such as alcohol advertisements and alcohol outlet density as risk factors associated with adolescents' opportunities to use alcohol and progression to actual alcohol use (Milam et al., 2014; Paschall et al, 2007; Pasch et al., 2007, 2009a, 2009b), there has been relatively few studies which have considered both school and community influences simultaneously. Ecological theory suggests that both the community and school context have an important influence on child development and may play a role in increasing risk for substance use (Bronfenbrenner and Morris, 1998). Therefore, we sought to simultaneously explore potential community environmental factors, such as density of alcohol outlets, and school-related risk factors,

such as perceived peer use and perceived availability of substances, in relation to adolescents' own substance use.

The current study explored how the density of alcohol outlets, in particular off-premise alcohol outlets around high schools influenced perceived ATOD availability and ATOD use among 9th–12th grade students. We hypothesized that increased alcohol outlet density would be associated with higher perceived availability of ATOD and increased ATOD use. We applied a school-based perspective in trying to understand the ecological influences on youth's use of ATOD by examining these associations using a large and diverse sample of both students and schools across urban and suburban communities. As such, this study aims to address some of the inconsistencies reported in previous studies, which have largely focused on urban elementary school students (Milam et al. 2014) and largely suburban Caucasian high schoolers (Pasch et al., 2009b). These findings have potential implications for policy related to alcohol outlet zoning and land use regulations (Ashe et al., 2003).

Method

Overview

Data for this study came from the Maryland Safe and Supportive Schools (MDS3) Initiative, a joint project between the Maryland State Department of Education, Johns Hopkins University, and Sheppard Pratt Health System. The MDS3 Initiative is a statewide project focused on measuring and improving school climate (i.e., safety, engagement, and environment); it includes 58 high schools (9th–12th grade) in 12 counties across the state. Non-identifiable data from the MDS3 School Climate Survey were collected via an online self-report survey completed by students across the participating 12 districts. Alcohol outlet data were obtained from Liquor License Boards. The non-identifiable data analysis was approved the Institutional Review Board at Johns Hopkins Bloomberg School of Public Health.

Procedures

The Maryland State Department of Education approached local school districts for participation in the initiative. Upon expressing interest in MDS3, meetings were conducted to obtain school level commitment to the project. Schools' participation in the MDS3 project was voluntary. Once schools agreed to participate, letters were sent home to parents providing information about the survey and the larger initiative. An anonymous online student survey was administered using a passive parental consent process and youth assent process; all participation was voluntary. The survey was administered online in language arts classrooms to approximately seven 9th grade classrooms and six 10th, 11th, and 12th grade classrooms. School staff in each school administered the survey following a written protocol developed by the university-based research team. Alcohol outlet data were obtained from each of the twelve Liquor License Boards, which are operated at the county-level. This data included the trade name of the facility, the address, and the license type.

Sample

Baseline data from the MDS3 School Climate survey were collected from 25,308 students in each of the 58 high schools participating in the MDS3 Initiative. An average of 24 classrooms per school was sampled. Participating schools included a diverse population with a minority rate of 45.2% (SD = 25.3%), with a mean student enrollment of 1282 (SD = 467.9).

Measures

The MDS3 School Climate Survey was developed by the Johns Hopkins Center for Youth Violence Prevention in collaboration with project partners drawing on previously published measures. It is comprised of over 150 questions focused on the three domains of school climate (i.e., safety, engagement, and environment) (see Bradshaw et al. [in press] for additional information about the creation and validation of the survey). The current paper focuses on the following core data elements captured through the MDS3 School Climate Survey.

Perceived Availability of ATOD—The perceived availability of substances was assessed through questions that asked “How difficult is it for students in your grade to get [substance] if they really want them?”. Questions were adapted from the Communities that Care Survey (Arthur et al., 2002) with answer choices on a 4-point Likert scale from very difficult to very easy. Response choices were coded such that a higher value corresponded with less difficulty. The three-item (i.e., alcohol, tobacco, and marijuana) Cronbach’s alpha (α) was . 865 for this sample.

Perception of Substance Use as a Problem—In a similar fashion, students also reported on whether student use of substances at the school was a problem (i.e., alcohol, tobacco, and marijuana) (Plank et al., 2009). Responses were also on a 4-point scale and ranged from large problem to not a problem. The three items were reverse coded to match the direction of the other substance related questions such that larger values indicated that substance use was more of a problem (α =.872 for this sample).

Self-reported Substance Use—The self-reported substance use questions assessed the number of days that participants used alcohol, tobacco, and marijuana (i.e. 0 days, 1–2 days, 3–5 days, 6–9 days, 10–19 days, 20–29 days, and all 30 days). These questions were adapted from the Youth Risk Behavior Surveillance Survey (CDC, 2011). The substance use responses were collapsed to determine past month substance use (i.e. use at least once during the past month) (α = .712 for this sample).

Research examining the association between alcohol outlets and crime as well as individual alcohol use generally focuses on off-premise alcohol outlets (i.e., package goods stores and other facilities such as bars and taverns that also sell alcohol for off-premise consumption) since earlier studies found a stronger association between off-premise alcohol outlets and problem behavior compared to on-premise alcohol outlets (e.g., restaurants) (Schonlau et al., 2008; Scribner et al., 1999). This investigation will focus on off-premise only alcohol outlets.

Alcohol Outlet Density—Alcohol outlet location and school location data were geocoded using ArcGIS v.10 (ESRI, 2011). Approximately 99% of the off-premise alcohol outlets were geocoded; the remaining 1% did not have complete addresses or could not be located. Two-mile buffers were added around the school using the Service Area tool in ArcGIS. The Service Area tool created a buffer based on distance navigating street networks (compared to straight line distance which would ignore street networks, highways, and buildings). The count of alcohol outlets within the buffer was determined using the spatial join tool (a tool used to append data from one map layer to another map layer using geographic location) in ArcGIS. The buffer size in square miles was included in the analyses to adjust for differences in buffer size by school. We will refer to the count of alcohol outlets within two miles as alcohol outlet density.

Statistical Analysis

The nested study design, namely students nested within schools, supported the use of multilevel modeling. Accordingly, multilevel path analysis was conducted in Mplus (Muthén and Muthén, 2012) to assess the extent to which alcohol outlet density and ATOD perceived availability were associated with youths' perception that substance use was a problem at their school and self-reported substance use (Figure 1). The two-level path model was clustered at the school-level (n = 58 schools/clusters). We conducted confirmatory factor analyses (CFA) a priori for each of the outcome variables (e.g. self-reported ATOD use) and covariates by gender (see Table 2 for estimates), which also adjusted for clustering at the school-level. This allowed inclusion of these latent variables into the models as "observed variables" using the factor estimates from the CFA models. We examined the following model-fit indices including the Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), and Tucker-Lewis Index (TLI), such that RMSEA values ≤ .05, CFI values ≥ .95, and TLI values ≥ .90 generally represented good fit to the observed data (Marsh et al., 2009).

The path models were stratified by gender based on preliminary data analyses, in which we found significant differences in the outcome variables as well as the covariates by gender; similarly, previous research has reported gender differences in the relationship between neighborhood environment (e.g., neighborhood disorder, alcohol outlet density) and behavioral outcomes (McGee et al., 2001; Milam et al., 2012). Chi-squared tests were used to compare differences by gender for categorical variables. The analyses controlled for grade and race/ethnicity at the individual-level. At the school-level, we considered the percentage of minority students as well as the percentage of students receiving free and reduced meals (FARMs), which were a proxy for socioeconomic status. Significant findings were reported for alpha levels below 0.05.

Survey weights—We weighted the sample of students to reflect the entire student population within the 58 schools. Specifically, sampling weights were created in Stata 11.0 (StataCorp, 2009) using the raking method (Battaglia et al., 2004; Deville et al., 1993), which is an iterative procedure that produces weights based on marginal results from multiple variables (e.g., grade, gender, and race) (see Bradshaw, Waasdorp, Debnam, & Johnson, 2014, in press, for more details).

Missing Data—Mplus uses Full Information Maximum Likelihood (FIML) to include all observed data unless the participant is missing on all outcome variables to build parameter estimates and standard errors. However, Mplus excludes cases that are missing survey weights. Participants who were missing data on gender, race/ethnicity, and grade were excluded as they had no values for survey weights (n = 2182; 8.4%). The majority of the participants without survey weights were missing on all values, i.e. they did not attempt to complete the survey. Among the participants with survey weights, there was little missing data (<3.7%). Data were more likely to be missing among males, African Americans, and those in higher grade levels; these variables were included in the analyses.

Results

Descriptive Statistics

Table 1 displays the descriptive statistics of the analytical sample stratified by gender (n = 22,851). The sample was nearly 50% male, 28.7% African American, and the average age was 15.9 years (SD = 1.3). More than one third of participants reported past month alcohol use (37%); there were no differences in current alcohol use between boys and girls (χ^2= 1.010; p = .315). Girls were more likely to endorse both past month cigarette (n = 1886; 17.4%; p < 0.001) and past month marijuana use (n = 2795; 25.4%; p < 0.001). Girls were more likely to report that students' use of alcohol (n = 3137; 34.5%), tobacco (n = 4647; 41.8%), and marijuana (n = 4818; 43.8%) was a large problem compared to males (p < 0.001). There were also differences in perceived availability of substance use; notably, girls were less likely to report that alcohol (n = 4598; 40.5%), tobacco (n = 5311; 48.7%), and marijuana (n = 5203; 47.5%) was very easy for students to get if they really wanted it. The school-level characteristics are also included in Table 1; the average count of off-premise alcohol outlets was 4.4 (SD = 4.4). The high schools included in this investigation were on average 25.6% minority and 31.9% of students received free and reduced priced meals.

Path Modeling

Girls—The path models were run separately for boys and girls. The fit indices for the female model were good; the chi-square test of model fit was not significant (χ^2 = 5.01, p = .287, df = 4), CFI was .999, TLI = .996, and RMSEA = .005. The average cluster size was 200 female high school students within 58 high schools. The intraclass correlation coefficient (ICC) for the outcome variables ranged from .01 to .06. At the individual-level (within model), perceived availability predicted both perception of students' substance use as a problem (Estimate = .403, p < .001) and self-reported substance use (Estimate = .072, p < .001); as students' perception of substance availability increased, individual use and perception of other students' use increased (Table 3). Self-reported substance use was positively associated with perception of other students' substance use (Estimate = .102, p < .001).

The between model (school-level; between schools) examined the association between school-level variables and substance use; the percentage of minority students (Estimate = -.005, p = .033) and alcohol outlet density (Estimate = .020, p = .027) were associated with perceived availability. As the count of alcohol outlets within the two-mile buffer increased,

the perception of ATOD availability increased adjusting for the size of the buffer. The relationship between the percentage of FARMs was not associated with perceived availability. Perceived availability was associated with both perception of students' substance use (Estimate = 1.483, p = .027) and self-reported substance use (Estimate = .130, p = .010), however, alcohol outlet density was not associated with students' substance use or self-reported substance use. Self-reported substance use was not associated with perception of students' substance use at the school-level (Estimate = .005, p = .356).

Boys—The fit indices for the model for boys did not indicate a good fit; the chi-square test of model fit was significant (χ^2 = 71.4, p < .001, df = 4), CFI was .945, TLI = .669, and RMSEA = .038. The average cluster size was 197 male high school students within 58 high schools. The ICC for the outcome variables ranged from .026 to .043. At the individual-level, perceived availability was associated with both students' substance use (Estimate = .383, p < .001) and self-reported substance use (Estimate = .077, p < .001). Self-reported substance use was positively associated with perceived substance use of students at the school (Estimate = .114, p = .001).

Finally, alcohol outlet density was not associated with perceived availability or the outcome variables at the school-level (Table 4). Neither the percentage of minority students at the school nor the percentage of students receiving FARMs were associated with perceived availability. Among boys, there was no association between self-reported substance use and perception of students' substance use (Estimate = -.006, p = .749).

Discussion

This study explored whether alcohol outlet density and perceived ATOD availability were associated with ATOD use among 9th–12th grade students. Significant positive effects were identified for girls, such that higher alcohol outlet density in relation to the high school, the more likely girls were to report ATOD availability; however, this association did not hold for boys, as alcohol outlet density was unrelated to ATOD perceived availability among boys. While density was not directly related to actual ATOD use for boys or girls, perceived availability is a strong predictor of future use, and is a potential signal for increased future risk among girls. Additionally, urbanicity (i.e., living in an urban, urban fringe, suburban, versus rural environment) was not statistically significantly related to perceived alcohol availability for boys or girls; but alcohol outlet density was higher in urban areas. The relationship between alcohol outlet density and perceived availability remained significant after controlling for urbanicity among girls. The current findings are consistent with other similar studies that examined children's and adolescents' neighborhood context and behavioral outcomes, in which girls were also more sensitive to the disordered neighborhood environment than boys (Brown et al., 2014; Drukker et al., 2010; Fagan and Wright, 2012; Milam et al., 2012). It is possible that high school girls may be more sensitive to environmental exposure and specifically the alcohol environment than their male counterparts. There may be other salient risk factors for high school boys not measured here that drive their attitudes about alcohol, tobacco, and other drugs as well as their use of these substances. If in fact environmental alcohol exposure is more hazardous for girls at this age than boys, more research is needed to understand the mechanism that accounts for this

association and gender-specific interventions should be developed that seek to mitigate these pathways. For example, there are other published studies that have found the neighborhood environment is more strongly associated with negative outcomes in boys during childhood and early adolescence; however, this relationship may change as the youth age (Leventhal and Brooks-Gunn, 2000).

It is important to note a few limitations when considering these findings. For example, much of our data were collected via youth self-reports and do not include detailed information on peer or familial ATOD use. We also focused on perceived availability and ATOD use, although there are other potentially important, but unmeasured variables that could further explicate the impact that alcohol outlet density has on high school drug and alcohol use. In addition, the cross-sectional study design prohibited analysis of causal relationships. It is possible that substance users who are seeking out substances may be more likely to perceive higher availability of alcohol, tobacco, and other drugs; this could explain the relationship between perceived availability and substance use. However, interventions that reduce alcohol outlets will reduce actual availability and may reduce use. Future studies should examine the relationship between substance use availability, perceived availability, and substance use over time in order to inform policies and potential interventions.

Despite these limitations, this study has several strengths. The study includes a very large and relatively diverse sample. We also focused on the earliest stages of drug and alcohol use, namely among high school students. Our use of GIS analyses with multi-level modeling, drawing upon school records data at the school level and community data regarding alcohol outlets is also unique.

In conclusion, the current findings suggest a role for gender-specific interventions to prevent and reduce ATOD use among high school girls. Future investigations will further explore potential mechanisms linking the alcohol environment to high school girls' risk for ATOD use as well as explore other potentially important domains that might explain risk for boys ATOD use. These findings also have potential policy significance regarding alcohol outlets, which are a salient environmental feature that can be regulated by zoning and land use regulations (Ashe et al., 2003). These regulations are permissible as a public health intervention strategy given that alcohol outlets are associated with public health problems such as crime, problematic alcohol use, and adolescent behavioral health (Ashe et al., 2003; Wittman 1997; Milam et al., 2014). For example, in Maryland there is a law that prohibits alcohol outlets to be within 300 feet of a school. Local jurisdictions have been able to extend this distance to 500 feet; however there are no regulations that limit the density of alcohol outlets. Future studies should explore differences in alcohol outlet regulations, alcohol outlet proximity, and behavioral outcomes in adolescents given the relationship between alcohol outlets and perceived availability, particularly among girls.

Acknowledgments

Grant Support: Support for this work comes from the Centers for Disease Control and Prevention (1U49CE000728), the U.S. Department of Education's Safe and Supportive Schools Initiative, and the William T. Grant Foundation).

References

Arthur MW, Hawkins JD, Pollard JA, Catalano RF, Baglioni AJ. Measuring risk and protective factors for substance use, delinquency, and other adolescent problem behaviors: The Communities that Care Youth Survey. Evaluation Review. 2002; 26(6):575–601. [PubMed: 12465571]

Ashe M, Jernigan D, Kline R, Galaz R. Land use planning and the control of alcohol, tobacco, firearms, and fast food restaurants. American Journal of Public Health. 2003; 93(9):1404–1408. [PubMed: 12948952]

Battaglia, MP.; Izrea, D.; Hoaglin, DC.; Frankel, MR. Tips and tricks for raking survey data (a.k.a. sample balancing). 2014. Retrieved from: http://www.amstat.org/sections/srms/proceedings/y2004/files/Jsm2004-000074.pdf

Bradshaw CP, Waasdorp TE, Debnam KJ, Johnson SL. Measuring school climate in high schools: A focus on safety, engagement, and the environment. Journal of School Health. 2014; 84(9):593–604. [PubMed: 25117894]

Bronfenbrenner, U.; Morris, P. The ecology of developmental processes. In: Damon, W., editor. Handbook of child psychology: Vol. 1: Theoretical models of human development. New York: John Wiley & Sons; 1998. p. 993-1028.

Brown, CH.; Mason, WA.; Brown, EC. Translating the intervention approach into an appropriate research design: The next-generation adaptive designs for effectiveness and implementation research. In: Sloboda, Z.; Petras, H., editors. Advances in prevention science: Defining prevention science. New York: Springer Publishing; 2014. p. 363-387.

Centers for Disease Control and Prevention (CDC). Youth Risk Behavior Survey. 2011. Retrieved from: www.cdc.gov/yrbs

Centers for Disease Control and Prevention(CDC). Percentage of high school students who ever drank alcohol and who drank alcohol for the first time before age 13 years, by sex, race/ethnicity, and grade. MMWR. 2012; 61(4):88.

Crum RM, Lillie-Blanton ML, Anthony JC. Neighborhood environment and opportunity to use cocaine and other drugs in late childhood and early adolescence. Drug and Alcohol Dependence. 1996; 43:155–161. [PubMed: 9023071]

Deville JC, Sarndal CE, Sautory O. Generalized raking procedures in survey sampling. Journal of the American Statistical Association. 1993; 88:1013–1020.

Drukker M, Bak M, Campo Já, Driessen G, Van Os J, Delespaul P. The cumulative needs for care monitor: A unique monitoring system in the south of the Netherlands. Social Psychiatry and Psychiatric Epidemiology. 2010; 45:475–485. [PubMed: 19572089]

ESRI. ArcGIS Desktop: Release 10. Redlands, CA: Environmental Systems Research Institute; 2011.

Fagan AA, Wright EM. The effects of neighborhood context on youth violence and delinquency: Does gender matter? Youth Violence and Juvenile Justice. 2012; 10(1):64–82.

Franklin FA, LaVeist TA, Webster DW, Pan WK. Alcohol outlets and violent crime in Washington DC. Western Journal of Emergency Medicine. 2010; 11(3):283. [PubMed: 20882151]

Grant BF, Dawson DA. Age at onset of alcohol use and its association with DSM-IV alcohol abuse and dependence: Results from the National Longitudinal Epidemiologic Survey. Journal of Substance Abuse. 1997; 9:103–110. [PubMed: 9494942]

Harrison PA, Fulkerson JA, Park E. The relative importance of social versus commercial sources in youth access to tobacco, alcohol, and other drugs. Preventive Medicine. 2000; 31(1):39–48. [PubMed: 10896842]

Hawkins JD, Graham JW, Maguin E, Abbott R, Hill KG, Catalano RF. Exploring the effects of age of alcohol use initiation and psychosocial risk factors on subsequent alcohol misuse. Journal of Studies on Alcohol. 1997; 58(3):280–290. [PubMed: 9130220]

Hearst MO, Fulkerson JA, Maldonado-Molina MM, Perry CL, Komro KA. Who needs liquor stores when parents will do? The importance of social sources of alcohol among young urban teens. Preventive Medicine. 2007; 44(6):471–476. [PubMed: 17428525]

Jennings JM, Milam AJ, Greiner A, Furr-Holden CDM, Curriero FC, Thornton RJ. Neighborhood alcohol outlets and the association with violent crime in one Mid-Atlantic city: The implications for zoning policy. Journal of Urban Health. 2014; 91(1):62–71. [PubMed: 24002723]

Kuntsche E, Kuendig H, Gmel G. Alcohol outlet density, perceived availability and adolescent alcohol use: A multilevel structural equation model. Journal of Epidemiology and Community Health. 2008; 62(9):811–816. [PubMed: 18701732]

Kypri K, Bell ML, Hay GC, Baxter J. Alcohol outlet density and university student drinking: A national study. Addiction. 2008; 103(7):1131–1138. [PubMed: 18554346]

Leventhal T, Brooks-Gunn J. The neighborhoods they live in: The effects of neighborhood residence upon child and adolescent outcomes. Psychological Bulletin. 2000; 126:309–337. [PubMed: 10748645]

Marsh HW, Muthén B, Asparouhov T, Lüdtke O, Robitzsch A, Morin AJS, Trautwein U. Exploratory Structural Equation Modeling, Integrating CFA and EFA: Application to Students' Evaluations of University Teaching. Structural Equation Modeling. 2009; 16(3):439–476.

McCord ES, Ratcliffe JH. A micro-spatial analysis of the demographic and criminogenic environment of drug markets in Philadelphia. Australian & New Zealand Journal of Criminology. 2007; 40:43–63.

McGee ZT, Davis BL, Brisbane T, Collins N, Nuriddin T, Irving S, Martin K. Urban stress and mental health among African-American youth: Assessing the link between exposure to violence, problem behavior, and coping strategies. Journal of Cultural Diversity. 2000; 8(3):94–104. [PubMed: 11855219]

Milam AJ, Furr-Holden CD, Whitaker D, Smart M, Leaf P, Cooley-Strickland M. Neighborhood environment and internalizing problems in African American children. Community Mental Health Journal. 2012; 48(1):39–44. [PubMed: 21234683]

Milam AJ, Furr-Holden CD, Bradshaw CP, Webster DW, Cooley-Strickland MC, Leaf PJ. Alcohol environment, perceived safety, and exposure to alcohol, tobacco, and other drugs in early adolescence. Journal of Community Psychology. 2013; 41(7):867–883. [PubMed: 25125766]

Milam AJ, Furr-Holden CDM, Cooley-Strickland MC, Bradshaw CP, Leaf PJ. Risk for exposure to alcohol, tobacco, and other drugs on the route to and from school: The role of alcohol outlets. Prevention Science. 2014; 15(1):12–21. [PubMed: 23408286]

Miller TR, Levy DT, Spicer RS, Taylor DM. Societal costs of underage drinking. Journal of Studies on Alcohol and Drugs. 2006; 67(4):519.

Muthén, LK.; Muthén, BO. Mplus User's Guide. 7. Los Angeles, CA: Muthén & Muthén; 1998–2012.

Pasch KE, Komro KA, Perry CL, Hearst MO, Farbakhsh K. Outdoor alcohol advertising near schools: What does it advertise and how is it related to intentions and use of alcohol among young adolescents? Journal of Studies on Alcohol and Drugs. 2007; 68(4):587. [PubMed: 17568965]

Pasch KE, Komro KA, Perry CL, Hearst MO, Farbakhsh K. Does outdoor alcohol advertising around elementary schools vary by the ethnicity of students in the school? Ethnicity & Health. 2009a; 14(2):225–236. [PubMed: 18821155]

Pasch KE, Hearst MO, Nelson MC, Forsyth A, Lytle LA. Alcohol outlets and youth alcohol use: Exposure in suburban areas. Health & Place. 2009b; 15(2):642–646. [PubMed: 19084464]

Paschall MJ, Grube JW, Black C, Ringwalt CL. Is commercial alcohol availability related to adolescent alcohol sources and alcohol use? Findings from a multi-level study. Journal of Adolescent Health. 2007; 41(2):168–174. [PubMed: 17659221]

Plank SB, Bradshaw CP, Young H. An application of "broken windows" and related theories to the study of disorder, fear, and collective efficacy in schools. American Journal of Education. 2009; 115:227–247.

Schonlau M, Scribner R, Farley TA, Theall KP, Bluthenthal RN, Scott M, Cohen DA. Alcohol outlet density and alcohol consumption in Los Angeles County and Southern Louisiana. GeoSpatial Health. 2008; 3:91–101. [PubMed: 19021112]

Scribner R, Cohen D, Kaplan S, Allen SH. Alcohol availability and homicide in New Orleans: Conceptual considerations for small area analysis of the effect of alcohol outlet density. Journal of Studies on Alcohol and Drugs. 1999; 60:310–316.

Scribner R, Mason K, Theall K, Simonsen N, Schneider SK, Towvim LG, DeJong W. The contextual role of alcohol outlet density in college drinking. Journal of Studies on Alcohol and Drugs. 2007; 69(1):112. [PubMed: 18080071]

Speer PW, Gorman DM, Labouvie EW, Ontkush M. Violent crime and alcohol availability: Relationships in an urban community. Journal of Public Health Policy. 1998; 19:303–318. [PubMed: 9798373]

StataCorp. Stata Statistical Software: Release 11. College Station, TX: StataCorp LP; 2009.

Stillman FA, Bone LR, Milam AJ, Ma J, Hoke K. Out of View but in Plain Sight: The Illegal Sale of Single Cigarettes. Journal of Urban Health. 2014; 91(2):355–365. [PubMed: 24500025]

Substance Abuse and Mental Health Services Administration, Center for Behavioral Health Statistics and Quality. The NSDUH Report: State Estimates of Underage Alcohol Use and Self-Purchase of Alcohol: 2008 to 2010. Rockville, MD: Substance Abuse and Mental Health Services Administration; 2012.

Substance Abuse and Mental Health Services Administration. Results from the 2012 National Survey on Drug Use and Health: Summary of National Finding. Rockville, MD: Substance Abuse and Mental Health Services Administration; 2013.

Substance Abuse and Mental Health Services Administration, Center for Behavioral Health Statistics and Quality. The NSDUH Report: State Estimates of Underage Alcohol Use and Self-Purchase of Alcohol: 2008 to 2010. Rockville, MD: Nov 20. 2012

Theall KP, Lancaster BP, Lynch S, Haines RT, Scribner S, Scribner R, Kishore V. The neighborhood alcohol environment and at risk drinking among African-Americans. Alcoholism: Clinical and Experimental Research. 2011; 35(5):996–1003.

Wagenaar AC, Finnegan JR, Wolfson M, Anstine PS, Williams CL, Perry CL. Where and how adolescents obtain alcoholic beverages. Public Health Reports. 1993; 108(4):459. [PubMed: 8341780]

Wagenaar AC, Toomey TL, Murray DM, Short BJ, Wolfson M, Jones-Webb R. Sources of alcohol for underage drinkers. Journal of Studies on Alcohol and Drugs. 1996; 57(3):325–333.

Wagner FA, Anthony JC. Into the world of illegal drug use: Exposure opportunity and other mechanisms linking the use of alcohol, tobacco, marijuana, and cocaine. American Journal of Epidemiology. 2002; 155(10):918–925. [PubMed: 11994231]

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

Widome R, Brock B, Noble P, Forster JL. The relationship of neighborhood demographic characteristics to point-of-sale tobacco advertising and marketing. Ethnicity & Health. 2013; 18(2):136–151. [PubMed: 22789035]

Wittman, F. Local control to prevent problems of alcohol availability: Experience in California communities. In: Plant, M.; Single, E.; Stockwell, T., editors. Alcohol: Minimizing the harm. What works?. New York: Free Association Books; 1997. p. 43-71.

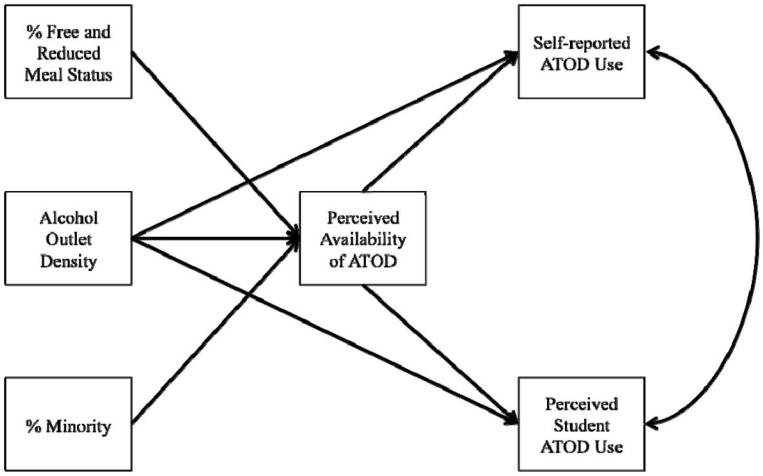

Figure 1.
Path Model of Alcohol Outlet Density, Perceived Availability, and ATOD Use

Table 1

Analytical Sample Descriptive Statistics with Weights

	Boys ***n*** **(weighted %)**	**Girls** ***n*** **(weighted %)**	***p***
African American	3,336 (35.0)	3,218 (32.6)	.032
Mean Age (SD)	16.0 (1.4)	15.9 (1.3)	<.001
Grade			.611
9th	3,529 (26.5)	3,609 (27.4)	
10th	2,854 (24.6)	2,940 (27.1)	
11th	2,950 (26.1)	2,783 (24.2)	
12th	2,076 (22.8)	2,110 (21.3)	
Current Alcohol Use	4,220 (37.1)	4,201 (37.0)	.315
Current Tobacco Use	1,886 (17.4)	1,495 (13.4)	<.001
Current Marijuana Use	2,795 (25.4)	2,050 (18.8)	<.001
Very easy for students to get alcohol if they really want it	4,257 (41.0)	4,598 (40.5)	<.001
Very easy for students to get tobacco if they really want it	5,283 (50.9)	5,311 (48.7)	<.001
Very easy for students to get marijuana if they really want it	5,265 (50.4)	5,203 (47.5)	<.001
Students' alcohol use at my school (beer, wine, liquor) is a large problem	2,671 (30.6)	3,137 (34.5)	<.001
Students' tobacco use at my school is a large problem	4,271 (38.1)	4,647 (41.8)	<.001
Students' drug use at my school) is a large problem	4,221 (39.1)	4,818 (43.8)	<.001
	n **= 11,409**	***n*** **= 11,442**	
School-level	**Mean (SD)**		
Alcohol Outlet Count, *two miles*	4.9 (4.9)		
% Minority Enrollment	45.2 (25.3)		
% Free & Reduced Priced Lunch	34.4 (16.4)		
% Out of School Suspension	27.8 (16.0)		

Table 2

Confirmatory Factor Analysis of Substance Use Questions with Standardized Factor Estimates

	Boys	Girls
	Factor Estimate	**Factor Estimate**
Substance Use		
Alcohol Use	0.833	0.819
Tobacco Use	0.885	0.815
Marijuana Use	0.867	0.907
Perceived Availability		
Alcohol	0.893	0.890
Tobacco	0.910	0.884
Marijuana	0.865	0.838
Student Use		
Alcohol	0.878	0.854
Tobacco	0.858	0.847
Marijuana	0.914	0.925

All estimates had $p < 0.001$; n ranged from 11,111 to 11,414 for boys and 11,257 to 11,444 for girls

Table 3

Alcohol Outlet, Substance Availability and Substance Use Path Model-Girls (n = 11442)

	Estimate (EST)	Standard Error (SE)	Est/SE	p-value
Individual-Level				
Perceived Availability on				
Grade Level	0.309	0.029	10.834	0.000
African American	−0.154	0.071	−2.173	0.030
Students' Substance Use on				
Grade Level	0.028	0.031	0.912	0.362
African American	−0.513	0.078	−6.613	0.000
Perceived Availability	0.403	0.017	23.224	0.000
Self-Reported Substance Use on				
Grade Level	0.060	0.011	5.658	0.000
African American	−0.131	0.028	−4.639	0.000
Perceived Availability	0.072	0.005	13.365	0.000
Students' Substance Use with	0.102	0.028	3.685	0.000
Self-reported Substance use				
School-Level				
Perceived Availability on				
% Minority Students	−0.005	0.002	−2.128	0.033
% Free and Reduced Meal Status	0.000	0.003	0.115	0.909
Count of Alcohol Outlets, two miles	0.020	0.009	2.217	0.027
Buffer Size (sq miles)	−0.013	0.030	−0.428	0.669
Self-Reported Substance Use on				
Count of Alcohol Outlets, two miles	−0.001	0.003	−0.448	0.654
Buffer Size (sq miles)	0.025	0.009	2.794	0.005
Perceived Availability	0.13	0.051	2.564	0.010
Students' Substance Use on				
Count of Alcohol Outlets, two miles	−0.010	0.015	−0.662	0.508
Buffer Size (sq miles)	0.026	0.076	0.337	0.736
Perceived Availability	1.483	0.373	3.978	0.000
Students' Substance Use with	0.005	0.006	0.904	0.356
Self-reported Substance use				

Table 4

Alcohol Outlet, Substance Availability and Substance Use Path Model--Boys (n = 11409)

	Estimate (EST)	Standard Error (SE)	Est/SE	p-value
Individual-Level				
Perceived Availability on				
Grade Level	0.304	0.036	8.409	0.000
African American	−0.186	0.097	−1.920	0.055
Students' Substance Use				
Grade Level	0.002	0.039	0.047	0.963
African American	−0.410	0.083	−4.955	0.000
Perceived Availability	0.383	0.016	23.301	0.000
Self-Reported Substance Use				
Grade Level	0.089	0.013	6.604	0.000
African American	−0.078	0.030	−2.580	0.010
Perceived Availability	0.077	0.005	14.146	0.000
Students' Substance Use with	0.114	0.034	3.403	0.001
Self-reported Substance use				
School-Level				
Perceived Availability on				
% Minority Students	−0.001	0.004	−0.245	0.806
% Free and Reduced Meal Status	−0.007	0.007	−0.969	0.332
Count of Alcohol Outlets, two miles	0.027	0.016	1.649	0.099
Buffer Size (sq miles)	0.018	0.048	0.370	0.711
Self-Reported Substance Use on				
Count of Alcohol Outlets, two miles	−0.003	0.005	−0.716	0.474
Buffer Size (sq miles)	0.029	0.013	2.329	0.020
Perceived Availability	0.113	0.093	1.211	0.226
Students' Substance Use				
Count of Alcohol Outlets, two miles	−0.007	0.018	−0.376	0.707
Buffer Size (sq miles)	0.072	0.064	1.135	0.256
Perceived Availability	0.295	0.444	0.663	0.507
Students' Substance Use with	−0.006	0.018	−0.320	0.749
Self-reported Substance use				