Population Density and Alcohol-related Risk Behaviors Among US High School Students

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ABSTRACT

By better understanding differences in health-risk behaviors among youth in rural, suburban and urban communities, health educators and other public health practitioners can more appropriately focus prevention and health care programs. In this study, we examined data from the national Youth Risk Behavior Survey (YRBS) to determine whether alcohol-related risk behaviors among students are associated with population density. We found that in 2003, only driving after drinking alcohol varied by population density; that is, students in urban communities were significantly less likely to report this behavior than students in rural communities. Temporal trend analyses of 1993–2003 national YRBS data suggested varied patterns in alcohol-related risk behaviors among students attending urban, suburban and rural schools. Given that alcohol-related risk behaviors are high overall, these findings suggest the need to examine school and community policies and programs designed to discourage such behaviors in all population density categories.

INTRODUCTION

Alcohol use is associated with many of America's most serious public health problems.[1] Alcohol use among youth is associated with a wide range of other health-risk behaviors. For example, youth who drink alcohol are more likely to smoke cigarettes and use marijuana, cocaine, heroin and LSD.[2,3] Early onset of alcohol use is related to continued use of alcohol and drugs later in life.[4] Alcohol use also is associated with early initiation of sexual activity[5] and other sexual risk behaviors.[6,7] Furthermore, economic costs associated with alcohol abuse have been estimated to be $167 billion per year in the United States[8] with the economic cost of underage drinking alone estimated at $58 billion.[9]

Population density may contribute to, or provide protection against, participation in risky behaviors, such as alcohol consumption, among adolescents. Indeed, an *Urban and Rural Health Chartbook* was produced because "urban and rural communities have different health priorities that are related to differences in demographics, health behavior, geographic isolation and access to health care."[10] Several researchers have commented on the paucity of literature that describes risk behaviors—particularly alcohol use—among rural adolescents.[11-14] Contrary to the historical view that a rural environment shelters youth from exposure to drugs, the few studies in which adolescent drug use was correlated with population density have either shown that rural adolescents are not engaging in fewer risk behaviors[15] or are actually engaging in more.[14,16]

If alcohol-related risk behaviors vary among urban, suburban and rural communities, that might suggest that school policies and programs to address these behaviors could benefit from modifications to

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accommodate the unique characteristics of youth in these communities or the unique characteristics of the communities themselves. In this study, we analyze data from the national Youth Risk Behavior Survey (YRBS) to further investigate the association between alcohol-related risk behaviors among high school students and population density.

METHODS

The YRBS, developed by the Centers for Disease Control and Prevention (CDC), monitors six categories of priority health-risk behaviors among youth and young adults: unintentional injury and violence, tobacco use, alcohol and other drug use, sexual behaviors that contribute to unintended pregnancy and sexually transmitted diseases (STDs) including human immunodeficiency virus (HIV) infection, unhealthy dietary behaviors and physical inactivity.[17] Since 1991, the YRBS has been administered biennially to a nationally representative sample of private and public school students in grades 9–12 using a three-stage cluster sample design. Participation in the survey is anonymous and voluntary. Students record their responses directly on a self-administered computer-scannable questionnaire with approximately 97 items. The YRBS sampling strategies and the psychometric properties of the questionnaire have been described in more detail elsewhere.[17,18]

We used the location of the respondents' school to categorize the population density in which they lived. School location data were available starting in 1993 and the same classification scheme was used for each survey administration since that year. A trilevel classification system was derived from locale codes developed by the National Center for Education Statistics.[19] The locale codes were based on data for each school from the National Center for Education Statistic's Common Core of Data[20] and from Quality Education Data, Incorporated.[21] A school was designated as urban if a) it was located in the central city of a consolidated metropolitan statistical area (CMSA) or metropolitan statistical area (MSA) with a population of 250,000 or more, or b) in a central city of a CMSA or MSA but not designated as a large central city. A school was designated as suburban if it was a) located within a CMSA or MSA of a large central city; b) within the CMSA or MSA of a mid-size central city; c) not within a CMSA or MSA but in a city with population of 25,000 or more and defined as urban; or d) not within a CMSA or MSA in a city with a population of at least 2,500 but less than 25,000. A school was designated as rural if it was a) not located within a CMSA or MSA and designated as rural, or b) within a CMSA or MSA designated as rural. Locale codes are based both on proximity to metropolitan areas and on population size and density.[19] In this coding scheme, schools are classified into eight categories based on the location of the individual school rather than the superintendent of the school district.[19]

Students were asked about the following alcohol use behaviors: lifetime alcohol use (ever consumed at least one drink during their lifetime), current alcohol use (consumed at least one drink of alcohol during the 30 days preceding the survey), episodic heavy drinking (drank five or more drinks on one occasion on one or more of the 30 days preceding the survey), riding with a driver who had been drinking alcohol at least once during the 30 days preceding the survey, driving after drinking alcohol at least once during the 30 days preceding the survey, and using alcohol on school property at least once during the 30 days preceding the survey. Two additional variables were examined among currently sexually active students (defined as having had sexual intercourse during the three months preceding the survey): alcohol or drug use prior to last sexual intercourse and risky sexual activity (defined as alcohol or drug use prior to, and no condom use during, their last sexual intercourse).

A weighting factor was applied to each student record to adjust for nonresponses and for varying probabilities of selection, including those resulting from over sampling of black and Hispanic students. The data were not weighted to be representative of rural, suburban and urban student populations nationwide, and no effort was made during sampling to either stratify or over sample within certain population densities. In 2003, the distribution of students in rural, suburban and urban areas in the YRBS was similar to that found among students nationally. According to the National Center for Educational Statistics, when locale code categories were collapsed into the trilevel population density categories used in the YRBS, 29% of public school students would be classified as being from urban areas, 52% from suburban areas and 19% from rural areas (2001, latest data available).[22] These percentages do not include the 11% of students in grades K-12 who attend private school.[23] In the 2003 YRBS sample, which included students from private schools, 28% of students attended urban schools (n=5793), 51% attended suburban schools (n=7027) and 22% attended rural schools (n=2394).

During 1993–2003, sample sizes ranged from 10,904 to 16,296, school response rates ranged from 70% to 81%, student response rates ranged from 83% to 90%, and overall response rates ranged from 60% to 70%. We used SUDAAN,[24] which accounts for the complex sampling design of these surveys to generate all point estimates and 95% confidence intervals. For 2003 data, logistic regression models (controlling for gender, race/ethnicity and grade in school) were used to identify statistically significant differences in alcohol-related risk behaviors between students attending rural schools and those attending urban and suburban schools. In addition, 1993–2003 temporal changes were analyzed by using logistic regression analyses that assessed linear and quadratic time effects simultaneously and controlled for sex, race/ethnicity and grade. Quadratic trends indicated significant but nonlinear trends in the data over time. When a significant quadratic trend accompanied a significant linear trend, the data demonstrated a nonlinear variation (e.g., leveling off or change in direction) in addition to an overall increase or decrease over time.

RESULTS

Gender, grade and race/ethnicity distributions for 2003 are provided in Table 1. Gender distributions were similar for each population density category. Grade distributions varied slightly between urban and rural schools and the percentages of black and Hispanic students were higher in urban areas. During 2003, most high school students (74.9%) reported lifetime alcohol use, slightly less than half (44.9%) reported current alcohol use, 28.3% reported episodic heavy drinking and 5.2% used alcohol on school property (Table 2). Almost one-third (30.2%) of students rode with a driver who had been drinking alcohol and 12.1% drove after drinking alcohol. One in four (25.4%) currently sexually active students used alcohol or drugs prior to their last sexual intercourse, and 10.8% engaged in risky sexual behavior.

Table 2 presents the prevalence and odds of engaging in alcohol-related risk behaviors by population density. We found no significant differences associated with population density except for driving after drinking; significantly fewer students in urban schools than in rural schools drove after drinking (OR = 0.7, 95% CI = 0.5, 1.0). Likewise, when these analyses were conducted separately for males and females, only driving after drinking varied by population density. Among males, but not females, significantly fewer students in urban schools than in rural schools drove after drinking (OR = 0.7, 95% CI = 0.5, 1.0).

Results of the temporal trend analyses are presented in Table 3. Both linear and quadratic trends were detected among students in urban schools for current alcohol use and episodic heavy drinking. During 1993-2003, the percentages of students engaging in these behaviors rose slightly early in the time period but then fell to the lowest rates in 2003. Negative linear trends were detected for lifetime alcohol use among students in urban schools and for rode with a drinking driver among students in urban, suburban and rural schools; that is, the rates of these behaviors among these subgroups declined significantly over the time period. Conversely, among students in suburban schools, rates of alcohol or drug use during last sexual intercourse significantly increased from 1993 to 2003. Significant quadratic trends were detected for lifetime alcohol use among students in rural schools, current alcohol use among students in both suburban and rural schools, episodic heavy drinking among students in both suburban and rural schools, and drove after drinking among students in both urban and suburban schools. Rates of these behaviors among these subgroups first increased but then decreased such that the 1993 and 2003 rates were similar.

DISCUSSION

Unlike other investigations[25,26] examining alcohol-related risk behaviors among students in urban, suburban and rural settings, this analysis revealed that the rates of alcohol-related risk behaviors among high school students were similar across population density, except driving after drinking. It is not clear to what extent differences in methods and definitions of rural, suburban and urban youth in the Monitoring the Future[25] (MTF) study and the National Household Survey on Drug Abuse[26] (now called the National Household Survey on Drug Use and Health) account for the discrepancy in these study results.

In one study analyzing MTF data, researchers found that 10th-grade students in rural areas were more likely to have been drunk in the previous year (43.4%) than were those in large metropolitan areas (39.4%).[15] Likewise, 12th-grade students in rural areas were more likely to have used alcohol in the previous month than were those in urban areas (52.8% compared to 48.9%).[15] Results of another study using MTF data revealed that rural students were as likely as urban students to use illicit drugs and even more likely to smoke cigarettes or consume alcohol.[27] That study, however, created a rural/urban dichotomy and did not consider students from a suburban setting. A third study using MTF data found that high school seniors' rates of driving after drinking or riding in a car with a driver who had been drinking alcohol were associated negatively with population density.[28]

The NHSDA measured rates of alcohol-related risk behaviors across different population densities using both a three-category format (similar to the one in our analysis of YRBS data) based on MSA and expanded population density categories.[24] In that study, rural youth aged 12 to 17 were found

Table 1. Percentage of Students in Urban, Suburban and Rural Schools by Gender, Grade in School and Race/Ethnicity—Youth Risk Behavior Survey, 2003

Population Density		Gender		Grade				Race/Ethnicity			
	Total	Female	Male	9	10	11	12	White*	Black*	Hispanic	Other*
Urban	27.8	48.1	51.9	32.7	25.9	22.4	18.9	35.1	26.2	27.4	11.3
Suburban	50.6	48.3	51.7	29.5	25.9	23.5	21.1	66.8	10.1	15.5	7.6
Rural	21.7	50.0	50.1	25.0	26.9	24.3	23.8	82.1	7.1	5.2	5.5

*Non-Hispanic
Unweighted N=15,214 (urban=5,793; suburban=7027; rural=2394).

Table 2. Percentages and Odds* of Alcohol-Related Risk Behaviors Among U.S. High School Students by Population Density—Youth Risk Behavior Survey, 2003

	Lifetime alcohol use		Current alcohol use†		Episodic heavy drinking §		Alcohol use on school property¶	
	% (95% CI)**	OR (95% CI)	% (95% CI)	OR (95% CI)	% (95% CI)	OR (95% CI)	% (95% CI)	OR (95% CI)
Urban	71.9 (4.8)	0.9 (0.6, 1.58)	41.5 (2.9)	1.0 (0.8, 1.3)	23.3 (2.7)	0.9 (0.6, 1.1)	6.1 (1.8)	1.0 (0.6, 1.4)
Suburban	77.0 (4.3)	1.2 (0.7, 2.19)	46.5 (4.1)	1.1 (0.8, 1.4)	30.2 (3.4)	1.1 (0.8, 1.4)	4.8 (1.1)	0.9 (0.7, 1.2)
Rural	73.8 (9.0)	1.0	45.3 (4.6)	1.0	30.2 (4.3)	1.0	4.7 (1.0)	1.0
Total	74.9 (2.7)		44.9 (2.4)		28.3 (2.0)		5.2 (0.9)	
	Rode with a driver who had been drinking alcohol¶		Drove after drinking alcohol¶		Alcohol or drug use prior to last sexual intercourse††		Engaged in risky sexual activity††,§§	
	% (95% CI)	OR (95% CI)	% (95% CI)	OR (95% CI)	% (95% CI)	OR (95% CI)	% (95% CI)	OR (95% CI)
Urban	31.6 (3.3)	0.9 (0.8, 1.2)	10.1 (1.8)	0.7 (0.5, 1.0)¶¶	22.4 (3.4)	0.9 (0.6, 1.2)	8.5 (2.1)	0.7 (0.4, 1.1)
Suburban	29.1 (2.7)	0.9 (0.7, 1.1)	12.2 (1.8)	0.9 (0.7, 1.2)	27.0 (3.0)	1.1 (0.8, 1.4)	11.6 (2.6)	0.9 (0.6, 1.3)
Rural	31.2 (4.1)	1.0	14.2 (2.8)	1.0	26.0 (4.3)	1.0	12.6 (3.8)	1.0
Total	30.2 (2.1)		12.1 (1.2)		25.4 (2.3)		10.8 (1.7)	

* Odds ratios adjusted for gender, race/ethnicity and grade in school.
† Drank alcohol on ≥1 of the 30 days preceding the survey.
§ Drank ≥5 drinks of alcohol on ≥1 occasion on ≥1 of the 30 days preceding the survey.
¶ One or more times during the 30 days preceding the survey.
** 95% confidence interval.
†† Among students who had sexual intercourse during the 3 months preceding the survey.
§§ Alcohol or drug use prior to, and no condom use during, last sexual intercourse.
¶¶ Statistically significant difference, p≤.05.

to have higher rates of past month alcohol use (18.9%) and heavy alcohol use (drinking five or more drinks on the same occasion on 5 or more of the past 30 days) (4.2%) than youth in large metropolitan areas (16.1% and 2.2%, respectively). Conversely, in a study using data from the National Longitudinal Study of Adolescent Health (Add Health), where population density was defined on the basis of interviewer observations at the time of the at-home interview,[29] researchers found no significant differences in rates of alcohol-related behaviors among rural, suburban, and urban youth.[30]

One might speculate that rural adolescents who drink may be more at risk for motor vehicle fatalities than adolescents in other areas because of their need to travel longer distances, the higher prevalence of less developed or more dangerous roads, the lack of public transportation and fewer alternative activities in rural areas. Although the MTF study showed that high school seniors who reported driving after drinking tended to drive more miles per week,[28] the study did not explore whether students who reported driving more miles per week were from rural areas. Further research is needed to determine why youth in rural communities are more likely to drive after drinking. In any case, these data suggest for this variable especially, school and community prevention programs might address drinking and driving in unique ways for students in different population density communities.

During 1993-2003, among students in urban schools, alcohol use declined, including lifetime alcohol use, current alcohol use and episodic heavy drinking. Likewise, it is encouraging that despite increases in current alcohol use and episodic heavy drinking among students in suburban and rural schools, these behaviors appear to be heading down as well, although rates in 2003 were approximately equivalent to those in 1993. Continued tracking of these behaviors using YRBS data will show whether public health and education efforts to reduce alcohol use among youth result in further declines.

When different criteria are used to classify the population density of communities, data from different studies are difficult to compare and a consensus concerning the influence of population density on adolescent risk behaviors, including alcohol use and alcohol-related behaviors is difficult to reach. For example, federal agencies use at least three different classifications to define the population density of communities: Beale codes, metro status codes, and locale codes.[19]

The results of studies of alcohol use in areas of varying population density would be more comparable if more consistent methods were used to classify youth as living in rural, suburban or urban communities. Rural research advocates have called

Table 3. Percentage of High School Students Engaging in Alcohol-related Risk Behaviors by Population Density, Youth Risk Behavior Survey, 1993–2003*

	1993	1995	1997	1999	2001	2003	Linear Trend		Quadratic Trend	
							ß	p-value	ß	p-value
Lifetime alcohol use										
Urban	81.0	79.0	78.1	79.1	76.9	71.9	- 0.03	.003	- 0.01	.16
Suburban	81.5	80.3	79.1	81.8	78.2	77.0	- 0.02	.11	- 0.01	.38
Rural	76.7	83.7	80.6	81.6	82.1	73.8	- 0.01	.57	- 0.04	.05
Current alcohol use†										
Urban	48.1	50.2	48.9	46.5	45.2	41.5	- 0.02	<.001	- 0.01	.02
Suburban	48.5	51.9	50.6	51.4	47.6	46.5	- 0.01	.47	- 0.02	.02
Rural	44.7	53.9	55.4	52.2	50.2	45.3	- 0.00	.81	- 0.04	.03
Episodic heavy drinking§										
Urban	29.3	29.3	30.5	29.4	27.5	23.3	- 0.02	.01	- 0.02	.01
Suburban	30.3	33.4	33.3	32.1	29.9	30.2	0.00	.84	- 0.02	.03
Rural	30.5	36.5	40.1	34.7	36.6	30.2	- 0.00	.86	- 0.04	.02
Alcohol use on school property¶										
Urban	5.8	6.5	6.4	5.0	5.4	6.1	- 0.01	.43	0.00	.95
Suburban	4.9	6.1	5.2	4.6	4.9	4.8	- 0.02	.27	- 0.00	.81
Rural	6.0	7.0	5.3	5.6	4.0	5.0	- 0.03	.09	- 0.00	.76
Rode with a driver who had been drinking alcohol¶										
Urban	37.0	38.1	36.4	33.8	30.8	31.6	- 0.03	< .001	- 0.01	.37
Suburban	33.9	37.6	34.6	32.7	30.4	29.1	- 0.03	< .001	- 0.01	.08
Rural	39.4	44.7	43.9	33.2	31.9	31.2	- 0.05	.02	- 0.02	.37
Drove after drinking alcohol¶										
Urban	12.4	13.5	16.1	11.3	12.2	10.1	- 0.02	.14	- 0.03	.04
Suburban	13.3	15.2	15.3	13.9	13.9	12.2	0.03	.93	- 0.02	.03
Rural	18.1	20.3	23.9	13.7	13.2	14.2	- 0.05	.11	- 0.02	.48
Alcohol or drug use prior to last sexual intercourse**										
Urban	18.5	23.7	21.3	23.0	21.5	22.4	0.01	.33	- 0.01	.63
Suburban	22.8	25.5	26.5	25.8	27.5	27.1	0.02	.03	- 0.01	.30
Rural	21.5	25.1	26.9	24.7	27.7	26.0	0.02	.15	- 0.01	.53
Engaged in risky sexual activity**,§§										
Urban	8.9	10.4	8.8	9.3	9.3	8.5	- 0.01	.50	0.00	.94
Suburban	10.8	12.9	12.6	12.1	11.5	11.6	0.01	1.0	- 0.01	.26
Rural	10.1	15.5	14.1	11.7	14.0	12.6	0.01	.94	- 0.01	.62

* Linear and quadratic trend analyses were conducted by using a logistic regression model controlling for sex, race/ethnicity and grade. Prevalence estimates shown here were not standardized by demographic variables.

† Drank alcohol on ≥1 of the 30 days preceding the survey.

§ Drank ≥5 drinks of alcohol on ≥1 occasion on ≥1 of the 30 days preceding the survey.

** Among students who had sexual intercourse during the 3 months preceding the survey.

§§ Alcohol or drug use prior to, and no condom use during, last sexual intercourse.

for a standard typology for classifying the population concentration in an area and have urged policymakers to think in terms of a rural/urban continuum rather than an urban/rural dichotomy.[31] Associations between substance use and population density should be investigated not just in terms of rural versus urban or metropolitan versus non-metropolitan, but also in terms of gradations of population density. Rural communities are not a homogenous dichotomy to urban communities; rather, rural communities, like all communities, are heterogeneous.[32] Finer classifications will allow researchers to capture subtle differences that may occur within the broader population density classifications.

The findings in this analysis are subject to several limitations. First, because the YRBS measures the prevalence of health-risk behaviors using cross-sectional surveys, it does not identify causal factors. Second, categorizing population density into only three categories may mask additional correlations between population density and rates of alcohol-related risk behaviors. For example, Donnermeyer and Scheer[33] investigated only seniors from "smaller places" in the MTF study. Students were categorized as MSA farm, MSA county, MSA small town, non-MSA farm, non-MSA county or non-MSA small town, based on both a classification of the subjects based on their school location as metropolitan or non-metropolitan and the students' own answers when asked where they grew up. Their findings revealed less substance use for the locations considered more rural. Students were not asked in the YRBS to classify their home or school location. Third, some students may not reside in an area with the same population density classification as the school they attend.

CONCLUSION

Results from this study suggest rates of alcohol-related risk behaviors among students in rural communities may be approximately equivalent to those in suburban or urban communities. Temporal trend analyses, however, suggest that students attending schools in urban areas may be achieving reductions in some alcohol-related risk behaviors faster then their suburban and rural peers (e.g., lifetime alcohol use, current alcohol use and episodic heavy drinking). Given that alcohol-related risk behaviors are high in all communities, these findings suggest the need to examine school and community policies and programs designed to discourage such behaviors in all population density categories.

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