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State Alcohol-Use Estimates Among Youth and Adults, 1993–2005

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Background: Underage drinking, particularly binge drinking, is an important public health problem that results in substantial premature mortality and morbidity. Little is known about the potential influence of the alcohol-use behaviors of adults on youth alcohol use at a population level. The purpose of this study was to examine the correlation of alcohol-use behaviors among youth with those of adults at a population level.

Methods: Data were analyzed in 2007 and 2008, using biennial 1993–2005 data from state school-based Youth Risk Behavior Surveys of students in grades 9–12, and from the Behavioral Risk Factor Surveillance System for adults aged ≥ 18 years. Pearson correlation coefficients (r) were used to compare state prevalence estimates for youth with those of adults for several alcohol-use measures.

Results: Overall and subgroup-specific state youth estimates of current drinking and binge drinking were generally moderately to strongly correlated with adult alcohol use (range of r -values for pooled estimates across all years: 0.35–0.68 for current drinking [$p < 0.01$ for all correlations]; 0.24–0.60 for binge drinking [$p < 0.01$ for all correlations]) and with youth and adult drinking-and-driving behaviors (range of r -values for pooled estimates: 0.12–0.52, $p < 0.01$ for all but one correlation). Correlation coefficients were generally higher for girls with women and for youth with younger adults aged 18–34 years. The use of alcohol by youth before they were aged 13 years was not correlated with adult alcohol-use measures, and most youth alcohol-use measures were not correlated with adult heavy-alcohol use.

Conclusions: Most state youth alcohol-use estimates were correlated with state adult estimates. These findings have implications for underage-drinking control strategies and suggest that efforts to address this problem need to be targeted on a broader societal level.

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Introduction

Excessive alcohol use is the third leading preventable cause of death in the U.S.¹ It accounts for an average of approximately 79,000 deaths annually as well as substantial health morbidity and broader societal adverse consequences, such as violence, unintended pregnancy, and lost productivity.^{2–5}

Binge drinking, which is generally defined as the consumption of ≥ 5 drinks in a row on a single occasion,⁶ is a hazardous drinking pattern and is especially common among adolescents.^{5,7–13} As with many health risk behaviors, alcohol use usually begins in adolescence.^{4,5,9,14} In addition to the health risks posed by alcohol use during adolescence itself (e.g., motor-

vehicle crashes), the early onset of alcohol use is associated with a substantially greater risk of alcohol misuse during adulthood.^{9,14}

A substantial research literature exists on the factors associated with youth alcohol use, including genetics, demographics, psychological characteristics, and family and peer influences. Previous studies^{4,5,15} have demonstrated a strong connection between youth and adult drinking at the household and the community levels. Somewhat surprisingly, little population-based research has been conducted on the relationship between youth and adult drinking at the state level.^{8,16}

Assessing this relationship is important because young people may model their drinking patterns after adults beyond those living within their own households; in addition, youth alcohol use occurs within a broader societal context shaped by adults.^{8,14,17–19} A need for a better understanding of the potential relationship between youth and adult drinking behavior on a population basis has practical implications, such as whether efforts to reduce underage drinking should be targeted to youth alone or to youth and adults more broadly.¹⁴

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To better assess potential population-based associations between youth and adult alcohol-use behaviors, biennial data from the state Youth Risk Behavior Surveys (YRBS) were correlated with data from the Behavioral Risk Factor Surveillance System (BRFSS). The purposes of this study were to determine if state alcohol-consumption patterns in youth and adults were correlated; if youth alcohol-impaired driving and adult alcohol-impaired driving were correlated; and to assess if there were changes in correlations over time. Because alcohol use among youth may be influenced more by younger-aged adults,²⁰ estimates for youth were compared to estimates for adults aged 18–34 years (younger adults) and adults aged ≥ 35 years (middle-aged and older adults). Estimates for boys were compared to those of men, and estimates for girls to those of women.

Methods

Youth Data

Youth alcohol-use prevalence estimates for the years 1993–2005 came from data tables published in the CDC's *Morbidity and Mortality Weekly Report* (MMWR) Surveillance Summaries from biennially conducted state YRBSs^{7,21–26}; details are available elsewhere.²⁷ Briefly, states use the YRBS to anonymously collect data on health risk factors from students in grades 9–12. Students complete a self-administered paper-and-pencil questionnaire during a regular class period. Participation is anonymous and voluntary. Local parental-permission procedures are followed before survey administration.

Most states employ a two-stage cluster-sample design to produce representative samples of students in public schools. The total number of states with published data in the MMWR Surveillance Summaries ranged from 29 to 40. Median state sample sizes ranged from 1619 to 2760, and median state response rates ranged from 61% to 67.5%. Data from states with a representative sample of students, appropriate documentation, and an overall response rate of $\geq 60\%$ were weighted to be representative of all students attending public schools in grades 9–12. Of all the states included in this study, only about two thirds had weighted data; unweighted data are representative of students who participated in the survey, not necessarily of all students statewide. (Because preliminary findings found virtually no differences in correlations when only weighted state YRBS data were used [data available from authors], this report includes YRBS data from every state published in each MMWR Surveillance Summary regardless of whether data were weighted or unweighted.)

Questions about alcohol use in general are contained on the YRBS. These include lifetime (ever) use of alcohol (respondent had at least 1 drink of alcohol on at least 1 day during his or her life); alcohol use for the first time before age 13 years (i.e., early age of initiation); current alcohol use (had at least 1 drink of alcohol on at least 1 day during the 30 days before the survey); and binge drinking (had ≥ 5 drinks of alcohol in a row within a couple of hours on at least 1 day during the 30 days before the survey). The YRBS also contain questions about alcohol use and motor vehicles, including driving after drinking alcohol (i.e., alcohol-impaired driving)

and riding with a driver who had been drinking alcohol ≥ 1 time during the 30 days before the survey. The same wording for all the alcohol questions was used over the entire study period; YRBS questions are available at www.cdc.gov/healthyouth/yrbs/data/index.htm.

Overall and gender-specific state data were available for all alcohol-use measures annually except for 1993; published data on alcohol-impaired driving and early age of initiation were available starting with the 1995 survey administration.²² Because states have final decision-making authority about questions, not all alcohol questions were included each year. Each year the MMWR Surveillance Summaries contained no data on lifetime alcohol use from approximately two to seven states; in 1995 and 1997, no data on binge drinking from one state; and in 1995 and 2001, no data on early age of initiation from one state.

Adult Data

Biennial adult data (corresponding to the years for which YRBS data were available) were obtained from publicly available CDC BRFSS data sets for 1993–2005. (Although BRFSS data are collected annually, only biennial BRFSS data from odd-numbered years were used for this study in order to be consistent with the years that YRBS data on youth were available.) Details about the BRFSS are available elsewhere.²⁸ In brief, state-based random-digit-dial telephone surveys of non-institutionalized people aged ≥ 18 years are conducted monthly in all states; survey instruments contain questions on a variety of health risk measures. Overall, median state sample sizes for the years studied ranged from 2045 to 5812, and median state response rates ranged from 51.1% to 68.5%. Data for all states were weighted to be representative of each state's adult population.

Questions in the BRFSS covered current alcohol use; the frequency and quantity of alcohol use (consumption); and alcohol-impaired driving (the actual wording for BRFSS questions is available at www.cdc.gov/brfss). Current alcohol use was defined as having at least 1 drink of an alcohol-containing beverage (beer, wine, wine cooler, or liquor) in the past month from 1993 to 1999, and as having ≥ 1 drink in the past 30 days in 2005. In 2001 to 2003, respondents were asked about the number of days they drank an alcohol-containing beverage within the past 30 days; those reporting ≥ 1 day were considered current alcohol users.

Binge drinking was defined as drinking ≥ 5 alcohol-containing beverages on one or more occasions within the past month (1993–1999) or within the past 30 days (2001–2005). Heavy drinking was defined as having >2 drinks per day on average for men, and >1 drink per day on average for women, within the past month (1993–1999) or within the past 30 days (2001–2005). Alcohol-impaired driving was defined as having driven after perhaps having had too much to drink within the past month from 1993–1999; questions on alcohol-impaired driving on the BRFSS were not included on the core survey in 2001, 2003, or 2005, preventing correlations with this measure with YRBS data for these years.

Data Analyses

Data analyses occurred in 2007 and 2008 and were limited to the same states and years for which YRBS data were available. Pearson correlation coefficients (r) were used in all analyses,

Table 1. Correlations of state youth and adult alcohol-use measures: direct comparisons, overall and by subgroups, 1993–2005

	1993	1995	1997	1999	2001	2003	2005	1993–1999 ^a	2001–2005	All years
Number of states	<i>n</i> =29	<i>n</i> =30	<i>n</i> =32	<i>n</i> =33	<i>n</i> =33	<i>n</i> =32	<i>n</i> =40			
Current drinking										
All youth/adults	0.34	0.51**	0.55**	0.52**	0.71**	0.45	0.57**	0.48**	0.55**	0.43**
Boys/men	0.25	0.41*	0.47**	0.52**	0.66**	0.40	0.52**	0.41**	0.51**	0.35**
Girls/women	0.44*	0.58**	0.59**	0.50**	0.70**	0.46**	0.59**	0.53**	0.56**	0.49**
All youth/adults aged 18–34	0.46*	0.62**	0.59**	0.59**	0.79**	0.58**	0.65**	0.56**	0.68**	0.55**
All youth/adults aged ≥35	0.29	0.45	0.51**	0.47**	0.64**	0.39	0.52**	0.44**	0.48**	0.35**
Binge drinking										
All youth/adults	0.16	0.36	0.42*	0.38*	0.64**	0.38*	0.46**	0.34**	0.49**	0.36**
Boys/men	0.00	0.27	0.32	0.34	0.63**	0.34	0.39*	0.25**	0.46**	0.27**
Girls/women	0.26	0.50	0.54**	0.35*	0.58**	0.33	0.41**	0.41**	0.44**	0.40**
All youth/adults aged 18–34	0.19	0.46*	0.50**	0.46**	0.71**	0.51**	0.52**	0.42**	0.60**	0.45**
All youth/adults aged ≥35	0.07	0.31	0.36*	0.29	0.54**	0.22	0.33*	0.29**	0.33**	0.24**
Alcohol-impaired driving										
All youth/adults	NA	0.62**	0.52**	0.52**	NA	NA	NA	0.53**	NA	NA
Boys/men	NA	0.55**	0.36*	0.53**	NA	NA	NA	0.45**	NA	NA
Girls/women	NA	0.51**	0.52**	0.37**	NA	NA	NA	0.45**	NA	NA
All youth/adults aged 18–34	NA	0.66**	0.58**	0.43*	NA	NA	NA	0.52**	NA	NA
All youth/adults aged ≥35	NA	0.49**	0.48**	0.54**	NA	NA	NA	0.49**	NA	NA

^a1995–1999 only for alcohol-impaired driving

p*<0.05; *p*<0.01

NA, not available

and significance, based on *p*-values <0.05, was used to assess if coefficients were different from 0. Correlations of 0.10–0.29 were considered weak, 0.30–0.49 moderate, and ≥0.50 strong.²⁹ Five broad types of prevalence correlations were estimated: overall youth with overall adults; overall youth with adults aged 18–34 years; overall youth with adults aged ≥35 years; boys with men; and girls with women.

Because of the differences in alcohol-use measures in the YRBS and BRFSS surveys, correlations were further categorized as direct or indirect. Direct comparisons consisted of correlations of the prevalence measures for current alcohol use, binge drinking, and alcohol-impaired driving for youth and adults (e.g., youth and adult binge-drinking estimates). Indirect comparisons consisted of correlating the remaining alcohol-use measures (e.g., youth binge drinking with adult heavy drinking).

Correlations were obtained separately by year, pooled for the time periods 1993–1999 and 2001–2005, and pooled across all years. Correlations using youth early age of initiation and youth alcohol-impaired driving were available only for 1995 to 2005, and comparisons with adults were performed for these years. Correlations of youth data with adult alcohol-impaired driving were conducted only for period 1993–1999. Direct comparisons (e.g., binge drinking among youth with binge drinking among adults) were performed both overall and for each subgroup for each year and for pooled years; indirect comparisons were limited to overall estimates and pooled years.

Results

The youth median overall state prevalence and the range for medians across the survey years for the alcohol-use measures were 78.4% (74.1%–80.8%) for lifetime alcohol use; 47.9% (42.8%–51.1%) for current

alcohol use; 30.4% (26.3%–33.1%) for binge drinking; 30.3% (24.9%–34%) for early age of initiation; 13.9% (11.1%–15.2%) for alcohol-impaired driving; and 34.1% (27.2%–36.6%) for riding with a driver who had been drinking alcohol. The median overall adult state prevalence and the range for medians across the survey years for the alcohol-use measures were 55% (51.4%–58.4%) for current alcohol use; 15% (13.8%–16.9%) for binge drinking; 4.7% (3.2%–5.9%) for heavy drinking; and 2.1% (2%–2.4%) for alcohol-impaired driving.

Correlations of state youth and adult alcohol prevalence for direct-comparison measures are included in Table 1. Overall, the pooled estimates of current youth alcohol use were moderately correlated with current adult alcohol use (*r* = 0.43, *p* < 0.01). Demographic-specific estimates of current youth alcohol use were consistently correlated in a positive manner with current adult alcohol use (range of *r*-values for pooled estimates: 0.35–0.68; range of *r*-values for annual estimates: 0.25–0.79; Table 1), with nearly all coefficients significant at *p* < 0.01. Coefficients for all comparisons were typically higher from 2001 to 2005 than in earlier years. Pooled and annual correlation coefficients for current alcohol use were generally higher among female youth and adults than among male youth and adults, and for youth estimates correlated with younger adults compared to older adults.

There were positive correlations for youth and adult binge-drinking prevalence, although correlation coefficients were slightly lower (the majority were moderately correlated) and annual findings somewhat less consistent than those for current drinking (Table 1 and

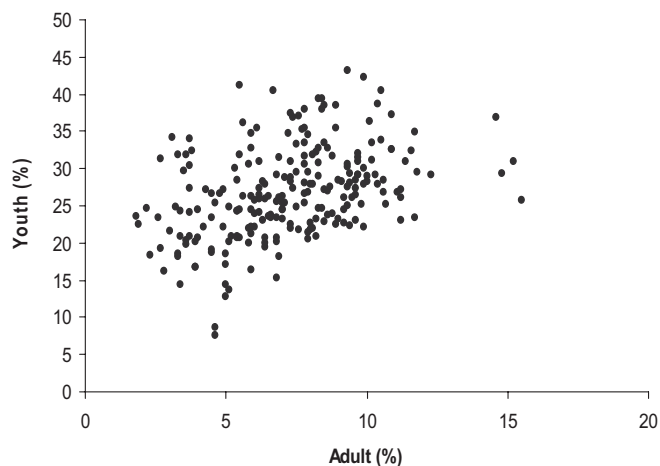


Figure 1. Correlation of binge drinking among youths and adults, 1993–2005

Figure 1; range of r -values for pooled estimates: 0.24–0.60; range of r -values for annual estimates: 0.00–0.71). As with current drinking, youth and adult binge-drinking correlations were generally stronger from 2001 to 2005, and were higher among girls and women and younger adults (Table 1). Youth alcohol-impaired

driving estimates from 1995 to 1999 were moderately to strongly correlated with those of adult alcohol-impaired driving for all years and among all subgroups (Table 1; range of r -values for pooled estimates: 0.45–0.53; range of r -values for annual estimates: 0.36–0.66), with all coefficients significant at $p < 0.01$.

Table 2 contains correlation coefficients of state overall youth and adult alcohol prevalence for indirect-comparison measures. State youth estimates of lifetime, current, and binge drinking were moderately to strongly correlated with state adult estimates of current alcohol use, binge drinking, and drinking-and-driving pooled across all years (range of r -values: 0.30–0.52, $p < 0.01$ for all correlation coefficients) but not with adult heavy-drinking estimates. The correlation for youth riding-with-a-drinking-driver estimates with adult alcohol-impaired driving estimates from 1993 to 1999 was moderate (0.42, $p < 0.01$).

Early age of initiation was not correlated with any adult alcohol-use measures. Youth estimates for alcohol-impaired driving and for riding with a drinking driver consistently correlated—albeit at a weak-to-moderate level—

with adult binge-drinking estimates (range of r -values for pooled estimates: 0.18–0.44) but were inconsistently correlated with estimates of adult current alcohol use and heavy drinking.

Table 2. Correlations of state youth and adult alcohol-use measures: indirect comparisons, overall and pooled years, 1993–2005

	1993–1999 ^{a,b}	2001–2005	All years ^c
Lifetime youth alcohol use with:			
Adult current alcohol use	0.40**	0.49**	0.40**
Adult binge drinking	0.30**	0.40**	0.31**
Adult heavy drinking	0.16	0.28**	0.12
Adult alcohol-impaired driving	0.33**	NA	NA
Current youth alcohol use with:			
Adult binge drinking	0.40**	0.52**	0.39**
Adult heavy drinking	0.09	0.30**	0.03
Adult alcohol-impaired driving	0.43**	NA	NA
Youth binge drinking with:			
Adult current alcohol use	0.32**	0.42**	0.31**
Adult heavy drinking	−0.01	0.14	−0.05
Adult alcohol-impaired driving	0.39**	NA	NA
Early age of initiation of alcohol use with:			
Adult current alcohol use	0.16	0.01	0.00
Adult binge drinking	0.10	0.05	0.02
Adult heavy drinking	0.12	0.11	−0.09
Adult alcohol-impaired driving	0.18	NA	NA
Youth alcohol-impaired driving with:			
Adult current alcohol use	0.15	0.25**	0.14*
Adult binge drinking	0.31**	0.44**	0.32**
Adult heavy drinking	−0.18	0.05	−0.18**
Youth riding with a drinking driver with:			
Adult current alcohol use	0.08	0.25**	0.05
Adult binge drinking	0.18*	0.40**	0.18**
Adult heavy drinking	−0.13	0.14	−0.20**
Adult alcohol-impaired driving	0.42**	NA	NA

^a1995–1999 only for youth alcohol-impaired driving, and youth early age of initiation of alcohol use, with all adult alcohol-use measures

^b1993–1999 only for all youth alcohol-use measures with adult alcohol-impaired driving

^c1995–2005 only for youth alcohol-impaired driving, and youth early age of initiation of alcohol use, for correlations with adult alcohol-consumption measures

* $p < 0.05$; ** $p < 0.01$

NA, not available

Discussion

This may be the first population-based study of the relationship between youth and adult alcohol-use measures at the state level. This study empirically demonstrated that state-level adult and youth alcohol use are generally correlated to a moderate or strong degree. These correlations were generally found for most state-level alcohol-use measures between youth and adults and were consistent over the 13-year time period, with some evidence that correlations were stronger in recent years. Correlations were higher for girls with women than for boys with men, and

for youth with younger adults than for youth with older adults. Youth estimates for early age of initiation did not correlate with adult alcohol-use measures, and youth alcohol-use measures did not correlate with adult heavy drinking. These findings provide further evidence of the need to address underage drinking through broader societal approaches that also influence excessive adult alcohol use.

Comparing these findings with prior work is difficult because there are few similar studies. However, this research is consistent with findings from a study by Nelson et al.,⁸ which demonstrated that adult binge-drinking estimates for 40 states were strongly correlated with binge drinking among college students and with young adults aged 18–24 years and not attending college who resided in the same state ($r=0.43$ and 0.45 , $p<0.01$, respectively). A study comparing YRBS findings for high school students with a telephone-administered YRBS survey of college students in Texas found that college students had a slightly higher prevalence of binge drinking and a slighter older age of first alcohol use than did high school students.³⁰

The only study³¹ involving a comparison of YRBS with BRFSS data was based on a survey of American Indians living on or near reservations in Montana. Although no comparisons were available on alcohol-use measures, that study found that the prevalence of youth tobacco use, physical inactivity, weight loss, and low levels of fruit and vegetable consumption was generally similar to, or higher than, that of adults. That study also found that risk-factor estimates about girls were generally more similar to those for women as opposed to estimates about boys compared to men.

A variety of factors at multiple levels influence youth alcohol use (e.g., religion, family members, peers).^{4,5,14,15,17} One reason for the correlations between youth and adult alcohol-use measures is that youth drinking patterns may persist into adulthood.³² Additionally, research has consistently shown that adolescents who begin drinking heavily at younger ages are at much greater risk of maintaining heavy use into adulthood and developing alcohol-use disorders.^{5,15} However, these findings of generally moderate-to-strong correlations between population-level estimates of youth and adult alcohol-use behaviors suggest that environmental influences, such as social, cultural, and legal factors, may have an important effect on youth alcohol use.^{14,17} This study also provides further evidence of the need for more scientifically rigorous research, such as intervention trials, on the effects of policies to reduce underage drinking.

Policies that result in higher alcohol excise taxes, in the enforcement of minimum legal drinking age laws, and in the restricted availability of alcohol reduce alcohol use among youth.^{3,8,33–39} In the 2005 Nelson et al. study⁸ of college students, alcohol-control policies—including those geared toward the general population

rather than just underage people—were independently associated with reduced binge drinking by college students, even after adjusting for the impact of same-state adult drinking patterns, emphasizing the impact that the policy environment may have on youth and adult drinking.

Possible reasons are unknown for the lack of state-level correlations between an early age of initiation of alcohol use among youth and adult alcohol use. Decisions by youth to begin drinking at a young age are complex and likely to be affected by other factors (e.g., genetics, parental alcohol use, peer pressure) besides adult alcohol-use patterns among nonhousehold adults.^{4,5,15} Similarly, other factors may account for the general lack of positive correlations for youth alcohol-use measures with adult heavy-drinking estimates.

This study had limitations. This was an ecologic analysis, and correlation does not equal causation; the strong youth–adult correlations for most alcohol-use behaviors could be the result of other factors. Data were based on self-reports, which underestimate alcohol consumption, at least among adults.⁴⁰ There were wording differences in the questions used in the YRBS and BRFSS, which may have influenced correlations. There was the potential for a slight overlap between YRBS and BRFSS respondents, given that some high school students are aged ≥ 18 years, although the effect of this overlap on BRFSS estimates would be small. Response rates for the BRFSS, as with other telephone-based surveys, declined over time,⁴¹ and the impact on correlations is not known. Both weighted and unweighted estimates were used from the YRBS; however, preliminary findings based on direct comparisons were similar only when weighted YRBS data were used. In addition, YRBS data are representative only of youth who attend school and not of all students in this age group. Finally, the generally stronger correlation between youth and adult alcohol-impaired driving should be interpreted cautiously, given that correlations could be calculated only through 1999.

This study's findings have implications for public health efforts to reduce excessive alcohol use. Regardless of the reasons for the youth–adult alcohol associations, the two are correlated. This is important because many citizens, policymakers, and even public health officials frame youth drinking as an age-related problem that should be addressed through youth-centered approaches. Certainly some youth-centered approaches are effective, such as the presence and enforcement of minimum legal drinking-age laws; laws that establish a lower legal blood alcohol concentration for young or inexperienced drivers (i.e., zero-tolerance laws); and school-based instructional programs to reduce riding with alcohol-impaired drivers.^{36,38} A youth-centered approach, however, can result in a lack of focus on reducing excessive drinking among the entire population through the use of policy interventions.^{42,43}

Higher alcohol taxes, for example, particularly those on beer, are inversely related to youth drinking, the frequency of youth drinking, heavy drinking by youth, youth motor-vehicle crashes, homicide, suicide, and youth violence.^{33,44–48} More-comprehensive sets of state policies, including those geared toward the general population, are associated with less alcohol-impaired driving among college students,¹⁸ including those who are underage¹⁹—e.g., one study found that states that lowered their legal limit for blood alcohol concentration to the 0.08 level experienced reductions in beer sales.⁴⁹ Similar findings have been shown for tobacco control.^{50,51} Reducing underage drinking, as noted by the 2004 National Research Council/IOM Underage Drinking Report, will require a broader focus on reducing excessive drinking in the entire population.¹⁴

The findings and conclusions in this article are those of the authors and do not necessarily represent the official position of the USDHHS or the CDC.

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