

An Ecological Analysis of Alcohol-Outlet Density and Campus-Reported Violence at 32 U.S. Colleges*

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ABSTRACT. Objective: The purpose of this study was to assess the relationships among campus violence, student drinking levels, and the physical availability of alcohol at off-campus outlets in a multisite design. **Method:** An ecological analysis of on-campus violence was conducted at 32 U.S. colleges. Dependent variables included campus-reported rates of rape, robbery, assault, and burglary obtained from a U.S. Department of Education online database for the years 2000-2004. Measures of student alcohol use and demographics were obtained from student surveys conducted for the Social Norms Marketing Research Project from 2000 to 2004. Measures of alcohol-outlet density within 3 miles of each campus were obtained from state alcohol-licensing authorities for 2004. **Results:** Both on- and off-premise alcohol-outlet

densities were associated with the campus rape-offense rate but not with the assault or robbery rates. Student drinking level was associated with both campus rape and assault rates but not with the campus robbery rate. The apparent effect of on-premise outlet density on campus rape-offense rates was reduced when student drinking level was included in the model, suggesting that the effect of on-premise outlet density may be mediated by student drinking level. Separate analyses revealed a similar mediational role for off-premise outlet density. **Conclusions:** These findings demonstrate that there is a campus-level association between sexual violence and the campus-community alcohol environment. (*J. Stud. Alcohol Drugs*, 71, 184-191, 2010)

ATTENTION TO THE ISSUE of campus violence was sparked by the 1986 rape and murder of Jeanne Clery, a 19-year-old woman at Lehigh University. Jeanne Clery's parents campaigned for greater transparency in campus violence statistics, arguing that, if they had known about violent-crime incidents at Lehigh in recent years, the family could have made a better decision regarding Jeanne's choice of college. The U.S. Congress passed the Crime Awareness and Campus Security Act in 1990, which required all colleges that participate in federal aid programs to provide campus crime statistics (Kassa, 1998). That law was amended in 1998 to strengthen and standardize reporting requirements and was renamed for Jeanne Clery at that time. The U.S. Department of Education now operates an online clearinghouse that provides statistics on campus violence (Office of Postsecondary Education, 2000).

The relationship between alcohol and crime is well estab-

lished in the research literature (Pernanen, 1991). The most recent statistics compiled by the U.S. Department of Justice's Bureau of Justice Statistics determined that, in the United States, 40% of violent crimes and two thirds of intimate-partner violence incidents are alcohol related (Greenfeld, 1998). Hingson and colleagues (2005) estimate that 600,000 college students are assaulted annually by another drinking student. Although the Hingson et al. estimate covers both on- and off-campus assaults, the Jeanne Clery Act requires the reporting of only on-campus crime. However, the Bureau of Justice Statistics report indicates that the role of alcohol in violence is greater for students living on campus and that alcohol-involved violence is more likely to occur on campus than off campus (Greenfeld, 1998).

A key environmental factor associated with violent crime is the physical availability of alcohol, which is typically measured by alcohol-outlet density. This relationship has been documented in several studies (Gorman et al., 2001; Lipton and Gruenewald, 2002; Norstrom, 2000; Reid et al., 2003; Scribner et al., 1995, 1999; Zhu et al., 2004). One explanation is that a higher density of alcohol outlets more often brings potential perpetrators and victims together in high-risk settings. An alternative explanation is that higher alcohol-outlet density leads to greater levels of alcohol consumption, which in turn are associated with more frequent violence.

Identifying a link between the physical availability of alcohol and campus violence is a logical extension of this

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past research. In this ecological study, we hypothesized that alcohol-outlet density in campus communities is associated with violence rates at the campus level, even after controlling for other independent predictors of campus violence. We also hypothesized that any relationship between alcohol-outlet density and violence rates would be mediated by student alcohol-consumption level.

Method

Student data

Measures of student alcohol use and demographics were obtained from the Survey of College Alcohol Norms and Behavior (SCANB; DeJong et al., 2006), a survey of students from 32 colleges representing all four U.S. census regions (31% Northeast, 31% North Central, 16% West, and 22% South). This survey was used to evaluate the Social Norms Marketing Research Project. Fully 58.1% of the colleges were public institutions, and 41.9% were private.

The evaluation involved two independent trials to evaluate social-norms marketing campaigns designed to reduce alcohol consumption, the first with 18 colleges (DeJong et al., 2006) and the second with 14 colleges (DeJong et al., 2009). Each trial used a panel design involving cross-sectional surveys administered annually at each campus for 4 years. Students completed the SCANB during the spring semesters of either 2000 (baseline) through 2003 (posttest) or 2001 (baseline) through 2004 (posttest). With each cross-sectional survey, a random sample of 300 students per campus, stratified by class year, received the SCANB by mail. Details of the survey contents and administration are described elsewhere (DeJong et al., 2006, 2009).

The overall response rate for all 32 campuses across all 4 years was 53.1%. This response yielded a sample size of 19,838. Response rates over the 4 years in the first trial ranged from 53.1% to 58.8%. Response rates over the 4 years in the second trial ranged from 52.4% to 60.2%. On average, 159 students were surveyed annually at each institution. Across all four survey administrations, the total number of unique respondents per institution ranged from 503 to 724.

Relevant measures for the analyses reported here included campus demographics (mean age, proportion male, proportion White) and participation in fraternity/sorority activities (proportion involved for 6 or more hours per week). These variables were chosen because of their strong association with alcohol consumption in both the literature and previous analyses using these data.

Two measures of alcohol consumption also were included in the analyses: (a) campus mean for the average number of drinks consumed per week and (b) campus mean for the greatest number of drinks consumed in one sitting in the last 2 weeks. These measures were generated for each campus by

combining individual responses from each institution's four annual SCANB surveys and then aggregating them to the campus level.

The institutional review boards at the Education Development Center, Inc., Newton, MA, where the two evaluation studies were based, and all 32 participating institutions approved the survey procedure.

Campus violence data

Campus violence data were obtained from the Office of Postsecondary Education in the U.S. Department of Education (U.S. Department of Education, n.d.; Office of Postsecondary Education, 2000). Under the Jeanne Clery Act, all Title IV-eligible colleges are required to provide the department with annual enumerations of on-campus offenses reported to campus security or local police. For each institution, a count was made of the number of reported rapes, assaults, and robberies for 2000 through 2004. Burglaries also were counted to provide comparison data on a nonviolent offense. Each crime rate was calculated by dividing the mean annual number of offenses over the 4-year study period by the mean total student population (both undergraduate and graduate) and then multiplying by 1,000 to yield an annual rate per thousand students. All crime rates were log transformed to reduce skew in the distributions.

Alcohol-outlet density data

Alcohol-outlet information was obtained for 2004 from the active alcohol-license files kept by the alcoholic-beverage control or alcohol-licensing agency for the state where each campus was located. Outlets were classified as either on premise or off premise, a differentiation shared by all of the state agencies. On-premise outlets include bars and restaurants that sell alcohol on the premises; off-premise outlets are stores that sell carry-out alcoholic beverages.

MapInfo software (Pitney Bowes Software, Inc., Troy, NY) was used to "geocode" the outlets found within a 3-mile buffer around the published boundary of each campus. The overall geocode rate was 96%. Failure to geocode a valid address was typically related to lack of specificity in the address dictionary. Alcohol-licensing information was not available for one campus community. In this case, a site visit was conducted to count the number of off-campus alcohol outlets within the 3-mile buffer.

For each campus community, each alcohol-outlet density was determined by dividing the number of alcohol outlets within the 3-mile boundary by the 4-year mean for the total student population (both undergraduate and graduate) and then multiplying by 1,000 to yield densities per 1,000 students. The outlet densities were log transformed to reduce skew in the distributions.

Other data

The total population for the town or city in which each campus is located was obtained from the 2000 U.S. census. The overall violent-crime rate for each town or city, measured as the number of violent crimes in 2001 per 100,000 population, was obtained from the U.S. Department of Justice, Bureau of Justice Statistics.

Data analysis

Demographic indices for the survey participants at each college were compared with student-body data obtained from either the institution's Web site or the registrar's office. Correlations between demographic indices for the survey participants and those reported for the corresponding student population were high for the proportions of men, Whites, and part-time students (Pearson correlations = .91, .93, and .98, respectively).

Ordinary least squares regression analyses were performed to test the relationship of alcohol-outlet density and violent-crime rates while controlling for the proportion of surveyed students who were male, who were White, and who participated in fraternity/sorority activities for 6 or more hours per week. Models were developed separately for on- and off-premise alcohol outlets. Alcohol-outlet density was entered into the model first, followed by the three control variables entered together. The violent crimes of rape, assault, and robbery were analyzed individually and also combined and analyzed as a group. To test whether student

alcohol-consumption level mediated the relationship between alcohol-outlet density and campus violent-crime rates, additional models were run, adding in the greatest number of drinks in one sitting in the last 2 weeks. Models also were run substituting average weekly alcohol consumption as the drinking variable; results for those analyses were similar and are not reported here.

Both the overall town/city crime rate and town/city population were added last to the models to test for any independent effects that those municipal-level variables might have on the campus crime rates. These analyses are discussed but not shown in detail.

All analyses were done using SPSS Statistical Software, Version 14.0 (SPSS Inc., Chicago, IL).

Results

The overall annual violence rate on campus was 0.57 offenses per 1,000 students (Table 1). Rape was the most common violent offense reported, with almost 0.32 offenses reported annually per 1,000 students. On-campus assaults and robberies were the least prevalent of the reported offenses, with annual rates of 0.16 and 0.09 per 1,000 students, respectively. The overall annual rate for burglary, a nonviolent crime, was 2.26 offenses per 1,000 students.

Alcohol-outlet densities within the 3-mile buffer around campus varied widely. On-premise outlets were by far the most common, ranging from 2.02 to 81.76 outlets per 1,000 students. Other covariates also varied widely between the campuses. The mean number of drinks in the past week

TABLE 1. Crime rates, alcohol-outlet densities, student characteristics, and town/city characteristics for 32 colleges in 2000-2004

Variable	<i>N</i>	<i>M</i>	Min.	Max.	<i>SD</i>
Outcomes^a					
Violent-crime rate	32	0.57	0.09	1.69	0.35
Rape rate	32	0.32	0.02	1.21	0.26
Assault rate	32	0.16	0	0.61	0.15
Robbery rate	32	0.09	0	0.32	0.08
Burglary rate	32	2.26	0.18	7.84	1.75
Other variables					
On-premise outlet density ^b	32	17.12	2.02	81.76	19.35
Off-premise outlet density ^b	32	6.56	0.10	24.23	6.46
Mean greatest no. drinks at one sitting in last 2 weeks	32	4.31	2.19	6.88	1.45
Mean no. of drinks consumed per week	32	5.42	1.97	10.10	2.53
Proportion male students	32	0.39	0.28	0.54	0.06
Proportion White students	32	0.77	0.16	0.97	0.18
Proportion students spending 6 or more hours per week on fraternity/sorority activities	32	0.05	0	0.15	0.38
Violent-crime rate in the town/city per 100,000 population in 2001	32	795	60	2,528	680
Total town/city population	32	279,251	10,781	1,954,848	367,960

Notes: Min. = minimum; max. = maximum. ^aCrime rates are calculated as the average annual number of crimes on-campus for 2000-2004 per 1,000 undergraduate and graduate students enrolled; ^balcohol-outlet densities are calculated as the number of outlets within 3 miles of campus in 2004 per 1,000 undergraduate and graduate students enrolled.

ranged from 1.97 to 10.10 drinks, and the mean for the greatest number of drinks in one sitting in the last 2 weeks ranged from 2.19 to 6.88 drinks. On average, 5% of students were involved in fraternity/sorority activities for 6 or more hours per week; this proportion varied by campus from 0% to 15%.

Table 2 reports the results of regression analyses to test the effect of on-premise alcohol-outlet density on reported violence rates. Model 1 includes on-premise outlet density and the proportion of students who are male, who are White, and who participate in fraternity/sorority activities. Model 2 adds an individual drinking variable: the greatest number

TABLE 2. Regression models to predict campus crime rates for 32 colleges: On-premise outlet density

Variable	Model 1 β (SE)	Model 2 β (SE)
All violent offenses		
On-premise outlet density ^a	0.28 (0.11)*	0.09 (0.12)
Proportion male	1.48 (0.97)	0.99 (0.86)
Proportion White	0.55 (0.24)*	-0.14 (0.31)
Proportion participating \geq 6 hrs/week in fraternity/sorority activities	-1.80 (1.18)	-1.29 (1.04)
Greatest no. of drinks at one sitting in the last 2 weeks	—	0.13 (0.04)**
Adj. R ²	.265	.441
F	F(4, 27) = 3.80, p = .014	F(5, 26) = 5.88, p = .001
Rape		
On-premise outlet density ^a	0.32 (0.13)*	0.18 (0.15)
Proportion male	2.33 (1.10)*	1.96 (1.08) [§]
Proportion White	1.51 (0.28)**	1.00 (0.38)*
Proportion participating \geq 6 hrs/week in fraternity/sorority activities	-1.96 (1.34)	-1.58 (1.30)
Greatest number of drinks at one sitting in the last 2 weeks	—	0.10 (0.05) [§]
Adj. R ²	.573	.608
F	F(4, 27) = 11.39, p < .001	F(5, 26) = 10.60, p < .001
Assault		
On-premise outlet density ^a	0.16 (0.19)	-0.16 (.20)
Proportion male	-0.44 (1.66)	-1.29 (1.47)
Proportion White	0.13 (0.42)	-1.05 (0.52) [§]
Proportion participating \geq 6 hrs/week in fraternity/sorority activities	-2.62 (2.00)	-1.74 (1.77)
Greatest number of drinks at one sitting in the last 2 weeks	—	0.23 (0.07)**
Adj. R ²	.016	.256
F	F(4, 27) = 1.13, p = .365	F(5, 26) = 3.13, p = .024
Robbery		
On-premise outlet density ^a	0.12 (0.20)	0.24 (0.24)
Proportion male	1.89 (1.72)	2.20 (1.76)
Proportion White	-0.70 (0.43)	-0.28 (0.63)
Proportion participating \geq 6 hrs/week in fraternity/sorority activities	-1.18 (2.09)	-1.50 (2.12)
Greatest number of drinks at one sitting in the last 2 weeks	—	-0.08 (0.09)
Adj. R ²	-.002	-.006
F	F(4, 27) = 0.99, p = .431	F(5, 26) = 0.96, p = .460
Burglary		
On-premise outlet density ^a	0.41 (0.16)*	0.32 (0.19)
Proportion male	0.12 (1.38)	-0.11 (1.41)
Proportion White	-0.14 (0.35)	-0.45 (0.51)
Proportion participating \geq 6 hrs/week in fraternity/sorority activities	2.70 (1.67)	2.94 (1.70) [§]
Greatest number of drinks at one sitting in the last 2 weeks	—	0.06 (0.07)
Adj. R ²	.203	.195
F	F(4, 27) = 2.97, p = .037	F(5, 26) = 2.51, p = .056

Notes: Hrs = hours; adj. = adjusted. ^aAlcohol-outlet densities are calculated as the number of outlets within 3 miles of campus in 2004 per 1,000 undergraduate and graduate students enrolled.

[§]p < .10; *p < .05; **p < .01.

of drinks at one sitting in the last 2 weeks. Looking at the rates for all violent crimes taken together, on-premise outlet density and the proportion of students who were White were the strongest predictors. In Model 2, the effect of on-premise outlet density was reduced to nonsignificance in the presence of the student-drinking measure, suggesting that student

drinking mediated the relationship between alcohol-outlet density and campus violent-crime rates. A similar effect was noted for the proportion of White students on campus. This suggests that the relationship between the proportion of White students and violent-crime rates is also mediated by student drinking.

TABLE 3. Regression models to predict campus crime rates for 32 colleges: Off-premise outlet density

Variable	Model 1 β (SE)	Model 2 β (SE)
All violent offenses		
Off-premise outlet density ^a	0.16 (0.11)	0.04 (0.10)
Proportion male	0.72 (0.94)	0.74 (0.78)
Proportion White	0.65 (0.25)*	-0.17 (0.31)
Proportion participating ≥ 6 hrs/week in fraternity/sorority activities	-1.95 (1.29)	-1.27 (1.08)
Greatest number of drinks at one sitting in the last 2 weeks	—	0.14 (0.04)**
Adj. R^2	.172	.432
F	$F(4, 27) = 2.61,$ $p = .058$	$F(5, 26) = 5.72,$ $p = .001$
Rape		
Off-premise outlet density ^a	0.24 (0.12) [§]	0.14 (0.12)
Proportion male	1.63 (1.04)	1.64 (0.96)
Proportion White	1.63 (0.28)**	0.97 (0.38)*
Proportion participating ≥ 6 hrs/week in fraternity/sorority activities	-2.28 (1.43)	-1.74 (1.34)
Greatest number of drinks at one sitting in the last 2 weeks	—	0.12 (0.05)*
Adj. R^2	.539	.605
F	$F(4, 27) = 10.05,$ $p < .001$	$F(5, 26) = 10.48,$ $p < .001$
Assault		
Off-premise outlet density ^a	0.16 (0.17)	-0.004 (0.16)
Proportion male	-0.61 (1.50)	-0.58 (1.32)
Proportion White	0.18 (0.40)	-0.94 (0.53) [§]
Proportion participating ≥ 6 hrs/week in fraternity/sorority activities	-2.92 (2.05)	-2.00 (1.84)
Greatest number of drinks at one sitting in the last 2 weeks	—	0.20 (0.07)**
Adj. R^2	.023	.236
F	$F(4, 27) = 1.18,$ $p = .340$	$F(5, 26) = 2.92,$ $p = .032$
Robbery		
Off-premise outlet density ^a	-0.11 (0.18)	-0.09 (0.20)
Proportion male	0.84 (1.56)	0.83 (1.59)
Proportion White	-0.61 (0.42)	-0.49 (0.63)
Proportion participating ≥ 6 hrs/week in fraternity/sorority activities	-0.68 (2.15)	-0.78 (2.21)
Greatest number of drinks at one sitting in the last 2 weeks	—	-0.02 (0.08)
Adj. R^2	.000	-.036
F	$F(4, 27) = 1.00,$ $p = .426$	$F(5, 26) = 0.79,$ $p = .569$
Burglary		
Off-premise outlet density ^a	0.15 (0.16)	0.06 (0.16)
Proportion male	-1.36 (1.37)	-1.34 (1.32)
Proportion White	0.04 (0.37)	-0.62 (0.53)
Proportion participating ≥ 6 hrs/week in fraternity/sorority activities	2.75 (1.88)	3.29 (1.85) [§]
Greatest number of drinks at one sitting in the last 2 weeks	—	0.12 (0.07) [§]
Adj. R^2	.046	.111
F	$F(4, 27) = 1.37,$ $p = .269$	$F(5, 26) = 1.77,$ $p = .154$

Notes: Hrs = hours; adj. = adjusted. ^aAlcohol-outlet densities are calculated as the number of outlets within 3 miles of campus in 2004 per 1,000 undergraduate and graduate students enrolled.

[§] $p < .10$; * $p < .05$; ** $p < .01$.

When the overall campus violence rates were disaggregated into rape, assault, and robbery rates, the models for rape explained the greatest amount of variance, with R^2 ranging from .57 to .61. Model 1 shows that campus rates for rape are positively associated with on-premise outlet density, the proportion of students who are male, and the proportion of students who are White. Adding the student-drinking measure increased the amount of variance explained and reduced the effect for on-premise outlet density, again suggesting that student drinking mediated the outlet-density/crime-rate relationship.

Assault, robbery, and burglary offenses were not well explained by the models. A significant effect for student drinking on assaults was observed, but no strong effect was observed for robbery. In addition, the assault rate was negatively associated with the proportion of students who are White. Burglary, a property crime, was better explained by the models than assault or robbery (see the adjusted R^2 s in Table 2). On-premise outlet density and fraternity/sorority participation were strongly associated with the burglary rate, but adding the student-drinking measure did not improve the amount of variance explained.

Findings for off-premise outlets are presented in Table 3. For some offenses, the associations between off-premise outlet density and violence were similar but weaker than those found for on-premise outlet density. Off-premise alcohol-outlet density was not associated with robbery, burglary, or assault rates but did show a positive association with the rape-offense rates, as was seen with on-premise outlet density. Adding the student-drinking variable into the models revealed a strong relationship between drinking and rates for rape, assault, and burglary. Looking at rape, introducing the student-drinking variable reduced the effect of off-premise outlet density, just as in the model for on-premise outlet density.

Discussion

Given the established association between college student alcohol use and interpersonal violence (Abbey et al., 2001; Harford et al., 2003; Ullman and Brecklin, 2000), it was not surprising that, at the campus level, mean student alcohol consumption was strongly associated with the overall violence rate. Our findings extend this literature by demonstrating that a campus-level measure of the physical availability of alcohol—namely, the number of on-premise or off-premise alcohol outlets within 3 miles of campus—also was associated with the overall violence rate. Also noteworthy is that introducing the student-drinking measure into the models substantially reduced the association between outlet density and the overall violence rate. This finding suggests that campuses with higher alcohol-outlet density have higher drinking levels, which in turn explains their higher rates of violence. It should be noted that this is an

ecological study, and these individual-level inferences are not intended to suggest a causal mechanism. After controlling for individual drinking, the strength of the bar-density/violence association was reduced in this analysis, consistent with the simple explanation that more bars per capita lead to more violence through the mechanism of increased drinking. Individual drinking is then an intermediate variable in the causal pathway. Another way of conceptualizing these relations, however, is as a cross-level interaction, where the campus context operates by regulating or modifying risk (Glass and McAtee, 2006). Higher outlet density might lead to more drinking among those who do drink, thus increasing the likelihood of violence for a given proportion of drinkers or presenting more venues in which a drunken perpetrator commits a crime or a victim falls prey to violence.

Also of note was the varying profile of study variables associated with the individual violence outcomes. Rape-offense rates were positively associated with student drinking, alcohol-outlet density, the proportion of male students, and the proportion of White students. Higher levels of student drinking are associated with alcohol-outlet density (Scribner et al., 2008; Weitzman et al., 2003), and White and male students tend to be the heaviest drinkers (Task Force of the National Advisory Council on Alcohol Abuse and Alcoholism, 2002). Because alcohol use is involved in a high percentage of campus sexual assaults (Abbey et al., 2001; Baum and Klaus, 2005), the association of these variables with rape-offense rates is not surprising. Note that, when the alcohol-consumption measure was added to the model, the effect of outlet density was no longer significant, suggesting that alcohol outlets are contributing to higher levels of alcohol consumption and do not serve as a significant independent situational risk factor for sexual assault. In contrast, studies of alcohol-outlet density in the community context have suggested that the association of alcohol-outlet density with violence may be, in part, the result of the situational risk that alcohol outlets pose by bringing victims and perpetrators together in a high-risk setting, rather than by increasing drinking levels (Gruenewald and Remer, 2006; Scribner et al., 1995).

Assault-offense rates were positively associated with student drinking but negatively associated with the proportion of White students and not at all associated with alcohol-outlet density. This pattern of results was unexpected. Contrary to studies of alcohol-outlet density in the community context (Felson, 1997; Scribner et al., 1995; Zhu et al., 2004), we found no association between outlet density and assault rates. It should be noted, however, that the reported campus assault rates were surprisingly low, with the average rape-offense rate being twice the average assault rate. Given this apparent underreporting, the study design may not have been sensitive enough to detect the expected relationship between outlet density and the assault rate.

Surprisingly, the proportion of White students was

negatively associated with campus assault rates while being positively associated with the rape-offense rates. In a follow-up analysis (not shown), we found a negative relationship between the proportion of White students and overall crime rate for the metropolitan statistical area where each campus was located. This finding suggests that the negative association between the proportion of White students and campus assault rates may be explained by overall community crime rates.

There are several study limitations that should be considered when interpreting these results. First, the study is ecological, and therefore caution should be taken in drawing inferences from the campus to the individual level. Consequently, the relationships described here can be considered only suggestive of an environmental effect on individual drinking and violent behavior. Validation of these findings will require larger studies using multilevel and longitudinal designs to adequately model the person-in-environment fit and to establish the directionality of the relationships.

Second, several characteristics of the neighborhoods surrounding the college campuses were not considered (e.g., the socioeconomic status of the campus neighborhood). This is largely a result of the restricted number of variables that can be studied using a sample of only 32 campuses. Consequently, larger studies involving more campuses will be required to assess the effects of additional environmental variables.

In addition, the student data were aggregated over multiple years, yet the determination of alcohol-outlet densities at each campus was based on 2004 data. Clearly, there is the potential for bias if the number of alcohol outlets changed during the study period before or after the 2004 determination of outlet densities. Furthermore, student drinking is likely to be underreported, and therefore the full impact of potential mediation by student drinking may have been reduced by any underreporting.

Finally, although the campus violence data were obtained from the same source, the reliability of those data depends on whether individual campus authorities are following the same reporting procedures. A study evaluating the possibility of reporting bias in the U.S. Department of Education data set has not been conducted.

Colleges and universities around the United States have implemented a wide range of campus-focused programs and policies to reduce student drinking and thereby decrease alcohol-related outcomes such as violence. This study adds to the growing evidence that community-level efforts are equally important (Holder, 2000, 2002; Toomey et al., 2007). Zoning regulations that limit the number of bars, mandate responsible beverage service, and mandate strict adherence to underage drinking laws have all been demonstrated effective in community-level interventions and should be embraced by campus officials (Toomey and Wagenaar, 2002).

References

- Abbey, A., Zawacki, T., Buck, P. O., Clinton-Sherrod, A. M., & McAuslan, P. (2001). Alcohol and sexual assault. *Alcohol Research & Health, 25*, 43-51.
- Baum, K., & Klaus, P. (Eds.) (2005). *Violent victimization of college students 1995-2002* (NCJ Publication No. 206836). Washington, DC: Office of Justice Programs, Bureau of Justice Statistics, Department of Justice.
- DeJong, W., Schneider, S. K., Towvum, L. G., Murphy, M. J., Doerr, E. E., Simonsen, N. R., Mason, K. E., and Scribner, R. A. (2006). A multisite randomized trial of social norms marketing campaigns to reduce college student drinking. *Journal of Studies on Alcohol, 67*, 868-879.
- DeJong, W., Schneider, S. K., Towvum, L. G., Murphy, M. J., Doerr, E. E., Simonsen, N. R., Mason, K. E., and Scribner, R. A. (2009). A multisite randomized trial of social norms marketing campaigns to reduce college student drinking: a replication failure. *Substance Abuse, 30*, 127-140.
- Felson, R. B. (1997). Routine activities and involvement in violence as actor, witness, or target. *Violence and Victims, 12*, 209-221.
- Glass, T. A., & McAtee, M. J. (2006). Behavioral science at the crossroads in public health: Extending horizons, envisioning the future. *Social Science & Medicine, 62*, 1650-1671.
- Gorman, D. M., Speer, P. W., Gruenewald, P. J., & Labouvie, E. W. (2001). Spatial dynamics of alcohol availability, neighborhood structure and violent crime. *Journal of Studies on Alcohol, 62*, 628-636.
- Greenfeld, L. A. (1998). *Alcohol and crime: An analysis of national data on the prevalence of alcohol involvement in crime* (NCJ168632). Washington, DC: Bureau of Justice Statistics, Office of Justice Programs, Department of Justice.
- Gruenewald, P. J., & Remer, L. (2006). Changes in outlet densities affect violence rates. *Alcoholism: Clinical and Experimental Research, 30*, 1184-1193.
- Harford, T. C., Wechsler, H., & Muthén, B. O. (2003). Alcohol-related aggression and drinking at off-campus parties and bars: A national study of current drinkers in college. *Journal of Studies on Alcohol, 64*, 704-711.
- Hingson, R., Heeren, T., Winter, M., & Wechsler, H. (2005). Magnitude of alcohol-related mortality and morbidity among U.S. college students ages 18-24: Changes from 1998 to 2001. *Annual Review of Public Health, 26*, 259-279.
- Holder, H. D. (2000). Community prevention of alcohol problems. *Addictive Behaviors, 25*, 843-859.
- Holder, H. D. (2002). Prevention of alcohol and drug "abuse" problems at the community level: What research tells us. *Substance Use & Misuse, 37*, 901-921.
- Kassa, J. (1998). *Complying with the Jeanne Clery Act*. King of Prussia, PA: Security on Campus, Inc. Retrieved from <http://www.securityon-campus.org>
- Lipton, R., & Gruenewald, P. (2002). The spatial dynamics of violence and alcohol outlets. *Journal of Studies on Alcohol, 63*, 187-195.
- Norstrom, T. (2000). Outlet density and criminal violence in Norway, 1960-1995. *Journal of Studies on Alcohol, 61*, 907-911.
- Office of Postsecondary Education. (2000). *Campus security*. Washington, DC: Department of Education. Retrieved from <http://www2.ed.gov/admins/lead/safety/campus.html>
- Pernanen, K. (1991). *Alcohol in human violence*. New York: Guilford Press.
- Reid, R. J., Hughey, J., & Peterson, N. A. (2003). Generalizing the alcohol outlet-assaultive violence link: Evidence from a U.S. midwestern city. *Substance Use & Misuse, 38*, 1971-1982.
- Scribner, R., Cohen, D., Kaplan, S., & Allen, S. H. (1999). 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, 60*, 310-316.

- Scribner, R. A., MacKinnon, D. P., & Dwyer, J. H. (1995). The risk of assaultive violence and alcohol availability in Los Angeles County. *American Journal of Public Health, 85*, 335-340.
- Scribner, R., Mason, K., Theall, K., Simonsen, N., Schneider, S. K., Towvim, L. G., & DeJong, W. (2008). The contextual role of alcohol outlet density in college drinking. *Journal of Studies on Alcohol and Drugs, 69*, 112-120.
- Task Force of the National Advisory Council on Alcohol Abuse and Alcoholism (2002). *High risk drinking in college: What we know and what we need to learn*. Bethesda, MD: National Institute on Alcohol Abuse and Alcoholism.
- Toomey, T. L., Lenk, K. M., & Wagenaar, A. C. (2007). Environmental policies to reduce college drinking: An update of research findings. *Journal of Studies on Alcohol and Drugs, 68*, 208-219.
- Toomey, T. L., & Wagenaar, A. C. (2002). Environmental policies to reduce college drinking: Options and research findings. *Journal of Studies on Alcohol, Supplement No. 14*, 193-205.
- Ullman, S. E., & Brecklin, L. R. (2000). Alcohol and adult sexual assault in a national sample of women. *Journal of Substance Abuse, 11*, 405-420.
- U.S. Department of Education. (n.d.) *Alcohol and other drug prevention models on college campuses*. Washington, DC: Author. Retrieved from <http://www.ed.gov/programs/dvpcollege/index.html>.
- Weitzman, E. R., Folkman, A., Folkman, M. P., & Wechsler, H. (2003). The relationship of alcohol outlet density to heavy and frequent drinking and drinking-related problems among college students at eight universities. *Health Place, 9*, 1-6.
- Zhu, L., Gorman, D. M., & Horel, S. (2004). Alcohol outlet density and violence: A geospatial analysis. *Alcohol and Alcoholism, 39*, 369-375.