

College Students' Responses to a 5/4 Drinking Question and Maximum Blood Alcohol Concentration Calculated From a Timeline Followback Questionnaire*

BRIAN A. McMILLEN, PH.D.,[†] STEPHANIE M. HILLIS, M.S., AND JANICE M. BROWN, PH.D.[†]

Department of Pharmacology and Toxicology, Brody School of Medicine at East Carolina University, Greenville, North Carolina 27858

ABSTRACT. Objective: Many surveys employed to study college drinking ask whether students have had a five-drink (for men) or four-drink (for women) episode in one sitting at least once during the previous 2 weeks to indicate risky or heavy episodic drinking. However, some researchers have questioned the predictive validity of the 5/4 measure. This study tested whether such students attained extremely high blood alcohol concentrations (BACs) during the previous 30 days. **Method:** Freshmen students were recruited by presentation of short screening surveys in the classroom or outside the student stores. Students who reported a risky drinking episode were invited to enroll in the study and were given a lengthy survey battery that included a computerized 30-day Timeline Followback recall of their drinking. The amount of alcohol consumed was used along with each subject's gender and weight to

calculate an estimated BAC (eBAC) for each event and the maximum eBAC taken for this report. **Results:** Fifty-five percent of the 953 students who completed the screening survey met criterion for enrollment, and 381 students entered the study. The average peak calculated eBAC was 233 mg/dl. Only 9.2% of subjects did not have an eBAC value at or above the threshold for a driving while intoxicated offense, 80 mg/dl. **Conclusions:** Students who report one recent risky drinking episode are very likely to have had at least one heavy drinking episode that generated a BAC in excess of the threshold for driving while intoxicated. Many report extremely high consumption levels. The 5/4 screening question is highly predictive of abusive drinking and can be used to identify students at severe risk for adverse events related to the consumption of alcohol. (*J. Stud. Alcohol Drugs* **70**: 601-605, 2009)

THE IMPACT OF EXCESSIVE CONSUMPTION of alcohol by college students has received increasing attention over the last 10 years. Concerns include the number of deaths attributable to alcohol poisoning or secondary to high blood alcohol concentrations (BACs), alcohol-associated accidents, and alcohol-associated violence that may account for a large number of deaths annually (Hingson et al., 2005). In addition, the impact on academic performance can be significant not only for the drinker but also for others who suffer the consequences of inebriated behaviors, such as disrupted studies or sleep, or the need to care for an intoxicated roommate (Wechsler et al., 1995b). For academic institutions, the economic costs include decreased retention rates (Martinez et al., 2008) and prolonged transit times from matriculation to graduation. The University of North Carolina system of 16 constituent institutions uses a complex funding formula that establishes approximately one full-time faculty position for every 18 undergraduate students. Therefore, for every 18 freshmen who drink their way out of school, the institution has a loss of one full-time faculty position. Thus, the

economic consequences of abusive alcohol consumption are very large for the institution.

Many institutions of higher learning have established a number of programs in attempts to reduce the consumption by their students and the impact of alcohol on their campuses (Larimer and Cronce, 2007; Weitzman et al., 2004). These efforts include parental notification policies, social normalization campaigns, the addition of trained substance abuse counselors, increased enforcement on campuses and in adjoining neighborhoods, stronger relationships with local law enforcement, educational activities (including peer educators), and more (see "A Call to Action," Task Force of the National Advisory Council on Alcohol Abuse and Alcoholism, 2002). More intensive and time consuming, some schools make use of motivational interviewing (Miller, 1996; Miller and Rollnick, 2002) or other methods as interventions for students referred to counseling as a result of alcohol problems (cf. Walters and Neighbors, 2005). Motivational interviewing is a demonstrated, effective intervention method for several different populations, including college students (Borsari and Carey, 2005; McNally et al., 2005; White et al., 2007).

However, many more students than those who were caught drinking may be in need of help, which highlights the need for a way to effectively screen and identify students at risk. Many surveys of students use the criterion of five standard drinks for a man or four for a woman in one sitting as a

Received: June 17, 2008. Revision: February 9, 2009.

*This research was supported by U.S. Public Health Service Commissioned Corps grant RO1AA014374.

[†]Correspondence may be sent to Brian A. McMillen at the above address or via email at: mcmillenb@ecu.edu. Janice M. Brown is with RTI International, Research Triangle Park, NC.

heavy drinking episode (i.e., Core Institute Student Survey, Outside the Classroom Student Health Survey, and others). The basis for this cutoff is that the risk of an adverse event increases rapidly with each drink after four have been consumed (Cahalan et al., 1969; Klatsky and Armstrong, 1993; Wechsler and Austin, 1998; Wechsler et al., 1995a). For an average man, five drinks within two hours will likely put the BAC above 80 mg/dl, the threshold for a driving while intoxicated (DWI) offense in all U.S. states. Although this appears to be useful, some complain that the 5/4 cutoff may not predict true excessive drinking or that, if the five drinks are spread over many hours, the subject will never attain a significant BAC (Wechsler and Nelson, 2006; White et al., 2006). Also, it should be borne in mind that, although five or more drinks may be called a "risky drinking" episode, increased risk can begin after smaller amounts or at a lower BAC. For research purposes, other measures of drinking and consequences may be more useful to understand student attitudes and practices (Read et al., 2008); but, as a quick measure, it may remain useful.

As part of a large, ongoing research study of the factors that influence the response to motivational interviewing, the 5/4 measure is being used to determine whether freshmen students will be recruited into the study as subjects. Once enrolled, all student subjects take a computerized survey battery that includes a Timeline Followback of drinking during the previous 30 days (Sobell et al., 1988). The responses by the students are then used to calculate a maximum BAC for each subject. Thus, it is possible to determine what percentage of students who indicated at least one 5/4 drinking episode during the previous 2 weeks actually attained an estimated BAC (eBAC) equal to or above the threshold for a DWI offense and to test the hypothesis that the 5/4 rule is a useful predictor of excessive alcohol consumption.

Method

Subjects were recruited starting spring semester 2006 through fall semester 2007. A consent form and a brief screening instrument were distributed by trained graduate assistant students to sections of three different courses with high freshmen enrollments (English 1100; Health 1000; and an academic preparation class, COAD 1000). Additional recruiting was done at the start of spring and fall semesters by staffing a table located in the plaza in front of the student stores. An informed consent form was attached to each survey, and the graduate assistant provided information to the students about the short survey and explained that participation is purely voluntary. Participation was restricted to those students who had freshmen status and were younger than age 25. Those students who completed the form and indicated at least one in response to the question "During the past 2 weeks, on how many days did you have 5 or more drinks of beer, wine, or liquor on the same occasion (4 or more if

you are a woman)?" were invited to participate in the study. Recruitment surveys were completed by 953 students; 381 entered the study, 97 declined (10.2%), and 53 were pending (this is an ongoing study).

When the students came to the office for the intake session, they were given a second informed consent document and reminded that they may withdraw at any time. All consent forms, psychological tests, interventions, and other procedures were reviewed and approved by both the RTI International Institutional Review Board (Research Triangle Park, NC) and the University and Medical Center Institutional Review Board for East Carolina University. All subjects took an extensive battery of tests that may take as long as 2 hours to complete. Included in the battery was a computerized Timeline Followback that asked for the students to recall what they had consumed, as well as the brands and volumes consumed, during each of the last 30 days (based on Sobell et al., 1988). They were presented with different size cups and containers on the computer to assist their recollection of volumes (Brown, 2001). Data from the calendar program for types of drinks and volumes were converted into "standard drinks" and the amount, the time consumed, and the subject information for gender and weight were put into a BAC calculator (BACCHUS) that used the equation of Matthews and Miller (1979): $BAC\ estimate = ([standard\ drinks / 2] \times [gender\ constant / weight]) - (0.017 \times hours)$. The gender constant was 9.0 for females and 7.5 for males. The computer program calculated an eBAC for each drinking event described by the subject. The maximum drinking event (or peak eBAC) for each subject was used for this report.

Results

Based on enrollment at this institution, a 60% female:40% male split is representative of the overall population. Experience at this institution with online or mail-back surveys of alcohol and drug use routinely results in oversampling of females. In some of these surveys, females represent up to 70% of respondents. The in-classroom recruiting may have helped reduce this bias. However, to approach an equal number of male and female subjects, an oversampling of male students would be necessary. In harmony with in-classroom surveys conducted in 2004 (59.0%) and 2006 (55.6%) at this institution with the Core Alcohol and Drug Survey long form, 55% of students who completed the recruitment instrument reported at least one heavy drinking episode during the previous 2 weeks.

The percentage of students who had at least one episode of 5/4 drinks on the same occasion was 55%. As Table 1 indicates, there was a greater participation by female students (63.8%) than male students. The overall calculated mean (SD) for peak eBAC was 233 (129) mg/dl, or almost three times the threshold for a DWI offense. There was no statistical difference between male and female students for

TABLE 1. Comparison of male and female freshmen on maximum calculated blood alcohol concentration (BAC) obtained from a 30-day Timeline Followback questionnaire. All subjects had reported at least one episode of five or more drinks (for males) or four or more drinks (for females) on their screening survey instrument.

Measure	Male	Female	Overall
<i>N</i>	138	243	381
Percentage	36.2%	63.8%	100%
BAC, ^a mean (SD)	234 (131)	233 (128)	233 (129)
Percentage < DWI ^b	9.4%	9.1%	9.2%

Notes: BAC = blood alcohol concentration; DWI = driving while intoxicated. ^aPeak estimated BAC; ^bthe percentage of subjects above the threshold 80 mg/dl for a DWI offense.

maximum eBAC ($t = 0.92$, 379 df, $p > .05$). The overall median eBAC was 221 mg/dl. For 113 of these students (29.7%), the eBAC was in excess of 300 mg/dl. Only 9.2%, or 35 students, had a calculated eBAC that was less than the threshold for a DWI offense.

Figure 1 presents the distribution of calculated eBAC values for men and women broken down into multiples of 80 mg/dl. As seen in the figure, a large percentage of students reported drinking at levels that were calculated as likely to produce very high eBAC values. A chi-square analysis did not reveal a significant difference in the two distributions ($\chi^2 = 5.996$, 4 df, $p > .05$).

Discussion

The results from the calculated maximum eBAC attained by each subject during the previous 30 days at the time of

the baseline testing showed that 91% of the subjects had consumed enough alcohol to exceed the threshold for a DWI offense at least once. This is clearly a level that puts the students and their colleagues at risk for an adverse event. A large percentage of students had inordinately high eBAC levels, and this may possibly reflect a problem with the students correctly estimating the volumes consumed. Alternatively, the students may not be able to accurately recall amounts consumed because of the effect of alcohol on memory. How well can a student remember the amount consumed when the BAC climbs past 200 mg/dl, a level known to fragment memory even in chronic alcoholics (Tamerin et al., 1971)? This will need to be examined. Even so, the amount of alcohol consumed would have put them at a very high risk for an adverse event, and several may have been at risk for alcohol poisoning. With so many students consuming such large amounts, the large rates of blackouts and other deleterious events based on surveys are not surprising (Wechsler et al., 1994).

The reverse way to look at these data is that 9.2% of the students were “false positives” based on the 5/4 screening instrument. If the quick screen were applied to all freshmen to identify freshmen at risk and then administer some form of an intervention, a significant number would not be risky drinkers. The cost of providing an intervention to this group would have to be weighed against the costs of not intervening with the larger population (Wechsler and Nelson, 2006). Read and co-workers (2008) have described that student drinking determined from a 90-day Timeline Followback calendar may break into two groups: one that averages less than 5/4 for typical drinking occasions and another that meets a

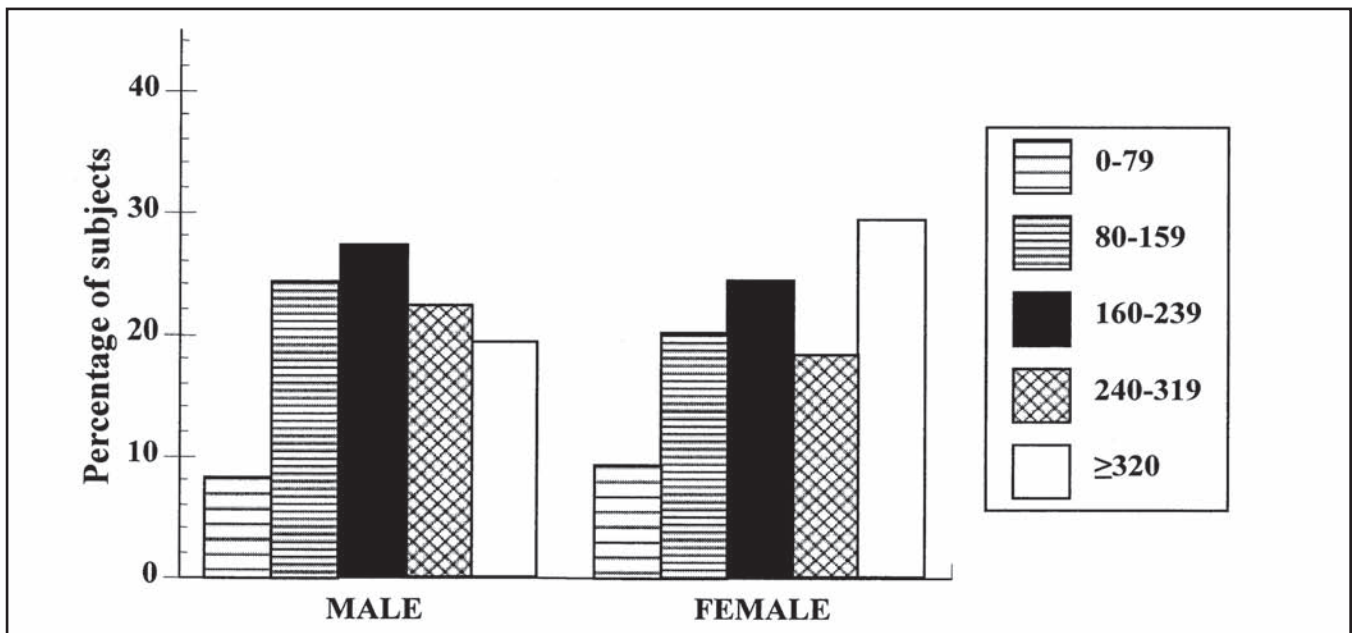


FIGURE 1. Distribution of calculated blood alcohol concentration levels (in mg/dl) for male and female college students. Data are from 138 men and 243 women who completed a 30-day Timeline Followback recall of their drinking.

7/5 criterion (the former tends to stay at a consumption level that is "sociable," and the latter is a high-risk group). Yet, for most freshmen, any alcohol consumption is illegal given the 21-year-old age minimum limit for consuming alcohol. Because most of the students had returned within 30 days of the screening survey in which they had already indicated recent heavy drinking, it is not surprising that none of the students had the legal limit of 0 mg/dl expected of underage students.

A limitation to this study is that it was conducted at a single southeastern comprehensive university with about one third of the undergraduate population living on campus in residence halls and the remainder in a variety of apartments, rental houses, or remaining at home. Each institution has its own characteristics. Repeatedly, both online and in-classroom surveys at this institution produce percentages for drinking, heavy episodic drinking, drug use, and other behaviors that are near national rates. Thus, 55% of students screened met the 5/4 criterion for entry in the study, and 55.8% of 33,379 students who received the Core Alcohol and Drug Survey met this criterion (see Core Institute at www.siu.edu/departments/coreinst/public_html). Although black students represent about 12%-14% of the student population at this institution, very few meet the 5/4 criterion. In this southeastern setting, abstinence rates appear to be very high among the black population of college students (personal observations of author B.A.M. from focus group meetings with students and from surveys) that may not be true for other areas of the country.

In conclusion, the 5/4 drink rule appears to remain a useful tool for a quick determination of the number of students engaged in risky drinking. For about 10% of those deemed positive by this item, their consumption may not produce high-risk levels for BAC, but risk of an adverse event can still be increased by a BAC less than 80 mg/dl (Midanik et al., 1996). Nonetheless, the ability to identify students who are drinking at higher levels is the first step to decreasing the myriad problems associated with heavy episodic drinking in college populations, including DWI, accidents, academic failure, and even death.

Acknowledgments

The authors thank the many graduate assistants who have helped with this project, especially Cheri MacLean and Andrew Lytton, and the Center for Student Counseling and Development at East Carolina University.

References

BORSARI, B. AND CAREY, K.B. Two brief alcohol interventions for mandated college students. *Psychol. Addict. Behav.* **19**: 296-302, 2005.

BROWN, J.M. Assessing alcohol use in college students with three different measures (Abstract). *Alcsm Clin. Exp. Res.* **25** (5 Supplement): 136A, 2001.

CAHALAN, D., CISIN, I.H., AND CROSSLEY, H.M. *American Drinking Practices: A National Study of Drinking Behavior and Attitudes*, Rutgers Center of Alcohol Studies Monograph No. 6, New Brunswick, NJ, 1969.

HINGSON, R., HEEREN, T., WINTER, M., AND WECHSLER, H. Magnitude of alcohol-related mortality and morbidity among U.S. college students ages 18-24: Changes from 1998 to 2001. *Annual Rev. Publ. Hlth* **26**: 259-279, 2005.

KLATSKY, A.L. AND ARMSTRONG, M.A. Alcohol use, other traits, and risk of unnatural death: A prospective study. *Alcsm Clin. Exp. Res.* **17**: 1156-1162, 1993.

LARIMER, M.E. AND CRONCE, J.M. Identification, prevention, and treatment revisited: Individual-focused college drinking prevention strategies 1999-2006. *Addict. Behav.* **32**: 2439-2468, 2007.

M McNALLY, A.M., PALFAI, T.P., AND KAHLER, C.W. Motivational interventions for heavy drinking college students: Examining the role of discrepancy-related psychological processes. *Psychol. Addict. Behav.* **19**: 79-87, 2005.

MARTINEZ, J.A., SHER, K.J., AND WOOD, P.K. Is heavy drinking really associated with attrition from college? The alcohol-attrition paradox. *Psychol. Addict. Behav.* **22**: 450-456, 2008.

MATTHEWS, D.B. AND MILLER, W.R. Estimating blood alcohol concentration: Two computer programs and their applications in therapy and research. *Addict. Behav.* **4**: 55-60, 1979.

MIDANIK, L.T., TAM, T.W., GREENFIELD, T.K., AND CAETANO, R. Risk functions for alcohol-related problems in a 1988 U.S. national sample. *Addiction* **91**: 1427-1437, 1996.

MILLER, W.R. Motivational interviewing: Research, practice, and puzzles. *Addict. Behav.* **21**: 835-842, 1996.

MILLER, W.R. AND ROLLNICK, S. *Motivational Interviewing: Preparing People for Change*, 2nd Edition, New York: Guilford Press, 2002.

READ, J.P., BEATTIE, M., CHAMBERLAIN, R., AND MERRILL, J.E. Beyond the "binge" threshold: Heavy drinking patterns and their association with alcohol involvement indices in college students. *Addict. Behav.* **33**: 225-234, 2008.

SOBELL, L.C., SOBELL, M.B., LEO, G.L., AND CANCELLA, A. Reliability of a timeline method: Assessing normal drinkers' reports of recent drinking a comparative evaluation across several populations. *Brit. J. Addict.* **83**: 393-402, 1988.

TAMERIN, J.S., WEINER, S., POPPEN, R., STEINGLASS, P., AND MENDELSON, J.H. Alcohol and memory: Amnesia and short-term memory function during experimentally induced intoxication. *Amer. J. Psychiat.* **127**: 1659-1664, 1971.

TASK FORCE OF THE NATIONAL ADVISORY COUNCIL ON ALCOHOL ABUSE AND ALCOHOLISM. *A Call to Action: Changing the Culture of Drinking at U.S. Colleges*, NIH Publication No. 02-5010, Bethesda, MD: National Institute on Alcohol Abuse and Alcoholism, 2002, pp. 16-26 (available at www.collegedrinkingprevention.gov/niaacollegematerials/taskforce/taskforce_toc.aspx).

WALTERS, S.T. AND NEIGHBORS, C. Feedback interventions for college alcohol misuse: What, why and for whom? *Addict. Behav.* **30**: 1168-1182, 2005.

WECHSLER, H. AND AUSTIN, S.B. Binge drinking: The five/four measure (correspondence). *J. Stud. Alcohol* **59**: 122-123, 1998.

WECHSLER, H., DAVENPORT, A., DOWDALL, G., MOEYKENS, B., AND CASTILLO S. Health and behavioral consequences of binge drinking in college: A national survey of students at 140 campuses. *JAMA* **272**: 1672-1677, 1994.

WECHSLER, H., DOWDALL, G.W., DAVENPORT, A., AND RIMM, E.B. A gender-specific measure of binge drinking among college students. *Amer. J. Publ. Hlth* **85**: 982-985, 1995a.

WECHSLER, H., MOEYKENS, B., DAVENPORT, A., CASTILLO, S., AND HANSEN, J. The adverse impact of heavy episodic drinkers on other college students. *J. Stud. Alcohol* **56**: 628-634, 1995b.

- WECHSLER, H. AND NELSON, T.F. Relationship between level of consumption and harms in assessing drink cut-points for alcohol research: Commentary on "many college freshmen drink at levels far beyond the binge threshold" by White et al. *Alcsm Clin. Exp. Res.* **30**: 922-927, 2006.
- WEITZMAN, E.R., NELSON, R.F., LEE, H., AND WECHSLER, H. Reducing drinking and related harms in college: Evaluation of the "A Matter of Degree" program. *Amer. J. Prev. Med.* **27**: 187-196, 2004.
- WHITE, A.M., KRAUS, C.L., AND SWARTZWELDER, H.S. Many college freshmen drink at levels far beyond the binge threshold. *Alcsm Clin. Exp. Res.* **30**: 1006-1010, 2006.
- WHITE, H.R., MUN, E.Y., PUGH, L., AND MORGAN, T.J. Long-term effects of brief substance use interventions for mandated college students: Sleeper effects of an in-person personal feedback intervention. *Alcsm Clin. Exp. Res.* **31**: 1380-1391, 2007.