

# Social Influences on the Clustering of Underage Risky Drinking and Its Consequences in Communities

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**ABSTRACT. Objective:** The purpose of this research was to examine whether the clustering of underage risky drinking and its consequences within communities might arise from shared perceptions regarding underage drinking as well as the social context of drinking. **Method:** The Enforcing Underage Drinking Laws Randomized Community Trial provided data from repeated cross-sectional samples of 5,017 current drinkers (2,619 male) ages 14–20 years from 68 communities surveyed in 2004, 2006, and 2007. Alternating logistic regressions were used to estimate the influence of social factors on the clustering of getting drunk, heavy episodic drinking, nonviolent consequences, and driving after drinking or riding with a drinking driver. **Results:** The clustering of getting drunk, heavy episodic drinking, and nonviolent consequences was no longer statistically significant after adjustment for drinking with

friends and drinking with parents. Parents providing alcohol explained the clustering of heavy episodic drinking and nonviolent consequences, whereas drinking with other underage drinkers and friends providing alcohol explained the clustering of nonviolent consequences. Drinking with friends or other underage drinkers and friends providing alcohol increased the risk of these behaviors, whereas drinking with parents and parents providing alcohol were protective. Perceptions regarding peer drinking, community norms, consequences for drinking, and drinking at a party did not influence clustering. **Conclusions:** These findings suggest that interventions to reduce underage risky drinking in communities should focus on the differential effects of the social context in which drinking occurs. (*J. Stud. Alcohol Drugs*, 73, 890–898, 2012)

**B**Y THE TIME YOUTH REACH 8th GRADE, a third have tried alcohol, and by 12th grade the proportion increases to almost three fourths (Johnston et al., 2011). From a public health perspective, rates of heavy episodic drinking, which increase dramatically during this same developmental period (7% of 8th graders and 23% of 12th graders report heavy episodic drinking at least once in the past 2 weeks), are of particular concern (Johnston et al., 2011). This pattern of drinking is risky and too often results in widespread consequences that may negatively affect a youth's successful transition from adolescence to adulthood. These consequences include motor-vehicle crashes, unintentional injuries, violent and aggressive behaviors, and unsafe sexual practices (Brown et al., 2000).

Although researchers have identified several individual and community-level influences on underage drinking (Johnston et al., 2011; Reboussin et al., 2006, 2010; Song et al., 2009), each adolescent is also making decisions about drinking within a particular social setting. In contrast to the early developmental years, adolescents spend approximately twice as much time with peers as they spend with parents or

other adults, making peers a major source of socialization and development for adolescents (National Research Council and Institute of Medicine, 2004). Youth may be influenced by their peers directly (e.g., by observing peers' behavior, by peer pressure, and by peers providing alcohol) and indirectly (e.g., by their perceptions of whether their peers are drinking). Several researchers have shown that perceived use of alcohol by one's peers independently predicts self-reported alcohol use (Olds and Thombs, 2001; Prinstein and Wang, 2005; Reboussin et al., 2006; Song et al., 2012).

Oetting and Beauvais (1986a, 1986b) proposed "peer cluster theory" as a means to explain the strong relationship typically found between drug use and the drug involvement of peers. The basic premise is that adolescent drug use is almost entirely a group activity, taking place in the social context of peer clusters. Peer clusters consist of small groups of friends that share attitudes and drugs and establish group norms for drug use. Drinking with peers, especially in unsupervised settings, has been shown to be associated with the heaviest alcohol consumption by adolescents (Connolly et al., 1992; Hartford and Spiegler, 1983). Large parties appear to be especially risky. For example, among high school students, those consuming five or more drinks on the last drinking occasion were more likely to report being in a group of 11 or more than those who reported consuming less alcohol (Mayer et al., 1998).

Although evidence suggests that peers have a greater influence on adolescent drinking than do parents (Kuther, 2002; Reboussin et al., 2006), parents remain important during the teen years. We know from prior research that

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parental monitoring and involvement are key components in reducing adolescent alcohol use (Bahr et al., 1995, 2005; DiClemente et al., 2001; Jackson et al., 1997; Reifman et al., 1998), as are parental norms against underage drinking (Sieving et al., 2000) and perceived parental consequences for drinking (Foley et al., 2004). There is some evidence that parental provision of alcohol and drinking with parents is protective against risky drinking, although parental provision of alcohol at a party increases the risk (Foley et al., 2004). Not only are youth influenced by parental norms for drinking, but community norms and perceived availability of alcohol have been shown to influence underage drinking as well (Lipperman-Kreda et al., 2010; Song et al., 2012).

Recently, our research group found that underage risky drinking behaviors and consequences cluster within communities (Reboussin et al., 2010). *Clustering* in this context refers to the tendency of the behaviors of youth residing within the same community to be more alike to one another than they are to those of others from different communities. One possible explanation for this clustering is the epidemic (or social contagion) model proposed by Jencks and Mayer (1990), which is similar to peer cluster theory. In this framework, problem behaviors are assumed to be contagious and operate mainly through peer influences; adolescents engage in problem behaviors because peers living in the same neighborhood also exhibit these behaviors. In other words, beliefs and behaviors are transmitted from neighbor to neighbor.

In this study, we explored whether shared perceptions among youth residing in the same community with regard to underage drinking, as well as drinking context, might explain the clustering of risky drinking and consequences in communities, consistent with peer cluster and social contagion theory. We used data from a randomized community trial of underage drinking and the alternating logistic regression (ALR) approach to estimate clustering within communities. ALR is a statistical method that uses pairwise odds ratios (PWOR) to estimate the association between responses from individuals residing in the same geographic area and for modeling the influence of factors on this clustering (Carey et al., 1993).

## Method

### *Population and sample*

The Enforcing Underage Drinking Laws (EUDL) Program is a national initiative, funded by the U. S. Office of Juvenile Justice and Delinquency Prevention, that is intended to increase enforcement of underage drinking laws and reduce underage drinking. Annually from 1998 through 2007, each of the 50 states was awarded a block grant to support and enhance state and local efforts to prohibit the sale and consumption of alcoholic beverages to and by minors. In

addition, each year since the program began, discretionary grants were awarded on a competitive basis to a subset of the states to expand the number of communities taking a comprehensive approach to prevention of underage drinking. The Enforcing Underage Drinking Laws Randomized Community Trial (EUDL-CT) was funded under the FY 2003 appropriation. Thirty-four intervention communities were funded to participate in the EUDL-CT and were matched to 34 comparison communities from five states: California, Connecticut, Florida, Missouri, and New York (Wolfson et al., 2005).

Data used in the analyses presented below are from a repeated cross-sectional telephone survey of 14- to 20-year-olds conducted in 2004, 2006, and 2007 as part of the national evaluation of the EUDL-CT. The target sample size for each repeated cross-section was 100 youth per community in 68 communities (34 intervention and 34 matched comparison communities). All protocols for the study were approved by the Wake Forest University School of Medicine Institutional Review Board, and verbal informed consent was obtained by the interviewers before proceeding with the survey. (Informed assent was obtained for those younger than age 18.) A total of 18,730 youth completed (or partially completed) the telephone survey: 6,958 in 2004, 6,133 in 2006, and 5,639 in 2007. Of the 18,730 youth surveyed, 5,600 (or 30%) were current drinkers (defined as consuming alcohol in the past 30 days outside of parental supervision). This article focuses on the 5,017 current drinkers that had complete data for analysis.

### *Measures—dependent variables*

The clustering of risky drinking and its consequences among current drinkers in the EUDL-CT communities was examined based on yes/no responses constructed from the following survey questions:

1. *Getting drunk.* “Over the past 12 months, on how many days have you gotten drunk or ‘very, very high’ on alcohol? Would you say . . . every day or almost every day, 3–5 days a week, 1 or 2 days a week, 2 or 3 days a month, once a month or less, 1 or 2 days in the past 12 months, never.” Respondents who reported getting drunk almost monthly or more (i.e., every day or almost every day, 3–5 days a week, 1 or 2 days a week, 2 or 3 days a month, once a month or less) were contrasted with those who reported getting drunk 1 or 2 days in the past year or never.

2. *Heavy episodic drinking.* “Think back over the last 2 weeks. How many times have you had five or more drinks in a row? A drink is a glass of wine, a bottle of beer, a shot glass of distilled spirits, a mixed drink, or a wine cooler.” Respondents who reported heavy episodic drinking one or more times in the past 2 weeks were contrasted with respondents who did not report heavy episodic drinking in the past 2 weeks.

3. *Nonviolent consequences.* Respondents were asked, "Have you had any of the following experiences after you had been drinking?" These included being cited or arrested for drinking, possessing, or trying to buy alcohol; being cited or arrested for driving under the influence of alcohol; missing any school because of drinking; being warned by a friend about one's drinking; passing out; being unable to remember what happened while drinking; breaking or damaging something; having a headache or hangover; being punished by a parent or guardian; having sex without using a condom; and being involved in a motor vehicle crash. Respondents who reported at least one of these consequences during the past year were contrasted with those who did not experience any consequences after drinking during the past year.

4. *Driving after drinking or riding with a driver who had been drinking.* Respondents were asked if they had driven a car after drinking two or more drinks in an hour or less in the past 30 days or had ridden with a driver who had been drinking. Respondents who reported yes to either of these questions were contrasted with all others.

#### *Measures—demographic characteristics*

Because research suggests that individuals from the same socioeconomic status tend to reside in like communities (Coulton et al., 1996; Jencks and Mayer, 1990), it is important to examine whether any observed clustering can be explained by the sociodemographic characteristics of the individuals who live in the same community. This will provide evidence as to whether social factors have influence over the individual disadvantage of youth that predisposes them to participate in risky drinking (Massey, 1996; Wilson, 1996). Several individual-level characteristics of the participants—some of which mark varying levels of vulnerability, predisposition, or risk of underage drinking and that were found in our previous analyses of these data to be important (Reboussin et al., 2010; Song et al., 2009)—were considered. These include age, gender, race, parental education, and family structure as defined in Table 2.

#### *Measures—social influences*

We examined whether the clustering of risky drinking and its consequences in communities might be explained by shared perceptions regarding drinking, as well as the social context in which drinking occurs, based on responses to the following questions:

1. *Parental consequences.* Respondents were asked, "If your parents(s) (or guardian) caught you after you had been drinking, which of the following do you think they would do?" and were provided with separate responses for "talk with you about drinking," "yell at you," or "ground/punish you." Respondents who responded that their parents would

yell at them, ground them, or punish them were compared with all others.

2. *Community consequences.* Respondents were asked how likely it would be for school officials to catch them if they had been drinking before coming to class or a school-sponsored event and how likely it would be for police to catch them if they had been drinking. Adolescents responding "very likely" or "somewhat likely" to either question were compared with youth who responded "not too likely" and "not at all likely."

3. *Community cares.* Respondents were asked, "How much do you think people in your community care if people your age drink alcohol?" Youth responding "a great deal" or "somewhat" were compared with those responding "not too much" or "not at all."

4. *Believe most friends drink.* Respondents were asked, "How many of your friends do you think have had any alcohol to drink in the last 30 days?" Response categories were "0%–20%," "21%–40%," "41%–60%," "61%–80%," and "81%–100%." Youth who reported that more than 60% of their friends drink were compared with all others.

5. *Drink with underage drinkers.* Respondents were asked, "The last time you drank alcohol, about what percentage of the people who were drinking with you were under the age of 21?" Response categories were "less than 25%," "26%–50%," "51%–75%," and "76%–100%." Youth who reported that more than 50% of the people were underage drinkers were compared with all others.

6. *Drink with friends or parents.* Respondents were asked, "The last time you drank any alcohol, who were you with?" Response categories were "parents," "brothers/sisters," "date, girlfriend, boyfriend," "other friend(s)," "people you just met/strangers," "spouse," "other," and "was by myself." More than one response category could be chosen. The "other" category was back-coded when possible into existing categories. This question was used to construct the measures:

A. *DRINK WITH FRIENDS:* Respondents who reported that they drank with a date, girlfriend, boyfriend, or other friends were compared with all other respondents.

B. *DRINK WITH PARENTS:* Respondents reporting that they drank with their parents were compared with all other respondents.

7. *Provision of alcohol by friends or parents.* Respondents were asked, "The last time you drank any alcohol, how did you get the alcohol?" Response categories were "got alcohol from my parents' home without permission," "got alcohol from a friend's home without permission," "was given alcohol by a co-worker," "was given alcohol by my parent," "was given alcohol by a parent other than my own," "was given alcohol by a brother or sister," "was given alcohol by a stranger," "was given alcohol by a friend or acquaintance," "bought alcohol from a business (grocery, convenience store, liquor store, bar, or restaurant)," "took alcohol from a business," "other." More than one response category could be

chosen. The “other” category was back-coded when possible into existing categories. This question was used to construct the measures:

A. *FRIENDS PROVIDE ALCOHOL*: Respondents reporting that they got alcohol from a friend’s home with or without permission or were given it by a co-worker, friend, or acquaintance were compared with all other respondents.

B. *PARENTS PROVIDE ALCOHOL*: Respondents reporting that their parent or a friend’s parent provided alcohol were compared with all other respondents.

8. *Parents provide alcohol at a party*. Respondents were asked, “In the past year, have your parents or a friend’s parents provided alcoholic beverages you drank at a party?” Youth who reported that their parents or a friend’s parents provided alcohol were compared with all others.

9. *Drink at a large party*. Respondents were asked, “The last time you drank alcohol, about how many people were you with?” Respondents who reported drinking with 11 or more people were compared with all others.

*Statistical methods*

Clustering was estimated within communities using the ALR method developed by Carey and colleagues (1993) and implemented by other researchers in the area of drug use (e.g., Bobashev and Anthony, 2000; Delva et al., 2000; Petronis and Anthony, 2000, 2003; Reboussin et al., 2010, 2011; Wells et al., 2009). PWOR estimated from ALR reflect how strongly behaviors co-occur in communities (referred to as clustering). We began by estimating the observed within-community clustering for each outcome in an ALR model, ignoring the sociodemographic characteristics of the people who live in each community. In the absence of covariates, the PWOR can be calculated from a 2 × 2 table containing all possible pairs of youth from the same community, as shown in Table 1 (Katz, 1993). The cells of the table refer to pairs of youth with respect to the outcome of interest. Pairs of youth concordant on the outcome are counted in cells *a* and *c*. Because we do not distinguish between youth, the number of discordant pairs (outcome “yes” for exactly one youth) is evenly divided in the table. The PWOR is calculated like an ordinary odds ratio:  $PWOR = a \times c / (b / 2)^2$ , where *a* is the number of pairs with both youth reporting yes, *c* is the number of pairs with both youth reporting no, and *b* is the number of pairs with exactly one youth reporting yes. Consistent with odds ratios from logistic regression, a PWOR equal to 1.0 is evidence that there is no clustering within communities. A PWOR greater than 1.0 is evidence that the behavior of one youth is statistically dependent on the behavior of another randomly chosen youth residing in the same community, over and above the expectation based on randomly paired selections of youth without respect to area of residence.

TABLE 1. Basic 2 × 2 table for estimation of a pairwise odds ratio without covariates using alternating logistic regression

First youth in the pair	Second youth in the pair	
	Yes	No
Yes	<i>a</i>	<i>b</i> / 2
No	<i>b</i> / 2	<i>c</i>

In a joint model, we then examined how much clustering within communities remained after taking account of the sociodemographic characteristics of those who live in each community and the associations between each sociodemographic characteristic and the outcome. In the presence of covariates, the PWOR is estimated using a log odds ratio regression model given by

$$\text{Log PWOR } (Y_{ij}, Y_{il}) = \alpha \tag{1}$$

for  $j \neq l$  where  $Y_{ij} = 1$  if the  $j^{\text{th}}$  youth in the  $i^{\text{th}}$  community reports, for example, getting drunk,  $Y_{il}$  is the corresponding response for the  $l^{\text{th}}$  youth in the  $i^{\text{th}}$  community. It follows that  $\exp(\alpha)$  is the within-community PWOR. We can then simultaneously adjust for an individual’s age, gender, race, parent’s education, and family structure in a logistic regression model given by

$$\text{Logit P } (Y_{ij} = 1) = \beta_0 + \sum \beta_q X_q \tag{2}$$

where  $Y_{ij}$  takes a value of 1 if youth  $j$  in community  $i$  reports getting drunk and 0 else and  $X_{iq}$  are individual-level covariates  $q$  associated with getting drunk. The parameter  $\beta_q$  is the log odds ratio for the odds of getting drunk associated with the  $q^{\text{th}}$  individual-level covariate. ALR estimates the clustering and the association of covariates with the binary outcomes by alternating iteratively between an offset logistic regression for estimation of the PWORs in Equation 1 and a logistic regression for the individual-level covariate parameters in Equation 2 (see Carey et al., 1993, for estimation details). The inclusion of covariates in the mean model in Equation 2 that describe youth and are associated with getting drunk will increase or decrease the PWOR depending on the direction of the correlation of the covariate within communities (Katz et al., 1993). The impact of adding covariates will be gauged by comparing the adjusted and unadjusted PWORs and examining whether the clustering of behaviors remains statistically significant. The model in Equation 2 can be interpreted as adjusting the PWOR for the composition of communities with respect to the individual-level covariates (Petronis and Anthony, 2003). Next, we added social factors one at a time to the models in Equation 2 to examine the extent to which any remaining clustering might be explained by a process whereby attitudes, beliefs, or behaviors are shared within communities and transmitted between individuals. Last, we fit a multivariate model that included all social factors.

## Results

The characteristics of the sample are shown in Table 2. The majority of the sample was between 16 and 18 years old and slightly more male than female. Most of the sample was White, was living in a dual parent/guardian household, and had at least one parent who was a college graduate. About two thirds believed there would be parental consequences for drinking, whereas only a quarter thought school officials or police would catch them and that people in their community cared about drinking. Almost half believed most of their friends drank. The last time youth drank, they reported doing so with their friends and other underage drinkers; few drank with their parents. About a third reported being at a large party the last time they drank. Alcohol was most often provided by friends and not parents, although one third reported that parents had provided alcohol at a party in the past year. About two thirds reported getting drunk almost monthly or more, and more than one third reported heavy episodic drinking in the past 2 weeks. Nonviolent consequences were reported by two thirds of youth in the past year, whereas slightly less than a third reported driving after drinking or riding with a drinking driver in the past year.

Early adulthood (ages 19–20) was associated with an increased risk for all outcomes, as seen in Table 3. Males were significantly more likely to get drunk and to report

heavy episodic drinking and driving after drinking or riding with a drinking driver compared with females. Whites were significantly more likely than non-Whites to get drunk, report heavy episodic drinking, and report nonviolent consequences. Living in a dual-parent household was associated with a significantly increased risk of getting drunk, heavy episodic drinking, and driving after drinking or riding with a drinking driver. No association was found between parents' education and any of the outcomes.

Before adjusting for sociodemographic characteristics, there was evidence of clustering within communities of getting drunk (PWOR = 1.085; 95% CI [1.032, 1.140]), heavy episodic drinking (PWOR = 1.045; 95% CI [1.012, 1.080]), nonviolent consequences (PWOR = 1.039; 95% CI [1.012, 1.067]), and driving after drinking or riding with a drinking driver (PWOR = 1.082; 95% CI [1.032, 1.133]). For example, the odds that a youth reports getting drunk are 8.5% greater if a randomly selected youth from the same community reports getting drunk relative to the odds if that youth does not report getting drunk. After including sociodemographic characteristics in the model in Equation 2, clustering remained statistically significant with little attenuation, as shown in Table 3. This finding suggests that within-community clustering is not an artifact of the composition of communities with respect to individual sociodemographic characteristics.

TABLE 2. Description of the Enforcing Underage Drinking Laws Randomized Community Trial sample of current drinkers in relation to sociodemographic characteristics, social factors, risky drinking behaviors, and consequences ( $N = 5,017$ )

Variable	<i>n</i>	%
Sociodemographics		
Age		
14–15 years	945	18.8
16–18 years	3,096	61.7
19–20 years	976	19.5
Gender		
Female	2,398	47.8
Male	2,619	52.2
Race		
White	4,247	84.7
Non-White	770	15.3
At least one parent a college graduate	3,525	70.3
Living in a dual-parent/guardian household	4,058	80.9
Social factors		
Parents would yell at, ground, or punish them if caught drinking	3,335	66.5
School officials or police would catch them	1,290	25.7
People in community care about drinking	1,388	27.7
Believe most friends drink	2,451	48.9
Drank with other underage drinkers	3,083	61.5
Drank with friends	3,994	79.6
Drank with parents	610	12.2
Friends provided alcohol	2,702	53.9
Parents provided alcohol	717	14.3
Parents provided alcohol at a party	1,475	29.4
Drank at a large party	1,580	31.5
Risky drinking behaviors and consequences		
Getting drunk	3,331	66.4
Heavy episodic drinking	1,883	37.5
Nonviolent consequences	3,410	68.0
Driving after drinking or riding with a drinking driver	1,496	29.8

TABLE 3. Clustering of risky drinking behaviors and consequences and associations with sociodemographic characteristics among current drinkers (*N* = 5,017). Entries in the table are odds ratios (OR) and 95% confidence intervals for the correlate associations and pairwise odds ratios (PWOR) and 95% confidence intervals for the clustering

Variable	Getting drunk	Heavy episodic drinking	Nonviolent consequences	Driving/riding after drinking
<b>Age</b>				
14–15 years	0.347 [0.288, 0.417]	0.282 [0.233, 0.343]	0.428 [0.356, 0.515]	0.487 [0.398, 0.595]
16–18 years	0.784 [0.680, 0.904]	0.701 [0.611, 0.804]	0.778 [0.670, 0.903]	0.565 [0.476, 0.670]
19–20 years	1.000	1.000	1.000	1.000
<b>Gender</b>				
Female	0.716 [0.651, 0.787]	0.562 [0.497, 0.637]	0.940 [0.832, 1.061]	0.828 [0.737, 0.929]
Male	1.000	1.000	1.000	1.000
<b>Race</b>				
White	1.729 [1.457, 2.050]	1.655 [1.358, 2.017]	1.289 [1.070, 1.552]	1.049 [0.894, 1.231]
Non-White	1.000	1.000	1.000	1.000
<b>Parent college education</b>				
At least one parent	1.050 [0.896, 1.231]	1.068 [0.920, 1.240]	0.960 [0.846, 1.089]	1.085 [0.955, 1.232]
Neither parent	1.000	1.000	1.000	1.000
<b>Family structure</b>				
Single-parent household	0.788 [0.661, 0.939]	0.829 [0.706, 0.975]	0.890 [0.745, 1.063]	0.816 [0.695, 0.959]
Dual-parent household	1.000	1.000	1.000	1.000
<b>Within-community clustering</b>				
No covariates	1.085 [1.032, 1.140]	1.045 [1.012, 1.080]	1.039 [1.012, 1.067]	1.082 [1.032, 1.133]
Fully adjusted	1.064 [1.022, 1.108]	1.033 [1.004, 1.063]	1.032 [1.007, 1.059]	1.075 [1.028, 1.124]

Several social factors were associated with individual risk for reporting risky drinking behaviors and consequences, as indicated by the odds ratios (OR) in Table 4 (Row 2). A belief in parental or community consequences, a belief that the community cares about drinking, drinking with parents, and parents providing alcohol were significantly associated

with a decreased risk of all outcomes with the exception of parental consequences, which was not associated with nonviolent consequences. Drinking with other underage drinkers, drinking with friends, friends providing alcohol, parents providing alcohol at a party, and drinking at a large party were significantly associated with an increased risk of

TABLE 4. Clustering of risky drinking behaviors and consequences after adjustment for each social factor and associations with social factors among current drinkers (*N* = 5,017)

Variable	Getting drunk	Heavy episodic drinking	Nonviolent consequences	Driving/riding after drinking
	PWOR [95% CI] OR [95% CI]	PWOR [95% CI] OR [95% CI]	PWOR [95% CI] OR [95% CI]	PWOR [95% CI] OR [95% CI]
Unadjusted for social factors <sup>a</sup>	1.064 [1.022, 1.108]	1.033 [1.004, 1.063]	1.032 [1.007, 1.059]	1.075 [1.028, 1.124]
Parental consequences	1.066 [1.024, 1.110] 0.740 [0.646, 0.847]	1.036 [1.005, 1.068] 0.685 [0.594, 0.790]	1.033 [1.007, 1.060] 0.917 [0.807, 1.042]	1.077 [1.029, 1.128] 0.777 [0.665, 0.908]
Community consequences	1.067 [1.024, 1.111] 0.713 [0.614, 0.829]	1.036 [1.006, 1.066] 0.735 [0.642, 0.840]	1.035 [1.009, 1.061] 0.716 [0.624, 0.822]	1.081 [1.031, 1.134] 0.663 [0.573, 0.767]
Community cares	1.070 [1.026, 1.116] 0.785 [0.683, 0.903]	1.036 [1.006, 1.066] 0.796 [0.684, 0.926]	1.035 [1.010, 1.062] 0.834 [0.731, 0.952]	1.075 [1.027, 1.125] 0.832 [0.726, 0.954]
Believe most friends drink	1.052 [1.012, 1.092] 3.720 [3.295, 4.198]	1.030 [1.001, 1.059] 3.870 [3.492, 4.289]	1.029 [1.005, 1.053] 2.869 [2.521, 3.264]	1.076 [1.030, 1.124] 2.223 [2.005, 2.464]
Drink with underage drinkers	1.047 [1.008, 1.087] 3.592 [3.118, 4.139]	1.028 [1.001, 1.057] 2.289 [2.024, 2.588]	1.019 [0.995, 1.043] 3.226 [2.859, 3.641]	1.075 [1.028, 1.124] 1.149 [1.009, 1.307]
Drink with friends	1.038 [0.999, 1.080] 6.211 [5.224, 7.384]	1.024 [0.999, 1.050] 3.900 [3.250, 4.679]	1.012 [0.988, 1.038] 4.711 [4.027, 5.511]	1.073 [1.026, 1.122] 1.333 [1.140, 1.558]
Drink with parents	1.037 [0.998, 1.078] 0.096 [0.078, 0.119]	1.018 [0.995, 1.041] 0.145 [0.107, 0.197]	1.016 [0.992, 1.040] 0.151 [0.123, 0.185]	1.072 [1.026, 1.120] 0.738 [0.610, 0.892]
Friends provide alcohol	1.049 [1.014, 1.085] 2.245 [1.977, 2.548]	1.030 [1.002, 1.059] 1.391 [1.209, 1.600]	1.024 [0.997, 1.051] 1.929 [1.701, 2.188]	1.075 [1.028, 1.124] 0.977 [0.868, 1.101]
Parents provide alcohol	1.049 [1.001, 1.094] 0.171 [0.142, 0.206]	1.026 [0.998, 1.054] 0.272 [0.218, 0.340]	1.021 [0.997, 1.045] 0.240 [0.197, 0.293]	1.073 [1.026, 1.122] 0.757 [0.623, 0.919]
Parents provide alcohol at a party	1.065 [1.022, 1.109] 1.127 [0.987, 1.286]	1.036 [1.007, 1.066] 1.432 [1.246, 1.646]	1.033 [1.007, 1.059] 1.330 [1.149, 1.540]	1.076 [1.030, 1.124] 1.809 [1.568, 2.087]
Drink at a large party	1.062 [1.022, 1.103] 1.792 [1.557, 2.063]	1.034 [1.005, 1.065] 1.034 [1.005, 1.065]	1.032 [1.005, 1.060] 1.622 [1.420, 1.853]	1.075 [1.028, 1.124] 0.979 [0.861, 1.112]

Notes: Entries in the table are pairwise odds ratios (PWOR) and 95% confidence intervals for the clustering after adjustment for each covariate (Row 1) and odds ratios (OR) and 95% confidence intervals for the correlate associations (Row 2). <sup>a</sup>All models adjust for age, gender, race, parents' education, and family structure.

all outcomes with the exception of parents providing alcohol at a party (which was not associated with getting drunk) and friends providing alcohol and drinking at a large party (which were not associated with driving after drinking or riding with a drinking driver).

The magnitude of the clustering of getting drunk and heavy episodic drinking within communities decreased after adjustment for drinking with friends and after adjustment for drinking with parents, as seen in Table 4 (PWOR Row 1), and was no longer statistically significant. The magnitude of the clustering of heavy episodic drinking also decreased and was no longer statistically significant after adjustment for parents providing alcohol. With regard to nonviolent consequences, clustering was no longer statistically significant after adjustment for drinking with other underage drinkers, drinking with friends, drinking with parents, friends providing alcohol, and parents providing alcohol. In a multivariate model that included all social factors (data not shown), clustering of getting drunk (PWOR = 1.023; 95% CI [0.988, 1.059]), heavy episodic drinking (PWOR = 1.027; 95% CI [0.998, 1.056]), and nonviolent consequences (PWOR = 1.010; 95% CI [0.988, 1.033]) was not statistically significant. The magnitude of the clustering of driving after drinking or riding with a drinking driver changed very little and retained statistical significance even after simultaneous adjustment for all social factors (PWOR = 1.080; 95% CI [1.033, 1.130]).

### Discussion

Among current drinkers, we found that risky drinking and its associated consequences co-occur within communities 5%–10% more often than one would expect if these behaviors were distributed randomly across communities. We found no evidence that this clustering was an artifact of the composition of current drinkers within communities with respect to individual-level sociodemographics associated with risky drinking. We did find evidence that the clustering might be explained by social factors.

After adjustment for drinking with friends and drinking with parents, the clustering of getting drunk, heavy episodic drinking, and experiencing nonviolent consequences as a result of drinking decreased and was no longer statistically significant. The influences of these two drinking contexts, however, were not the same, as seen in Table 4. Drinking with friends is associated with an increased risk, whereas drinking with parents is associated with a decreased risk. Getting drunk co-occurs in communities where there is a higher concentration of youth reporting drinking with friends. In contrast, there is a greater co-occurrence of drinkers not reporting getting drunk if they reside in communities where there is a higher concentration of youth reporting drinking with parents. In the former scenario, drinking is taking place in the social context of peer clusters in which

pro-drinking attitudes and behaviors may be shared between friends—in particular, encouragement to consume excessive amounts of alcohol. In the latter case, parents may be sharing their attitudes and behaviors for drinking responsibly within a protected environment (Foley et al., 2004). Similarly, in communities with a greater concentration of parents providing alcohol, there is a greater co-occurrence of reports of no heavy episodic drinking or nonviolent consequences. On the other hand, reports of nonviolent consequences tend to co-occur in communities where drinking is occurring in groups of underage drinkers and alcohol is provided by friends, suggesting that this is not a context in which responsible drinking attitudes are shared and enforced by peers.

The findings above provide support for peer cluster and social contagion theories and the basic premise that risky drinking takes place in the social context of peer clusters. In communities with peer networks that share attitudes and beliefs toward drinking, where peer pressure might exist that supports risky drinking behaviors and where both alcohol and a place to drink alcohol are provided, a culture of risky drinking behavior can spread and increase the incidence and prevalence rates of risky behaviors. In contrast, within communities in which parents are sharing more responsible beliefs and behaviors toward drinking, more responsible drinking behaviors are transmitted between underage drinkers. Drinking at a large party and having parents provide alcohol at a party did not explain clustering. This might suggest that drinking with friends—and not the size of the party or who provided the alcohol—is the most important influence. Last, we did not find that beliefs regarding consequences for drinking or that the community cares explained clustering. This may be because we studied youth who had already made the decision to drink (current drinkers) and any additional influence of these factors is minimal.

Limitations in our study should be noted. First, communities in five states were funded to participate in the EUDL-CT. Therefore, our inferences are only valid for the population of communities from which we sampled. As is typical of telephone surveys, non-Whites and individuals of lower socioeconomic status are underrepresented, as are older adolescents. Our estimates of within-community (city level) clustering are generally smaller than those observed in studies of clustering of other drugs in neighborhoods (Bobashev and Anthony, 1998; Petronis and Anthony, 2000, 2003). However, we might expect clustering within smaller geographic regions to be greater in magnitude. It is important to note that our data are based on youths' self-reports, which may be subject to underreporting bias (Gruenewald and Johnson, 2006; Wagenaar et al., 1993). In particular, our sample is much younger than the afore-referenced national household surveys, in which 75% of the samples were older than 18. As described by Kandel and colleagues (2006), asking adolescents questions about underage drinking at home may elicit less truthful responses than asking them in

a school or research setting, resulting in an underestimation of clustering. Last, we considered peers and parents to have independent influences on underage risky drinking behaviors and consequences. Prior research suggests that parents may have an indirect influence on their child's drinking into the college years through the youth's selection of drinking or nondrinking friends (Abar and Turrisi, 2008). As such, our findings of the effects of parental factors on both risk and clustering might be greater than this study suggested.

A significant strength of the present study is the application of an innovative statistical approach to study the clustering of underage drinking and its relationship to contextual factors. Estimation of the extent to which individuals within a given community or neighborhood are correlated in regard to health has advantages in thinking about the efficacy of focusing interventions on places (or environments) instead of people. ALR quantifies the degree to which behaviors might cluster within communities (or neighborhoods) other than what one might expect if these behaviors were distributed at random across communities. An advantage of the ALR approach over other approaches is that it fits a separate model for the clustering. This is in contrast to multilevel models, in which the model for the clustering is implicit in the model for the mean.

Separate models for the clustering and the mean allow greater flexibility in analysis and can help target prevention and intervention strategies to different factors or levels (e.g., individual, community, neighborhood) more accurately. For example, modeling the pattern of clustering with and without covariate adjustment in the mean model can help identify risk factors that might mitigate or explain the magnitude of clustering. In addition, the separate model for the PWORs can be used to estimate the level of clustering as a function of cluster-level characteristics (e.g., neighborhood disadvantage). When the clustering is of interest from a scientific and not just a design standpoint, the ALR approach with its separate model for the PWORs may be more informative.

ALR is also well suited for studying the clustering of binary outcomes. Its measure of clustering is the traditional odds ratio used in epidemiology, which is considered to be easier to interpret for binary outcomes than the intraclass correlation coefficient used in multilevel models. Another important advantage of ALR for this type of research is that it is computationally feasible for studying large clusters (e.g., neighborhoods, communities, cities). This allowed us to estimate the quantitative clustering of underage drinking using data from a very large randomized community trial to reduce youth alcohol use and problems. Randomization of 68 communities is a significant increase in size over most community trials (cf., Holder et al., 1997; Perry et al., 1996; Wagenaar et al., 2000). Not only did this enhance the precision of our estimates, but it also allowed us to examine associations across a broad array of individual and social factors.

Our findings suggest that interventions focused on underage risky drinking and its consequences in communities need to address the social context in which drinking is occurring and the patterns of influence of both friends and parents. In particular, community-level interventions focused on reducing social sources of drinking (i.e., friends provide alcohol) and the context of drinking with friends, as well as interventions focused on the familial context of underage drinking, might be warranted.

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