

What We Have Learned From the Harvard School of Public Health College Alcohol Study: Focusing Attention on College Student Alcohol Consumption and the Environmental Conditions That Promote It*

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ABSTRACT. The Harvard School of Public Health College Alcohol Study surveyed students at a nationally representative sample of 4-year colleges in the United States four times between in 1993 and 2001. More than 50,000 students at 120 colleges took part in the study. This article reviews what we have learned about college drinking and the implications for prevention: the need to focus on lower drink thresholds, the harms produced at this level of drinking for the drinkers, the second-

hand effects experienced by other students and neighborhood residents, the continuing extent of the problem, and the role of the college alcohol environment in promoting heavy drinking by students. In particular, the roles of campus culture, alcohol control policies, enforcement of policies, access, availability, pricing, marketing, and special promotions of alcohol are highlighted. (*J. Stud. Alcohol Drugs* 69: 000-000, 2008)

The Harvard School of Public Health College Alcohol Study (CAS) began in 1992. It ended 14 years, four national surveys, and more than 80 publications later. The CAS was designed to provide the first nationally representative picture of college-student alcohol use and to describe the drinking behavior of this high-risk group. In 1994, the first report of the CAS was published (Wechsler et al., 1994), launching a decade of research and debate about college-student drinking behavior. The purpose of this article is to review the findings of the CAS and the implication of these findings for addressing problems related to drinking among college students.

Focusing on lower drinking thresholds

The principal objective of the CAS was to learn more about the type of drinking college students engage in and the resulting consequences for themselves and for those around them. Several measures of alcohol consumption were incorporated into the CAS survey questionnaire. The pri-

mary measure was binge drinking, defined as the consumption of five or more drinks in a row for men and four or more drinks for women on one or more occasions during the 2-week period immediately before the survey (Wechsler and Austin, 1998; Wechsler et al., 1995b; Wechsler and Nelson, 2001, 2006). Other consumption measures included any alcohol use in the past year; frequent binge drinking, defined as bingeing on three or more occasions in the past 2 weeks; number of drinking occasions in the past 30 days; the number of drunken occasions in the past 30 days; and the usual number of drinks on a drinking occasion. These measures were tracked in each of the CAS surveys and are strongly intercorrelated (Weitzman and Nelson, 2004).

The CAS research adapted a five-drink measure previously used in the University of Michigan's Monitoring the Future study (Johnston and Bachman, 1980) as an indicator of heavy drinking and created a gender-specific definition of binge drinking of five drinks for males and four drinks for females. This measure equated the experience of alcohol-related problems for college men and women (Wechsler et al., 1995b) that may reflect a range of gender differences in the effects of alcohol consumption, including body mass and alcohol metabolism rates.

From the inception of the CAS, use of the five/four measure and the term *binge* has proven to be controversial. A major criticism of the five/four drink binge measure is that it overstates the problem of heavy drinking among college students by adopting a low threshold that includes too many

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students who do not experience alcohol-related problems. We have maintained that students who drink at the five/four level and above pose a major public health problem at college (Wechsler and Austin, 1998; Wechsler and Nelson, 2001, 2006). (The policy of the Journal of Studies on Alcohol and Drugs is to reserve the use of the term *binge* for drinking or other substance use that extends for a period of 2 days or longer where the individual gives up their usual activities. [See www.jsad.com/jsad/static/binge.html.] With permission from the Editor, the term *binge* is used in the present article to refer to the consumption of five drinks in a row for males or four drinks in a row for females on a single occasion within a 2-week time period.)

Alcohol-related problems do not start at the level of drinking legally defined as intoxication. Reductions in cognitive and psychomotor performance are found at low levels of alcohol consumption (Breitmeier et al., 2007; Tagawa et al., 2000), which may lead to negative health consequences. Even relatively low levels of blood alcohol concentration are associated with increased risk of injury and death in motor vehicle crashes (Zador, 1991; Zador et al., 2000).

Although the five/four measure captures some students who do not experience alcohol-related harms, a large proportion of college drinkers imbibe at these lower levels. In contrast, risk of harm for the individual is greatest at the highest levels of consumption, but relatively few drinkers consume alcohol at the most extreme levels (Wechsler and Nelson, 2006; Weitzman and Nelson, 2004). As a consequence, most alcohol-related harms experienced by college students occur among drinkers captured by the five/four measure of consumption. This phenomenon is known as the "prevention paradox" (Rose, 1992) and has been documented using CAS data across several measures of consumption and harms (Weitzman and Nelson, 2004). Table

1 illustrates this point using CAS data to describe the relationship between the usual number of drinks consumed when drinking and self-reported alcohol-related injury. This table demonstrates that, among students who reported alcohol-related injuries, 53% drank five or fewer drinks in a row, and 21% had eight or more (see last column).

The other point of controversy relates to the label of *binge*, a term that had been previously used to describe the extreme drinking behavior of alcohol-dependent persons over a longer period (DeJong, 2001, 2003; Dimeff et al., 1995; White et al., 2006). Despite concerns of some about its use and meaning, the phrase *binge drinking* has by now been widely adopted. Today, a majority of its use in the scientific literature refers to the five/four drink measure or another a similarly low measure. We conducted a search of the ISI Web of Science database (Thomson Corporation, 2007) to locate English-language research articles published in 2006 that studied humans but were not CAS studies containing the terms *alcohol* and *binge*. After removing articles that referred only to *binge eating*, there were a total of 92 published studies. Of these, we could not locate 11, 4 referred specifically to an alcoholic binge, and three did not define binge drinking. The remaining 74 articles used the term *binge* to refer to lower levels of alcohol consumption, including the five/four measure, five or more, or six or more drinks.

Other studies of alcohol use employ similar measures, including the Monitoring the Future study (Johnston et al., 2005); the Core Institute survey of college students (Presley et al., 1996); and the Centers for Disease Control and Prevention's (CDC) Youth Risk Behavior Surveillance Survey, National College Health Risk Behavior Survey, and Behavioral Risk Factor Surveillance Survey (Naimi et al., 2003). Further, the World Health Organization recommends a five-drink measure for population surveillance surveys of

TABLE 1. Alcohol-related injury, by usual number of drinks in the population

No. of drinks usually consumed when drinking	% drinkers at each level of usual no. of drinks consumed	% at each level of usual no. of drinks reporting an alcohol-related injury in the past school year	Actual no. of CAS respondents who reported an alcohol-related injury in the past school year of 38,982 drinkers	% of total no. of students reporting an alcohol-related injury at each level of usual no. of drinks
1	13	2	90	2
2	21	4	366	7
3	18	9	598	12
4	15	14	791	16
5	12	18	804	16
6	8	23	731	15
7	4	26	441	9
8	3	30	360	7
≥9	5	33	700	14
Total	100	13	4,881	100

Notes: CAS = College Alcohol Study. Source: Harvard School of Public Health College Alcohol Study 1993, 1997, 1999, and 2001 national surveys. Adapted from Wechsler and Nelson (2006).

alcohol consumption (World Health Organization, 2000). A National Institute of Alcohol Abuse and Alcoholism (NIAAA) advisory panel recommended that researchers define a *binge* as a pattern of drinking that brings blood alcohol concentration to .08 gram percent or greater, a level of consumption that corresponds to five or more drinks for men and four or more drinks for women in a period of about 2 hours (NIAAA, 2004). The NIAAA also recommends to medical professionals the use of a five or four drinks in a day measure to identify risky alcohol consumption (NIAAA, 2007), and a recent article by NIAAA researchers made the case for including the five/four binge measure of consumption as a part of future classifications of alcohol-use disorders (Saha et al., 2007). The five/four measure may be a useful screen for stepped care within a population-based approach (Wechsler and Nelson, 2006).

Documenting the extent and persistence of the problem

In 1993, the first CAS study found that binge drinking was a prevalent activity among American college students. Two in five students (44%) attending 4-year colleges in the United States drink alcohol at this level or greater, and this rate of binge drinking has been stable in all four administrations of the CAS from 1993 to 2001 (Wechsler et al., 1994, 1998, 2000b, 2002b). These results have been corroborated by other major national surveys, including the CORE Survey (Presley et al., 1996, 1998), the Monitoring the Future study (Johnston et al., 2005; O'Malley and Johnston, 2002), the National College Health Risk Behavior Survey (CDC, 1997; Douglas et al., 1997), and the National Survey on Drug Use and Health (Substance Abuse and Mental Health Services Administration, 2006). A review of all of these surveys found consistent national rates of binge drinking of about 40%, despite varying sampling schemes and methodologies (O'Malley and Johnston, 2002).

Few changes in student binge drinking occurred between 1993 and 2001 (Wechsler et al., 2002b). Although the rate of binge drinking has remained at 44%, the most notable change during this time period has been the polarization of drinking behavior, with simultaneous increases in the number of abstainers and in the number of students who engage in frequent binge drinking (Wechsler et al., 1998, 2000b, 2002b).

The drinking style of many college students is one of excess and intoxication. Among drinkers, almost half (48%) report that drinking to get drunk is an important reason for drinking, 1 in 4 (23%) drink alcohol 10 or more times in a month, and 3 in 10 (29%) report being intoxicated three or more times in a month (Wechsler et al., 2002b). Binge drinkers consumed 91% of all the alcohol that students reported drinking, and 68% of alcohol was consumed by frequent binge drinkers (Wechsler et al., 1999).

Impact of binge drinking on the drinker

The CAS findings have shown that alcohol consumption at binge levels and beyond has a significant impact on college students' academic performance, social relationships, risk taking behaviors, and health. This form of drinking is associated with missing class, falling behind in schoolwork, and lower grade point average, a relationship mediated by fewer hours spent studying (Powell et al., 2004; Wechsler et al., 2002b). Binge drinking is associated with risky sexual behavior, including engaging in unplanned sexual activity and failure to use protection during sex (Wechsler et al., 2000b). It is also tied to antisocial behavior, including vandalism and getting into trouble with the police when drinking (Wechsler et al., 2002b). Overall, half of frequent binge drinkers, those who drink at the five/four level or beyond three or more times in a 2-week period report experiencing five or more different alcohol-related problems (Wechsler et al., 2000b).

An NIAAA chartered study estimated that 1,700 college students die per year from alcohol-related unintentional injuries, the majority in motor-vehicle crashes (Hingson et al., 2005). Driving is perhaps the most dangerous context for drinking alcohol. Among students who drove one or more times per week, 13% reported driving after consuming five or more drinks, and 23% of students said they rode with a driver who was high or intoxicated (Wechsler et al., 2003a). An estimated 2 million college students drove a motor vehicle under the influence of alcohol, and more than 3 million rode with an intoxicated driver (Hingson et al., 2005). Students who binge drink are more likely to put themselves and others at risk by operating or riding in a motor vehicle after drinking (Wechsler et al., 2003a). Few college students, less than 1% of drinkers, report that they required medical treatment after overdosing on alcohol. However, this number may involve an estimated 30,000 students when projected across the 5 million students attending 4-year colleges each year (Wechsler et al., 2000c, 2002b).

The heavy drinking of some students reaches levels of clinical significance. Using the Semi-Structured Assessment for the Genetics of Alcoholism (SSAGA; Bucholz et al., 1994; Hesselbrock et al., 1999), which elicits self-reports of Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (American Psychological Association, 1994) criteria for alcohol abuse or dependence, nearly 1 in 3 college students (including 3 in 5 frequent binge drinkers) qualifies for a diagnosis of alcohol abuse, and 1 in 17 (1 in 5 frequent binge drinkers) qualifies for a diagnosis of alcohol dependence (Knight et al., 2002). Despite the problems experienced by students who engage in frequent binge drinking, very few consider themselves to be heavy or problem drinkers. Less than one quarter of frequent binge drinkers thought they ever had a problem with alcohol, and only

13% of this group thought they were heavy or problem drinkers. As a result, among this heaviest drinking group, less than 3% have sought help for their drinking (Knight et al., 2002; Wechsler et al., 2002b).

Secondhand effects of alcohol

The impact of college student alcohol misuse is not limited to the drinkers themselves. From the beginning of the study, the CAS focused on the ways in which student alcohol use impacted others in the immediate environment. Adapting the concept of "secondhand effects" from tobacco research (Bayer and Colgrove, 2002), CAS research used the term to denote the way in which drink-driven behavior harmed others. Students who attended schools with high rates of binge drinking experienced a greater number of secondhand effects, including disruption of sleep or study; property damage; and verbal, physical, or sexual violence, than their peers attending schools with low binge drinking rates (Wechsler et al., 1995c). Three in 10 (29%) college students nationally reported that they were insulted or humiliated by another student who had been drinking, and 19% said they had been in a serious argument or quarrel with an intoxicated student (Wechsler et al., 2002b). One in 11 students (9%) reported having been pushed, hit, or assaulted by a student who had been drinking. An estimated 600,000 college students per year were hit or assaulted by another student who had been drinking (Hingson et al., 2002). Sexual assaults tend to occur at colleges with high rates of binge drinking (Wechsler et al., 1995c). One in 20 (5%) female students reported that they were the victims of a sexual assault, and 3 in 4 of these students were under the influence of alcohol at the time of the rape (Mohler-Kuo et al., 2004). In addition, residents of neighborhoods near schools with high binge-drinking rates were more likely to experience noise disruptions, property damage, and police visits than those who lived in neighborhoods surrounding schools with lower binge drinking rates and those who did not live near a college (Wechsler et al., 2002a).

Studying the college environment

Importance of college-level variation. The inclusion of more than 100 colleges in the four national surveys allowed an examination of the role of school, community, state, and regional factors in college drinking. With the exception of the 1950 study of Straus and Bacon (1953), nearly all studies of college drinking before the CAS were limited to single-school samples. In the few cases when several colleges were included, samples were opportunistic rather than representative. Although studies at one or a few colleges may provide valuable information about psychological, clinical, or attitudinal factors in alcohol use, the

design of these studies does not permit an examination of the role environmental and contextual factors play in student drinking. As a consequence, far less attention has been given to environmental factors that may influence college student drinking (Dowdall and Wechsler, 2002). The study design of the CAS captured the wide variation in the types of colleges, which created an opportunity to examine the influence on student drinking of different factors on multiple levels, including the college setting, the adjoining community, and the state in which the college is located (Dowdall and Wechsler, 2002).

The CAS results revealed that binge drinking varies by college (ranging from 1% to 76%), yet, within colleges, binge drinking has remained stable over time (Wechsler et al., 2002b). These findings suggest that factors in the environment may influence college student binge drinking. Binge drinking varies by student subgroups, by the region of the country (higher in northeastern and north-central states, lowest in western states), and by the sets of policies and laws governing alcohol sales and use (Nelson et al., 2005a; Wechsler et al., 1994, 1995a, 1997, 1998, 2000a,b, 2002c). Understanding the patterns of drinking by different groups of students and in different settings can help researchers understand the factors that promote heavy drinking and identify potential intervention strategies to reduce alcohol consumption and, in turn, the harms that result from heavy consumption. Features of the environment, such as residential setting, low price, and high density of alcohol outlets, as well as the prevailing drinking rates at the college, are significantly related to the initiation of binge drinking in college. We have referred to the combination of factors in the environment that promote heavy drinking as a "wet environment" (Kuo et al., 2003; Weitzman et al., 2003b).

College-level factors that influence student drinking

The transition from high school to college is a significant milestone in a young person's life that is marked by entirely new social environments and the adoption of adult roles as students become independent of their parents. Although about half of all college binge drinkers engage in binge drinking before their arrival on campus, an equal number pick up binge drinking behavior in college (Weitzman et al., 2003b). Student affiliations and their surrounding environments were important determinants of initiating drinking behavior in college (Weitzman et al., 2003b). Membership in a fraternity or sorority, belief that most friends binge drink, drinking to "fit in," easy access to alcohol through social affiliation, low-cost alcohol, and attending a college with a high rate of binge drinking were all independently associated with first-year students taking up binge drinking.

Where a student lives during college is an important factor in how much alcohol she or he consumes. Rates of

binge drinking vary according to the level of supervision in the living environment and to the presence of heavy drinkers (Harford et al., 2002a; Wechsler et al., 2002c). Underage students living at home with their parents had the lowest rates of binge drinking of all college students. Among those living on campus, residents in housing designated as substance-free, where alcohol and tobacco use are prohibited, had the lowest rates of binge drinking. Students living off campus away from their parents and students living in fraternity or sorority houses had the highest rates of binge drinking.

The amount of alcohol consumed per occasion appears to vary by setting (Harford et al., 2002b). Fraternity/sorority parties, off-campus bars, and off-campus parties were the sites of heaviest drinking. Although off-campus parties and bars were most heavily attended, a higher percentage of drinkers engaged in heavy drinking at fraternity/sorority parties. Older students were more likely to frequent off-campus bars, whereas younger students, particularly those younger than the minimum legal drinking age (21 years) were more likely to attend off-campus parties. Heavy consumption of alcohol at both off-campus parties and off-campus bars was associated with disruptive behavior and with becoming a victim of an altercation (Harford et al., 2003). Students who lived off campus with their parents and attended these drinking venues remained less likely to engage in disruptive behaviors or to become a victim of an altercation as a result of their drinking.

The CAS research has identified two other campus-level factors that may help limit the level of heavy drinking by students. The demographic composition of a college student body appears to influence student drinking (Wechsler and Kuo, 2003). A greater racial and ethnic diversity on campus is associated with lower binge drinking rates among the white majority students. Similarly, lower binge drinking rates were observed among male and underage students at colleges that had more female and older students. Students who did not binge drink during high school were more likely to take up binge drinking in college if they attended schools with fewer minority and older students. In addition, the amount of social capital (the social resources, trust, reciprocity, and mutual aid in a social group, measured as the aggregate level of student volunteerism) on a campus is associated with decreased risk for alcohol consumption and alcohol-related harms (Weitzman and Chen, 2005; Weitzman and Kawachi, 2000). The reduction in harms was associated with lower consumption. These findings suggest that increasing student involvement in their campus and community through volunteer service may help to limit overall campus alcohol consumption and the harms associated with it. In general, students with more involvement in productive college activities in addition to volunteer service (e.g., studies and special interests) were less likely to be binge drinkers.

Community factors that influence college-student drinking

The price students pay for alcohol is an important factor in their drinking. Low price and very easy access to alcohol are strong correlates of binge drinking (Wechsler et al., 2000a; Weitzman et al., 2003b). Underage drinking and binge drinking by female students is sensitive to the price of alcohol (Chaloupka and Wechsler, 1996). Students who pay a higher price for alcohol are less likely to transition from abstainer to any alcohol use and to binge drinking, and this effect is equal across thresholds (Williams et al., 2002). These findings, in concert with research on price in other populations (Cook and Moore, 2002), suggest that raising the unit price of alcohol may reduce student consumption.

Characteristics of the venues for purchasing alcohol in college communities are associated with student drinking. In a study that examined alcohol outlets surrounding the colleges that participate in the CAS (Kuo et al., 2003), more than half of the off-premise alcohol outlets used promotions with price discounting, and nearly three in four outlets that served alcohol for on-premise consumption had price-discounted specials on the weekend. The extent of these low-price promotions was associated with the binge-drinking rate at the nearby college. Community residents were more likely to report secondhand effects of heavy alcohol use if they lived near a heavy-drinking college campus, compared with those who lived near campuses with lower drinking rates or those who did not live near a college campus. The number of alcohol outlets in those communities mediated the relationship between heavy drinking and community resident reports of alcohol-related secondhand effects (Wechsler et al., 2002a). Higher rates of drinking, harms, and secondhand effects among students were observed in a study of eight college communities where the alcohol outlets were objectively identified using both local licensing information and direct observation (Weitzman et al., 2003a).

College-student drinking is also influenced by the state of residence. In a study comparing CAS data with data on drinking among adults in the general population from the CDC Behavioral Risk Factor Surveillance Survey, binge-drinking rates of college students by state were correlated with binge drinking by adults living in the same state, and students attending college in states with low rates of adult binge drinking were less likely to binge drink (Nelson et al., 2005a).

Relationship between student drinking and policy

Campus, local, and state alcohol control policies are associated with less drinking and binge drinking among college students. Students attending colleges that ban alcohol were less likely to binge drink and more likely to abstain

from alcohol (Wechsler et al., 2001a). However, students who drank at these colleges drank just as heavily as students at nonban schools. Perhaps the greatest benefit of banning alcohol was that fewer students experienced secondhand effects from the drinking of others than students at nonban schools. Campus alcohol bans appear to strongly deter students from any alcohol use if they were an abstainer, although the effect is less strong for heavier drinking levels (Chaloupka and Wechsler, 1996). At schools that allow students some access to alcohol in their campus residences, living in substance-free residences—where students are prohibited from using alcohol and tobacco—is associated with less alcohol use and fewer secondhand effects of alcohol (Wechsler et al., 2001b). The benefit of substance-free compared with unrestricted housing was greatest for students who did not binge drink in high school and for those on campuses with lower overall levels of binge drinking.

In several studies, state and local alcohol policies were associated with drinking behavior among college students. Strong state and local drunk-driving policies targeting youths and young adults were associated with lower levels of drinking (Williams et al., 2002). Students that attended college in states with more alcohol control policies were less likely to engage in binge drinking (Nelson et al., 2005a). These policies included keg registration; laws restricting driving at .08% or higher blood alcohol concentration; and restrictions on happy hours, open containers in public, beer sold in pitchers, and billboards and other types of alcohol advertising. Restrictions on sales to and possession by persons younger than the legal drinking age are associated with less drinking by underage college students. The laws pertaining to underage drinking that were considered included local minimum age to sell alcohol, prohibitions against using false identification, attempting to buy or consume alcohol for those younger than the legal drinking age, requirements for outlets to post warning signs about the consequences of violating alcohol laws, and state laws restricting the sale of alcohol by requiring a minimum age of 21 years to be a clerk and a minimum age of 21 years to sell alcohol. Underage students in states with extensive laws restricting underage and high-volume drinking were less likely to drink and to binge drink (Wechsler et al., 2002c). These policies were also associated with lower rates of drinking and driving among college students (Wechsler et al., 2003a).

The response of colleges to the heavy drinking of their students has focused on educating students about the risks of alcohol use. A nationwide survey of college presidents ($N = 747$) found that nearly all colleges conducted some form of alcohol education, with efforts targeted at high-risk populations such as first-year students, members of fraternities and sororities, and athletes (Wechsler et al., 2004). About one in three colleges (34%) banned alcohol for all

students, regardless of the students' age, and four in five (81%) offered at least some residential option that was alcohol free.

Evaluating prevention efforts

The CAS data and supplemental surveys of participating sites were used to examine changes over time in a prospective evaluation of the "A Matter of Degree" (AMOD) program. The AMOD program was a demonstration initiative to reduce binge drinking and related harms among college students by changing campus and community environments. The program used a coalition-based approach to bring campuses and communities together to change the conditions that promote heavy alcohol consumption prevalent in many campus community environments. Participant sites implemented program and policy interventions to change the alcohol environment on and off campus, such as mandatory responsible beverage-service training, greater monitoring and service standards for alcohol outlets, keg registration, parental notification policies, greater supervision and more stringent accreditation requirements for fraternity/sorority organizations, cracking down on unlicensed alcohol sales, and increasing substance-free residence hall offerings and alcohol-free activities. These interventions targeted the easy accessibility, low price, and heavy marketing of alcohol prevalent in college communities. Results from the AMOD program demonstrate that environmental prevention efforts can be implemented, even in the face of resistance from invested stakeholders, such as students and the alcohol industry (Weitzman et al., 2003c). These efforts do require considerable time and political resources. The extent to which coalition efforts can be successful in enacting these prevention programs may depend, in part, on the attitudes and degree of acceptance of an approach that focuses on changing the alcohol environment of the change agents themselves. The AMOD program sites that implemented the highest number of interventions addressing these environmental determinants of alcohol use had increases in student reports of difficulty obtaining alcohol. These same sites experienced modest, although statistically significant, declines in alcohol consumption, alcohol-related social and health consequences, and secondhand effects of alcohol in comparison with a similar group of colleges that did not implement these initiatives (Weitzman et al., 2004). One concern about intervention efforts to increase restrictions on alcohol such as those implemented in the AMOD program is that they will lead to more drinking and driving as students seek out alcohol or opportunities to drink in other areas. In a separate evaluation of the effect of the AMOD program on drinking and driving outcomes, the program colleges with the greater implementation of environmental prevention measures had significant declines in driving after drinking, driving after consuming five or more

drinks among students who drove a vehicle one or more times per month, and riding with a passenger who was intoxicated among all students (Nelson et al., 2005b). The declines in the two driving measures operated through significant declines in frequent binge drinking at the sites with higher implementation of environmental prevention.

The CAS data were also used to evaluate social-norms marketing, a popular media-based communications program that highlights healthy drinking norms on campus with the intent of reducing student drinking. Administrators at approximately half (49%) of the colleges reported using social-norms marketing as a prevention strategy to address student alcohol use (Wechsler et al., 2004). A CAS evaluation of colleges in which administrators reported that they used social norms marketing found that students attending these were more likely to report being exposed to social-norm program messages and materials than were students at other campuses (Wechsler et al., 2003b). However, no significant decreases in any measure of drinking were observed at colleges that employed a social-norms approach compared with schools that did not, regardless of the length or intensity of the program (Wechsler et al., 2003b). Conversely, a significant increase in any alcohol use was observed at these colleges (Wechsler et al., 2003b). Colleges that implemented social-norms marketing programs were less likely to implement policies that restricted alcohol on-campus and were more likely to receive funds for alcohol-prevention programming from public and/or alcohol industry sources (Wechsler et al., 2004).

The findings of the CAS evaluation of social norms have been hotly debated in the alcohol-prevention field. The primary criticisms of the study were that program quality was not directly examined and the administrator reports may not accurately reflect what was happening on campus (Berkowitz, 2003; Haines, 2003; Perkins and Linkenbach, 2003). Overall, the evidence on the efficacy of social-norms marketing programs is mixed, and further study of this approach and the specific features that may enhance its effectiveness are needed (Toomey et al., 2007).

Advantages and limitations of the CAS

The CAS study design had strengths and limitations. It was designed to provide a nationally representative sample of students attending 4-year colleges in the United States. Overall, the CAS survey samples were large in each survey year and included responses from a wide range of students. This variation in student characteristics provided the opportunity to make inferences about the population of college students nationally and to make comparisons among groups of students based on their reported characteristics. The CAS used a two-stage sampling scheme where colleges were selected proportionate to their enrollment size, and a fixed number of students were randomly selected

within colleges. This sampling scheme provided an efficient method for conducting the survey. The inclusion of multiple colleges over several surveys also permitted us to examine the variation in drinking behavior across these different settings and allowed us to study possible contextual, environmental, and policy determinants of student drinking. Single-college studies are limited in this regard because they control for these effects by design by holding them constant. We did observe wide variation in drinking behavior at the college level (Wechsler et al., 1994), and these behaviors were stable over time within colleges (Wechsler et al., 2002).

The sample was limited in at least three important ways. First, not all students who were selected to participate in the study responded to the survey. Overall response rates declined over the four national surveys, from 69% in 1993 to 52% in 2001. The number of colleges that participated also declined, from 140 in 1993 to 120 in 2001. In addition, response rates varied among colleges in each survey year. We took precautions to protect against possible response bias, including weighting the sample, comparing early and late responders, conducting brief surveys of nonresponders, and adjusting analyses for college-level response rate. We had the advantage of knowing the demographic characteristics of the full population of students at each of these colleges and were able to construct a weighting scheme to account for possible bias in student response to the survey. However, it is not possible to control for the influence of nonresponse bias related to other student characteristics. Second, we sampled a relatively small number of students within each college, thus limiting the precision of estimates for a single college. Third, we relied on self-reported responses to a questionnaire. No attempt was made to obtain measures of consumption other than self-reports. Students have been shown to underestimate their actual consumption (White et al., 2005), although self-report measures are generally considered to be valid for surveillance research (Cooper et al., 1981; Frier et al., 1991; Midanik, 1988).

Future directions

The CAS research has raised awareness about the extent of college binge drinking and associated harms. The findings of the CAS point to the need for a broad approach that goes beyond individual students and targets the alcohol environment at the college and the surrounding community. Population-based approaches that involve incremental change for all appear to yield the greatest public health benefit (Rose, 1992). It may be more feasible for prevention practitioners in college to incrementally shift the drinking behavior of the majority than to dramatically change the behavior of the heaviest drinker. This involves changing the way alcohol is made available, marketed, and served.

Future prevention efforts need to be directed toward limiting the exposure of college students to aggressive marketing or increasing counter-advertising, reducing the easy accessibility to low-priced alcohol and super-sized quantity sales, and limiting the high density of alcohol outlets (Gorman et al., 2001; Saffer, 2002; Toomey et al., 2007; Toomey and Wagenaar, 2002). College traditions; laws or policies at the college, community, and state levels; and law enforcement need to be re-examined. These strategies represent a promising avenue for prevention of alcohol-related problems (DeJong and Langford, 2002; Holder et al., 2000; Perry et al., 1996; Toomey et al., 2001). Implementing a comprehensive set of strategies will be difficult to achieve, particularly in the face of lobbying efforts by the alcohol industry to defeat or weaken programs and legislation aimed at reducing alcohol-related problems or controlling alcohol supply (Wechsler and Wuethrich, 2002). Efforts to reduce student alcohol misuse may benefit from the combined efforts of a range of people who represent various interests and strong, grassroots organizing (Hingson and Howland, 2002; Wagenaar et al., 2000). When colleges and college communities implement new interventions to reduce excessive alcohol use among students, they should be rigorously evaluated to determine their effectiveness (Toomey et al., 2007).

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