

Magnitude of and Trends in Alcohol-Related Mortality and Morbidity Among U.S. College Students Ages 18-24, 1998-2005

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ABSTRACT. Objective: The aim of this study was to estimate, among college students ages 18-24, the numbers of alcohol-related unintentional injury deaths and other problems over the period from 1998 through 2005. **Method:** The analysis integrated data on 18- to 24-year-olds and college students from each of the following data sources: the National Highway Traffic Safety Administration Fatality Analysis Reporting System, Centers for Disease Control and Prevention Injury Mortality Data, National Coroner Studies, census and college enrollment data, the National Household Survey on Drug Use and Health, and the College Alcohol Study. **Results:** Among college students ages 18-24, alcohol-related unintentional injury deaths increased 3% per 100,000 from 1,440 in 1998 to 1,825 in 2005. From 1999 to 2005, the proportions of college students ages 18-24 who reported consuming five or more drinks on at least one occasion in the past month increased from 41.7% to 44.7%,

and the proportions who drove under the influence of alcohol in the past year increased from 26.5% to 28.9%—7% and 9% proportional increases, respectively. The increases occurred among college students ages 21-24, not 18-20. In 2001, 599,000 (10.5%) full-time 4-year college students were injured because of drinking, 696,000 (12%) were hit or assaulted by another drinking college student, and 97,000 (2%) were victims of alcohol-related sexual assault or date rape. A 2005 follow-up of students in schools with the highest proportions of heavy drinkers found no significant changes in the proportions experiencing these events. **Conclusions:** The persistence of college drinking problems underscores an urgent need to implement prevention and counseling approaches identified through research to reduce alcohol-related harms among college students and other young adults. (*J. Stud. Alcohol Drugs*, Supplement No. 16: 12-20, 2009)

IN 1998, THE NATIONAL ADVISORY COUNCIL of the National Institute on Alcohol Abuse and Alcoholism (NIAAA) created a task force to review the research on college drinking to advise administrators and the NIAAA on implementing and evaluating college programs and future research directions. The study resulted in a 2002 report titled “A Call to Action: Changing the Culture of Drinking on U.S. College Campuses” (Task Force of the National Advisory Council on Alcohol Abuse and Alcoholism, 2002). Background articles appeared in an edition of the *Journal of Studies on Alcohol* called “College Drinking, What It Is, and What to Do About It: A Review of the State of the Science” (Goldman et al., 2002).

One of the 24 articles commissioned for this report (Hingson et al., 2002) estimated that, in 1998, more than 1,400 students ages 18-24 enrolled in 2- and 4-year colleges died from alcohol-related unintentional injuries, including motor-vehicle crashes. Also, of the 8 million U.S. college students,

more than 2 million drove under the influence of alcohol, and more than 3 million rode with a drinking driver in the previous year. More than 500,000 full-time 4-year college students were unintentionally injured under the influence of alcohol. Furthermore, more than 600,000 were assaulted by and more than 70,000 experienced a date rape or sexual assault caused by another student who had been drinking.

Updates on this article (Hingson et al., 2005; NIAAA, 2007) indicated that, from 1998 to 2001, alcohol-related unintentional injury deaths per 100,000 college students increased by 6%. The proportion of 18- to 24-year-old college students who reported driving under the influence of alcohol increased from 26.5% to 31.4%. In 1998 and 2001, 10.5% were injured under the influence of alcohol, 12% were assaulted, and 2% experienced a sexual assault by another drinking college student. The number of college students injured under the influence of alcohol was 599,000 in 2001. The numbers assaulted and who experienced a sexual assault or date rape by another drinking college student were 696,000 and nearly 100,000, respectively.

The purpose of this article is to assess whether the magnitude of alcohol-related morbidity and mortality among U.S. college students ages 18-24 has changed from 1998 to 2001 to 2005, the most recent year for which data are available.

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Method

Calculating changes in alcohol-related mortality

This review estimates the number of alcohol-related traffic and other unintentional injury deaths in 1998, 2001, and 2005 among 18- to 24-year-olds in the United States who are full- or part-time college students attending 2- or 4-year colleges. It was necessary to integrate information from multiple data sets, because the National Highway Traffic Safety Administration's (2007) Fatality Analysis Reporting System does not routinely record whether persons who die in alcohol-related motor-vehicle crashes are college students. In addition, people who die from other types of unintentional injuries are not systematically tested for blood alcohol concentrations (BACs). The data sources consulted are described below.

First, the Centers for Disease Control and Prevention (2008b) annually records the number and ages of unintentional injury deaths, but not whether these deaths are alcohol related, on its Web-Based Injury Statistics Query and Reporting System.

Second, a meta-analysis of 331 medical examiner studies from 1975 to 1995 revealed that 84% of unintentional non-traffic injury deaths were tested for BACs. This meta-analysis provides the best available estimates for alcohol involvement in injury deaths (other than motor-vehicle crash deaths), but it does not provide information on annual changes in the proportions of those deaths that are alcohol related (Smith et al., 1999). Of those tested by medical examiners, 38.5% had positive BACs greater than .0%, and 31% had BACs of .10% or higher. The proportions of unintentional injury decedents who tested positive for alcohol varied according to the following specific injury types: 37.9% for burns/fires; 90.0% for cold/hypothermia; 49.2% for drowning; 63.3% for falls; 48.7% for gunshots; and 26.6% for poisoning by solid, liquid, or gas. These percentages were used to estimate these specific types of alcohol-related nontraffic injury deaths in 1998, 2001, and 2005. For all other unintentional nontraffic injury deaths, we used 38.5% in our estimates of alcohol involvement.

Third, the Fatality Analysis Reporting System records all motor-vehicle crash deaths in the United States and the proportion that are alcohol related, defined as involving a driver or pedestrian with a positive BAC. The ages of the decedents are recorded, as are their BACs. Because BACs are not measured for all motor-vehicle crash deaths, the Fatality Analysis Reporting System uses an imputational formula to estimate the likelihood of alcohol involvement in those crashes for which test results are not available (Subramanian, 2002).

Fourth, the U.S. Census Bureau (2004) reports the numbers of 18- to 24-year-olds in the United States. The Department of Education's National Center for Education Statistics

(2000, 2002, 2004, and 2007) reports the number of undergraduate college students of those ages in the United States.¹ The numbers of 18- to 24-year-olds living in the United States were 26,155,000 in 1998, 28,058,000 in 2001, and 29,155,000 in 2005. For those same years, the numbers and percentages enrolled as full- or part-time college students in 2- or 4-year colleges were, respectively, 7,809,387 (30%), 8,580,318 (31%), and 9,628,069 (33%). Of the students enrolled as undergraduates in 1998, 2001, and 2005, 62%, 63%, and 64%, respectively, were ages 18-24.

Fifth, we analyzed the 1999, 2002, and 2005 national surveys sponsored by the Substance Abuse and Mental Health Services Administration (2000, 2002, 2006). Initially named the National Household Survey on Drug Abuse, but more recently titled the National Household Survey on Drug Use and Health, these surveys are the primary source for statistical information on illegal drug use in the United States. Computer-assisted interviews were conducted with representative samples of the U.S. population age 12 and older, including residents of households and noninstitutional group quarters (e.g., shelters, rooming houses, and dormitories) and civilians living on military bases.

The 1999, 2002, and 2005 National Household Survey on Drug Use and Health used an independent, multiarea probability sample for each of the 50 states and the District of Columbia (2000, 2003, 2006). Youths and young adults were oversampled so that each state's sample was approximately equally distributed among persons ages 12-17, 18-25, and 26 and older.

In 1999, 169,166 mailing addresses nationwide were screened, and 66,706 persons were interviewed within screened addresses. The weighted response rates for households screened and interviewed were 89.6% and 68.6%, respectively. The sample included 19,463 respondents ages 18-24, of whom 6,930 (36%) were enrolled in college. In 2002, from 150,162 eligible households or units within group quarters, 68,126 persons were interviewed within the screened addresses. Weighted response rates for households screened and persons interviewed were 91% and 79%, respectively. In the survey, 20,478 were respondents ages 18-24, of whom 8,041 (39%) were enrolled in college. In 2005, 68,308 persons from 134,055 household units were interviewed. The in-person and household response rates were 82% and 91%, respectively.

In each survey, respondents were asked how often they drank five or more alcoholic drinks on any occasion in the past 30 days (heavy episodic drinking) and if they had ever in the previous year driven a vehicle under the influence of alcohol only. In all three surveys, college students ages 18-24

¹It should be noted that census population totals and college enrollment totals for 18- to 24-year-olds in 1998, 2001, and 2005 have varied. To maximize consistency, all the data in this report were calculated using the same procedures and published in 2007 by the Department of Education.

were more likely than same-age, noncollege respondents to report engaging in both of these behaviors. On the basis of these surveys, we projected that the proportions of traffic and other unintentional injury deaths testing positive for alcohol would be as high among 18- to 24-year-olds in college as noncollege persons in the same age group. Because census data indicated that college students comprised 30% of the 18- to 24-year-old population in 1998, 31% in 2001, and 33% in 2005, we estimated that college students accounted for 30% in 1998, 31% in 2001, and 33% in 2005 of all traffic and other unintentional alcohol-related deaths experienced by 18- to 24-year-olds during those respective years.

Calculation of other alcohol-related risks

The Harvard School of Public Health's College Alcohol Study began in 1993 with a sample of 140 colleges selected from a list of all accredited 4-year colleges provided by the American Council on Education, and the survey used probability sampling proportional to the size of undergraduate enrollment at each institution. At each college, a random sample of 225 undergraduates was drawn from the total enrollment of full-time students. In 1999, another survey was conducted with 128 of the original 140 colleges (Wechsler et al., 2002). The inability of 10 colleges in 1997 and 2 in 1999 to provide a random sample of students and their mailing addresses resulted in the attrition of these schools. In 1999, 12,317 full-time students ages 18-24 from 40 states were surveyed—nearly half of these students lived in dormitory college housing, or fraternity or sorority houses (response rate 60%).

In 2001, 215 full-time students were randomly selected for the survey from 119 of the 128 colleges and universities that had been part of the 1999 sample (response rate 52%). Respondents in each College Alcohol Study survey were asked about their frequency and usual quantity of drinking, whether during the current school year they experienced a variety of health problems because of their drinking (e.g., alcohol-related injuries), and whether the drinking of other college students posed any of a series of social and health problems for them (e.g., assaults or sexual assaults).

In 2005, 42 colleges that participated in earlier College Alcohol Study surveys were assessed (Nelson et al., in press). The 2005 College Alcohol Study sample comprised schools with heavy episodic drinking prevalence levels greater than 50% in the 1993 College Alcohol Study, and thus focused on schools in the top one third of the national College Alcohol Study sample based on heavy episodic drinking prevalence. Heavy episodic drinking was defined as having five or more drinks in a row for men (four or more for women) in a 2-week period. Ten colleges from the 42 were excluded from the 2005 College Alcohol Study estimates because of their participation in the "A Matter of Degree" program, a long-running prevention demonstration

to reduce student heavy episodic drinking. Fourteen schools declined to participate, leaving 18 schools in 13 states as survey participants, with no systematic differences on several drinking measures identified between participating and non-participating schools and samples (Nelson et al., in press).

At the 18 schools, 4,518 college students completed surveys. Administrators at each school provided the names and the email and postal addresses of 500 randomly selected students enrolled full time. Most students completed an on-line survey, and the response rate was 56%. The 2005 survey questionnaire asked the same questions about alcohol use, alcohol-related problems, and demographic characteristics as previous College Alcohol Study surveys.

Statistical analyses of surveys

For the National Survey on Drug Use and Health and College Alcohol Study surveys, we present weighted results that consider their respective designs and nonresponse rates. All statistical estimates for the surveys were conducted using the SUDAAN statistical package to account for each survey's design (Shah et al., 1996). The SUDAAN package accounts for sampling weights in calculating both estimates and standard errors, and uses first-order Taylor Series approximations to provide standard errors and to approximately account for sampling design.

Using the National Survey on Drug Use and Health survey responses, we identified the percentage of 2- and 4-year college students ages 18-24 who responded affirmatively to the survey questions regarding heavy episodic drinking and driving under the influence of alcohol, and then calculated 95% confidence intervals (CIs) for these responses. To estimate the numbers of 18- to 24-year-old college students who engaged in these behaviors, we then multiplied those percentages and CIs by the appropriate population count from the Department of Education of students enrolled in 2- and 4-year colleges in the United States. Data from the Department of Education are considered to be true population totals; therefore, our confidence intervals reflect only the sampling variability in the percentage estimates. We also made projections from the College Alcohol Study responses regarding experiencing various other alcohol problems to the full-time 4-year college student population using the same analytic strategy.

Percentages of responses with 95% CIs were calculated from survey data collected, accounting for sampling design. The significance of changes in numbers of events and rates of events per 100,000 population were calculated using the Poisson model, which gives stable estimates for rare events (these CIs and percentages are available on request). In the 2005 College Alcohol Study survey, trend comparisons were made between the 18 high heavy-episodic-drinking-rate schools and reports from the same 18 schools in earlier surveys.

Results

Heavy episodic drinking and driving under the influence of alcohol

From 1999 to 2002 to 2005, based on the Substance Abuse and Mental Health Services Administration national surveys, the proportion of 18- to 24-year-old college students who drank five or more drinks on an occasion in the previous 30 days increased from 41.7% to 43.2% to 44.7%, a 7% proportional increase from 1999 to 2005. Increases were statistically significant from 1999 to 2005 ($p < .001$). The number of college students ages 18-24 who consumed at least five drinks on an occasion increased from 3,811,000 in 1999 to 4,690,000 in 2002 to 5,192,000 in 2005.

From 1999 to 2002 to 2005, the proportion of 18- to 24-year-olds not in college who consumed five or more drinks on an occasion in the previous 30 days increased from 36.2% to 39.8% to 39.9%, a proportional 10% increase from 1999 to 2005. Increases over time were statistically significant among both 18- to 24-year-olds in college and not in college, but those increases did not significantly vary between groups.

In 1999, 2002, and 2005, a greater percentage of 18- to 24-year-old college student respondents versus noncollege respondents drank five or more drinks on a single occasion

in the past month (41.7% vs 36.2% in 1999, 43.2% vs 39.8% in 2002, and 44.7 % vs 39.9% in 2005) (Substance Abuse and Mental Health Services Administration, 2000, 2002, 2006). Because the number of 18- to 24-year-olds not in college greatly exceeded those in college, the number who consumed five or more drinks on an occasion also greatly exceeded the numbers of college students who did so. The number of noncollege heavy episodic drinkers ages 18-24 was 5,849,000 in 1999, 6,700,000 in 2002, and 6,789,000 in 2005.

From 1999 to 2002, the proportion of college students ages 18-24 who drove under the influence of alcohol increased significantly from 26.9% to 31.4%, a 17% proportional increase. However, in 2005, the proportion was lower at 28.9%, a significant 8% decline since 2002. A similar pattern was observed among noncollege 18- to 24-year-olds: The proportion who drove under the influence of alcohol increased from 19.6% in 1999 to 23.7% in 2002, a 21% significant increase, but was lower in 2005 (21.6%), a 9% significant decline since 2002.

Despite the decline from 2002 to 2005, overall from 1999 to 2005, among 18- to 24-year-olds, there were significant proportional increases in those who drove under the influence of alcohol of 7% among college students and 10% among those not in college. The numbers of 18- to 24-year-

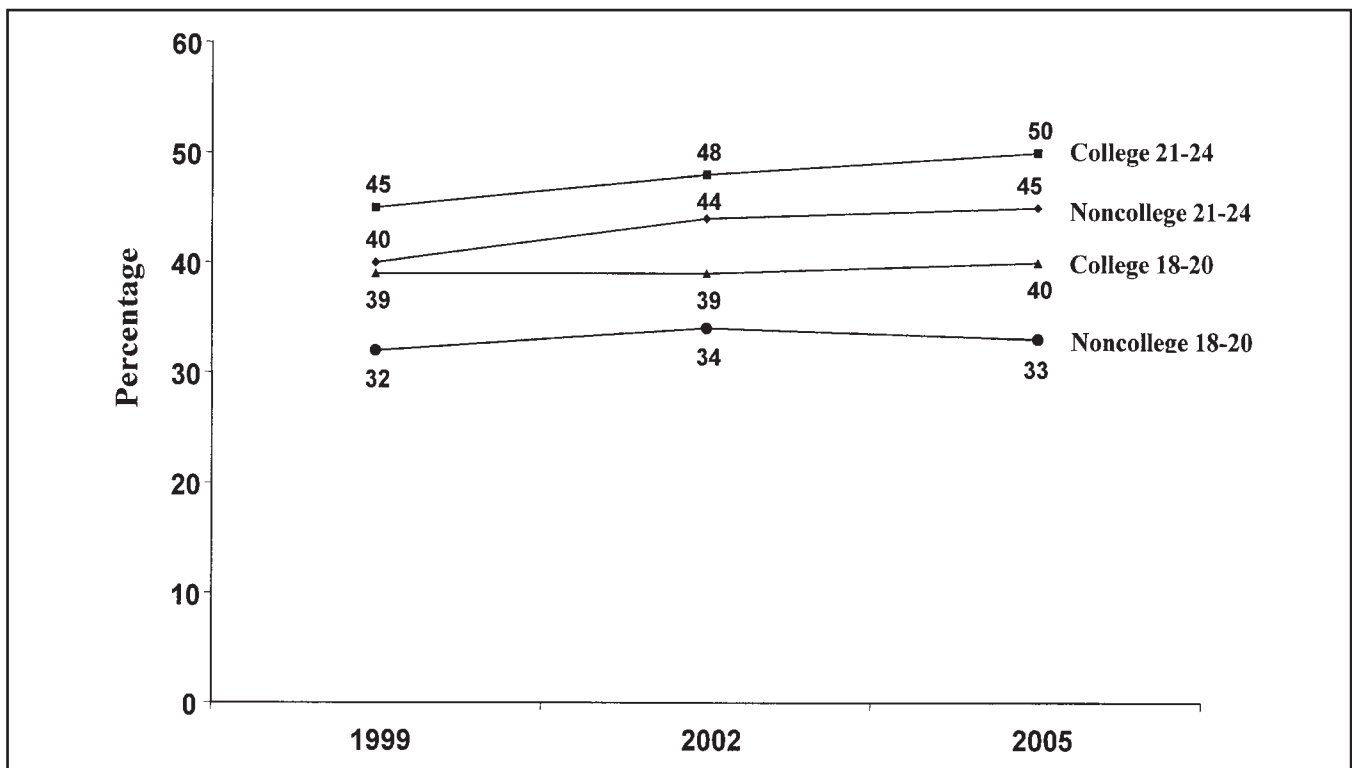


FIGURE 1. Percentage heavy episodic drinking in the past month, ages 18-20 and 21-24, in college versus noncollege persons, 1998, 2002, and 2005. Source: National Household Survey on Drug Use and Health. From 1999 to 2005, a greater increase in heavy episodic drinking was observed among 21- to 24-year-olds than among 18- to 20-year-olds in both college ($p < .001$) and noncollege ($p < .001$) populations.

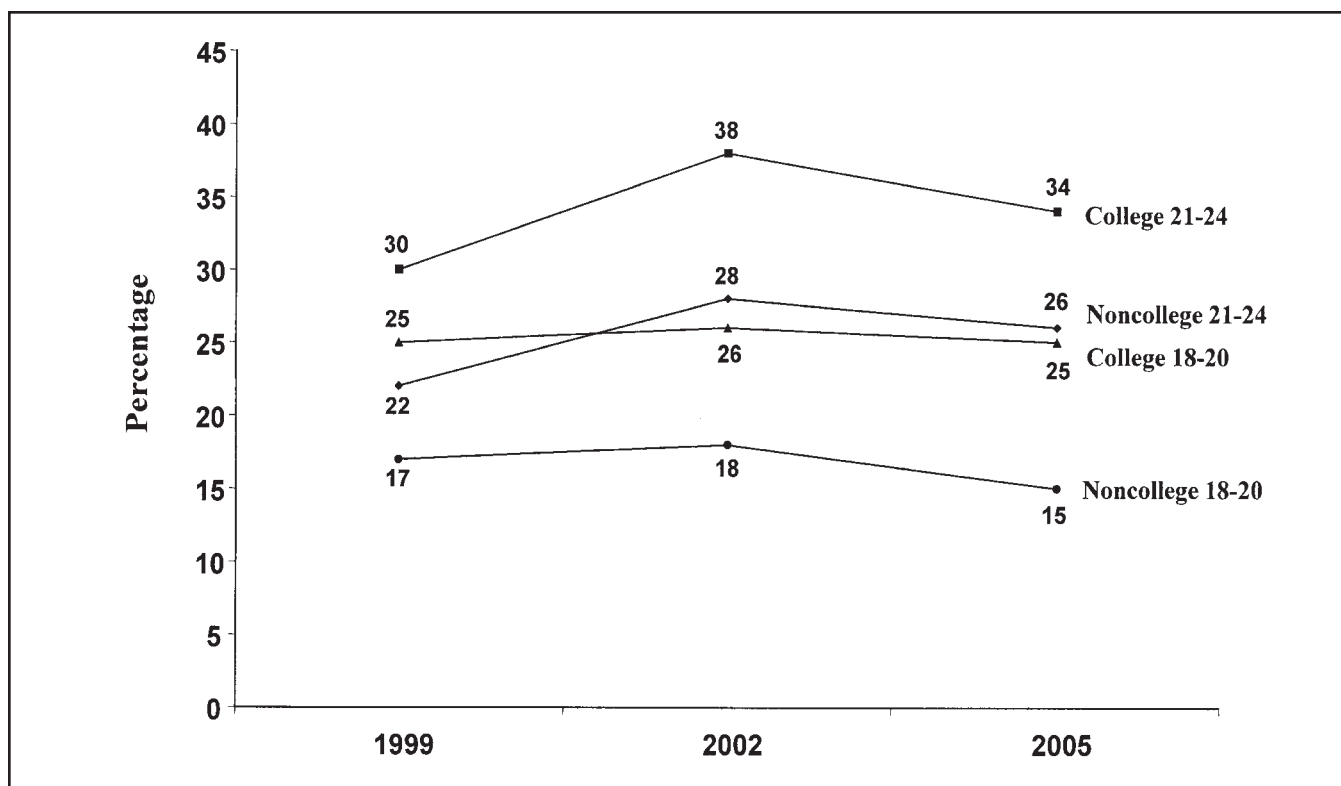


FIGURE 2. Percentage drove under the influence of alcohol in the past year, ages 18-20 and 21-24, in college versus noncollege, 1998, 2002, and 2005. Source: National Household Survey on Drug Use and Health. From 1999 to 2005, a greater increase in driving under the influence was observed among 21- to 24-year-olds than among 18- to 20-year-olds in both college ($p = .001$) and noncollege ($p < .001$) populations.

olds in college who drove under the influence of alcohol were 2,456,000 in 1999, 3,402,000 in 2002, and 3,360,000 in 2005. The numbers of noncollege 18- to 24-year-olds who did so were 3,162,000 in 1999, 3,999,000 in 2002, and 3,666,000 in 2005.

Figures 1 and 2 indicate that significantly greater increases from 1999 to 2005 in heavy episodic drinking and driving under the influence of alcohol occurred among respondents ages 21-24 than those 18-20. In each year examined, a greater percentage of 21- to 24-year-olds than 18- to 20-year-olds engaged in these behaviors. Among both 21- to 24-year-olds and 18- to 20-year-olds, college students were more likely than same-age respondents not enrolled in college to report these behaviors.

Alcohol-related traffic deaths

From 1998 to 2005, the rate of alcohol-related traffic deaths per 100,000 college students declined 3% from 14.5 to 14.1, a nonsignificant decline. From 1998 to 2001, the rate of alcohol-related traffic deaths increased 5% from 14.5 to 15.2 per 100,000 college students. This increase approached, but did not reach, statistical significance. In contrast, from 2001 to 2005, this rate decreased a statistically significant

7% from 15.2 to 14.1. Similar trends were observed among 18- to 24-year-olds not in college (data available on request).

As can be seen in Table 1, among persons ages 18-24, 3,783 (51%) of 7,452 traffic deaths in 1998, 4,219 (51%) of 8,253 traffic deaths in 2001, and 4,114 (49%) of 8,510 traffic deaths in 2005 were alcohol related. On the basis of the deliberately conservative assumption that college students (30% of the U.S. population of 18- to 24-year-olds in 1998, 31% in 2001, and 33% in 2005) experienced alcohol-related fatalities at the same rate as the entire 18- to 24-year-old population, we estimate that, of the alcohol-related traffic deaths in that population, 1,134 (30%) in 1998, 1,308 (31%) in 2001, and 1,357 (33%) in 2005 would have been college students. This assumption is conservative because a higher percentage of 18- to 24-year-old college students compared with those not in college reported driving under the influence of alcohol in the past year.

Of note, among persons age 18-20, there were 1,528 alcohol-related traffic deaths in 1998, 1,799 in 2001, and 1,533 in 2005, reflecting a 6% decline per 100,000 population from 1998 to 2005. Among persons 21-24, the numbers were 2,195, 2,420, and 2,581, respectively, reflecting a 1% increase per 100,000 population from 1998 to 2005.

TABLE 1. Estimated alcohol-related injury deaths, United States, 18- to 24-year-olds in college and not in college: 1998, 2001, and 2005

| Variable | 1998 | 2001 | 2005 | Change in frequency, 1998-2005 | Change in rate/population, 1998-2005 |
|---|------------|------------|------------|--------------------------------|--------------------------------------|
| Total U.S. population of 18- to 24-year-olds | 26,155,000 | 28,058,000 | 29,241,000 | ↑ 12% | |
| Total college population of 18- to 24-year-olds | 7,809,387 | 8,580,318 | 9,628,069 | ↑ 23% | |
| % of the U.S. population of 18- to 24-year-olds that have been in college | 30% | 31% | 33% | | |
| No. of unintentional injury deaths | 10,052 | 11,272 | 12,602 | ↑ 25% | ↑ 12% |
| Total no. of alcohol-related unintentional injury deaths, 18- to 24-year-olds | 4,808 | 5,314 | 5,534 | ↑ 15% | ↑ 3% |
| Total no. of alcohol-related injury deaths, college students ages 18-24 | 1,442 | 1,647 | 1,825 | ↑ 27% | ↑ 3% |
| No. of motor-vehicle crash deaths | 7,452 | 8,253 | 8,510 | ↑ 14% | ↑ 2% |
| No. of alcohol-related motor-vehicle crash deaths | 3,783 | 4,219 | 4,114 | ↑ 9% | ↓ 3% |
| No. of college student alcohol-related motor-vehicle crash deaths | 1,134 | 1,308 | 1,357 | ↑ 20% | ↓ 3% |
| No. of unintentional nontraffic injury deaths | 2,513 | 2,869 | 3,992 | ↑ 59% | ↑ 42% |
| No. of unintentional nontraffic injury deaths that were alcohol related | 1,026 | 1,095 | 1,420 | ↑ 39% | ↑ 24% |
| No. of alcohol-related unintentional injury college deaths | 308 | 339 | 468 | ↑ 52% | ↑ 23% |

Alcohol-related unintentional nontraffic deaths

From 1998 to 2001 to 2005, the rate of unintentional alcohol-related nontraffic injury deaths among 18- to 24-year-old college students increased from 3.9 to 4.0 to 4.9 per 100,000 college students, a significant 25.6% increase (relative risk ratio [RR] = 1.23, 95% CI: 1.07-1.42). We used the following procedures to estimate nontraffic alcohol-related unintentional injury deaths among college students ages 18-24. According to the Centers for Disease Control and Prevention (2008b), the numbers of unintentional nontraffic injury deaths among 18- to 24-year-olds were 2,513 in 1998, 2,869 in 2001, and 3,992 in 2005 (Table 1).² Table 2 provides the following estimates of the numbers of nontraffic injury deaths that were alcohol related: 1,026 in 1998, 1,095 in 2001, and 1,420 in 2005. If 30% of those deaths were among college students in 1998, 31% in 2001, and

33% in 2005, then 308 college students ages 18-24 died from unintentional nontraffic injuries in 1998, 339 in 2001, and 468 in 2005. It should be noted that, relative to other unintentional injury deaths, poisoning deaths increased much more sharply among 18- to 24-year-olds between 1998 and 2005, from 779 to 2,290, nearly tripling during that period. Unintentional injury deaths other than poisonings actually declined slightly about 2%.

Total alcohol-related unintentional injury deaths

Among 18- to 24-year-old college students, deaths from all alcohol-related unintentional injuries, including traffic and other unintentional injuries, increased from 1,442 in 1998 to 1,647 in 2001 to 1,825 in 2005 (Table 1), corresponding to increases in rates of death from 18.5 to 19.2 to 19.0, a 3% increase per 100,000 college population that approached, but did not reach, statistical significance (RR = 1.03, 95% CI: 0.96-1.1).

Other alcohol-related health problems

From 1999 to 2001 to 2005, the numbers of full-time, 4-year students ages 18-24 increased from 5,496,000 to 5,709,000 to 6,200,000. Because there were no changes

²Among persons ages 18-20, there were 1,058 nontraffic injury deaths in 1998, 1,104 in 2001, and 1,427 in 2005, a 27% increase per 100,000 population. Among persons ages 21-24, the respective numbers were 1,445, 1,745, and 2,566, a 51% increase per 100,000 population. The increases were because of increases in poisoning deaths. Excluding poisonings, nontraffic injury deaths declined 15% per 100,000 18- to 20-year-olds from 1998 to 2005 and 9% among 21- to 24-year-olds.

TABLE 2. Total and alcohol-related unintentional injury deaths, United States, ages 18-24

| Type of unintentional injury death | % alcohol related | 1998 | | 2001 | | 2005 | |
|--|-------------------|-------|-----------------|-------|-----------------|-------|-----------------|
| | | Total | Alcohol related | Total | Alcohol related | Total | Alcohol related |
| Burn/fire | 37.9 | 276 | 105 | 308 | 117 | 253 | 99 |
| Cold/hypothermia | 90.0 | 54 | 49 | 45 | 41 | 72 | 65 |
| Drowning | 49.2 | 568 | 279 | 418 | 206 | 480 | 236 |
| Fall | 63.3 | 185 | 117 | 222 | 141 | 202 | 128 |
| Gunshot | 48.7 | 174 | 85 | 163 | 76 | 151 | 74 |
| Poisoning | 26.6 | 779 | 207 | 1,220 | 324 | 2,290 | 609 |
| Other | 38.5 | 477 | 184 | 493 | 190 | 544 | 209 |
| Total | 38.5 | 2,513 | 1,026 | 2,869 | 1,095 | 3,992 | 1,420 |
| Alcohol-related nontraffic college unintentional injury deaths | — | — | 308 | — | 339 | — | 468 |

Source: Smith et al., 1999.

from 1999 to 2001 in the proportions of college student respondents in the College Alcohol Study ages 18-24 who reported being hurt or injured because of drinking (10.5%), hurt or assaulted by another drinking college student (12%), or sexually assaulted or date raped by another drinking college student (2%), the projected numbers of students who experienced these alcohol-related problems increased at the same rate as the population. We estimated that 599,000 were injured because of drinking, 646,000 were assaulted or hit by a drinking college student, and 97,000 experienced a sexual assault or date rape perpetrated by another drinking college student in 2001 (Hingson et al., 2005).

The 2005 follow-up study of the College Alcohol Study at colleges with the highest percentages of heavy episodic drinkers revealed that the proportions of students who drank five or more drinks on an occasion in the past 2 weeks did not significantly change from the 2001 survey, nor did the proportions who had been hurt or injured because of drinking, who had been assaulted by another drinking college student, or who had been a victim of a sexual assault or date rape perpetrated by another drinking college student. Thus, estimates of the numbers of students who were injured because of drinking, being assaulted, or being sexually assaulted or date raped by another drinking college student in 2001 remain the best available, and the numbers experiencing these events in 2005 are probably similar.

Discussion

From 1998-2005 among college students ages 18-24, there was an increase in the proportion who reported heavy episodic drinking from 41.7% to 44.7%, a significant 7% proportional increase. The rate of alcohol-related unintentional injury deaths (both traffic and nontraffic) per 100,000 college students ages 18-24 increased 3%. This approached, but did not reach, statistical significance. Among 18- to 24-year-olds not in college, the proportions who engaged in

heavy episodic drinking rose from 36.2% to 39.9%, a 10% proportional increase. Alcohol-related unintentional injury deaths (both traffic and nontraffic) per 100,000 18- to 24-year-olds not in college also rose 3%. The increase in heavy episodic drinking occurred primarily among 21- to 24-year-olds, but not among 18- to 20-year-olds. Each year during this period, a smaller percentage of 18- to 20-year-olds than 21- to 24-year-olds engaged in this behavior.

A slightly different pattern emerged for 18- to 24-year-olds in college and not in college regarding driving under the influence of alcohol and being killed specifically in alcohol-related traffic crashes. From 1999 to 2002, the proportion of college students ages 18-24 who reported that they drove under the influence of alcohol in the previous year increased from 26.9% to 31.4%, a 17% proportional increase. However, by 2005 the proportion was 28.9%, an 8% proportional decline since 2002. From 1998 to 2001, alcohol-related traffic deaths per 100,000 college students ages 18-24 rose 5% but then declined 8% from 2001 to 2005. A parallel pattern was observed among 18- to 24-year-olds not in college. From 1999 to 2002, the proportions who reported driving under the influence of alcohol in the previous year increased from 19.6% to 23.7%, a 21% proportional increase. However, by 2005, the percentage declined to 21.6%, a 9% decline since 2002. Per 100,000 18- to 24-year-olds not in college, alcohol-related traffic deaths increased 4% between 1998 and 2001 but then declined 6% between 2002 and 2005. Overall from 1998 to 2005, both among 18- to 24-year-olds in college and not in college, there was a 3% decline in alcohol-related traffic deaths per 100,000 persons. Among persons ages 18-20, the decline per 100,000 was 6%, whereas among 21- to 24-year-olds, there was a 1% increase.

In interpreting these results, it is important to note that most fatally injured drivers are tested for alcohol. This permits reliable estimates of alcohol involvement in fatal traffic crash deaths among 18- to 24-year-olds. However, whether the people who died were enrolled in college is not recorded.

Our estimates of these deaths among college students are based on the assumption that college students die in these motor-vehicle crashes at rates proportional to the college student percentage of the population. For the most accurate counts, it would be preferable to have the college student status of these persons recorded in the Fatality Analysis Reporting System. We also believe that all unintentional injury deaths other than traffic deaths should be tested for alcohol. Without consistent testing over time, we can only estimate the numbers of nontraffic injury deaths that are alcohol related, and projected changes over time in these deaths should be interpreted cautiously.

As we have noted, the type of nontraffic unintentional injury death that increased the most from 1998 to 2005 was unintentional poisoning. A limitation of the method used to estimate alcohol involvement in nontraffic unintentional injury deaths is that we assumed that the proportion of each type of death that involved alcohol has not changed over time. This assumption may or may not be correct. The Centers for Disease Control and Prevention has tracked the numbers of poisoning deaths exclusively attributed to alcohol among all ages from 1979 to 2004 (Centers for Disease Control and Prevention, 2008a). The annual totals have ranged from a high of 416 in 1979 to a low of 300 in 1998. In 2004, the total was 358, less than 2% of all poisoning deaths (Centers for Disease Control and Prevention, 2007).

There have not been increases in other types of unintentional nontraffic injury deaths that parallel the overall poisoning death increase in recent years. However, when other substances are listed as the primary cause of a poisoning death, it is not known whether the decedent may also have been drinking. The Sober Truth on Preventing Underage Drinking (STOP) Act, which Congress passed in 2007, and the Surgeon General's Call to Action to Prevent and Reduce Underage Drinking (Office of the Surgeon General, 2007) both have recommended that all injury deaths among those younger than age 21 be tested for alcohol. This would provide more accurate data on alcohol involvement in nontraffic injury deaths in that age subgroup of the U.S. population.

We recognize and have discussed the limitations of our methods for estimating alcohol-related mortality and morbidity (Hingson et al., 2002). We believe our estimates of college student alcohol-related injury deaths in 1998, 2001, and 2005 are conservative for the following five reasons: (1) We focused on college students ages 18-24, who comprise less than two thirds of all college students; (2) we did not include alcohol-related homicide and suicide deaths; (3) we estimated that nontraffic injury deaths among 18- to 24-year-olds are as likely to involve alcohol as those injury deaths among persons of all ages, although the prevalence of heavy episodic drinking is much higher among college students than the general adult population (in 2005, 48% of traffic deaths among 18- to 24-year-olds were alcohol related, compared with 39% in all other age groups); (4) we estimated

that alcohol-related traffic deaths among 18- to 24-year-old college students occur at a rate proportional to their percentage of the 18- to 24-year-old population, although a higher percentage of college students of that age reported driving under the influence of alcohol than 18- to 24-year-olds not in college; and (5) we estimated that nontraffic alcohol injury deaths among 18- to 24-year-old college students occur at a rate proportional to their percentage of the 18- to 24-year-old population, although a higher percentage of 18- to 24-year-old college students report drinking five or more drinks on an occasion in the past month than 18- to 24-year-olds not in college.

A growing body of evidence indicates that a variety of individually oriented screening and counseling approaches, environmental alcohol policies and their enforcement, and comprehensive community/college cooperative interventions can reduce drinking and alcohol-related problems among college age individuals and college students (Carey et al., 2007; Hingson et al., 2005; Larimer and Cronce, 2007; NIAAA, 2007; Task Force of the National Advisory Council on Alcohol Abuse and Alcoholism, 2002; Toomey et al., 2007). Unfortunately, notwithstanding the recognized limitations of our methods for estimating college alcohol-related mortality and morbidity, it does not appear that marked progress has been made in reducing the rates of alcohol-related mortality and morbidity among 18- to 24-year-old college students. Even alcohol-related traffic deaths, for which estimates are more precise, reveal only a 3% decline per 100,000 population from 1998 to 2005.

Also, for every 18- to 24-year-old in college, there are at least two not in college. Although the data on college students underscore the need for colleges to identify and implement prevention and counseling strategies identified through research to reduce drinking problems among college students, alcohol-related problems among the entire population of 18- to 24-year-olds in the United States are so numerous that colleges and the communities in which they are located must work together to change the culture of drinking in that age group to achieve optimal declines in alcohol-related problems. Furthermore, research has found that alcohol problems often begin before college. College student surveys have indicated that the younger students were when they first drank to intoxication, the greater the likelihood that, while in college, they will experience alcohol dependence, drive after drinking, ride with drinking drivers, have alcohol-related injuries, and have unplanned and unprotected sex after drinking (Hingson et al., 2003a,b).

In 2005, among 18- to 24-year-olds both in college and not in college, nearly 12 million consumed five or more drinks on at least one occasion in the past month, and more than 7 million drove under the influence of alcohol in the past year. Among 18- to 24-year-olds in the United States, injuries are the leading cause of death, and alcohol is the leading contributor, being a factor in more than 5,000 deaths

in that age group each year. To place that number in perspective, it exceeds the total number of U.S. soldiers who have died in the war in Iraq.

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