

Screening for High-Risk Drinking in a College Student Health Center: Characterizing Students Based on Quantity, Frequency, and Harms*

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ABSTRACT. Objective: This study examined characteristics of students who presented to a college health center and screened positive for the 5/4 definition of high-risk drinking (five or more drinks in a row for men, or four or more drinks in a row for women, on at least one occasion in the past 2 weeks) and analyzed the students' data according to their reporting of alcohol-related harms. **Method:** Secondary analysis of data obtained for an intervention study to reduce high-risk drinking in college students was used. Data on alcohol use and alcohol-related harms were obtained from Web-based Healthy Lifestyle Questionnaires and 30-day alcohol recall diaries (Timeline Followback calendar). Students ($N = 363$; 52% female) were classified as nonheavy, heavy, and heavy and frequent drinkers, based on their self-reported alcohol use. Alcohol-related harms

were measured using the Rutgers Alcohol Problem Index and eight additional items derived from the Drinker Inventory of Consequences-2L. **Results:** Students in the nonheavy, heavy, and heavy and frequent groups had mean Rutgers Alcohol Problem Index scores of 10, 14, and 23, respectively. The heavy-and-frequent drinking group comprised 20% of the sample but experienced 31% of the total harms. **Conclusions:** The 5/4 screening question accurately identified college students presenting to a college health center who were already experiencing significant alcohol-related harms. The addition of a frequency question (drinking 3 or more days per week) to the 5/4 screening question provided a simple method for identifying those students at highest risk and in greatest need of intervention. (*J. Stud. Alcohol Drugs*, Supplement No. 16, 34-44, 2009)

HEAVY EPISODIC DRINKING by college students is the most serious public health problem on college campuses (Office of Disease Prevention and Health Promotion, Department of Health and Human Services, 2000). Traditionally, heavy episodic drinking is defined as the consumption of five or more drinks in a row for men, or four or more drinks in a row for women, at least once in the past 2 weeks ("5/4 definition"; Wechsler et al., 1994). The National Institute on Alcohol Abuse and Alcoholism (NIAAA) defines heavy episodic (or "binge") drinking as a pattern of drinking that brings the blood alcohol concentration (BAC) to .08 grams percent or above. For the typical 150 pound adult, this corresponds to 5/4 consumption in about 2 hours (Task Force of the National Advisory Council on Alcohol Abuse and Alcoholism, 2002). High-risk drinking is reported by 44% of college students, a number that is essentially

unchanged from earlier studies, despite vigorous attempts at environmental and individual interventions (Wechsler et al., 2002). High-risk drinking is associated with substantial consequences and harms, and is a leading cause of morbidity and mortality among college students. It is estimated that each year more than 500,000 college students ages 18-24 are unintentionally injured while under the influence of alcohol, and approximately 1,700 students die from alcohol-related causes (Araujo and Wong, 2005; Hingson et al., 2005). The proportion of college students reporting driving under the influence increased from 26.5% to 31.4% from 1998 to 2001 (Hingson et al., 2005). Academic consequences of drinking include missed classes, falling behind in schoolwork, and poor grades (Perkins, 2002).

The U.S. Preventive Services Task Force (2006) recommends screening all adolescent and adult patients for problem drinking. The NIAAA (Task Force of the National Advisory Council on Alcohol Abuse and Alcoholism; 2002) recommends incorporating alcohol screening into standard practice at college student health centers. Screening for high-risk drinking in a student health center meets the preventive health standard of screening for a condition that is prevalent, harmful, and treatable (Gordon, 2006). The student health center provides an ideal opportunity to intervene with students who are identified as high-risk drinkers and who are experiencing alcohol-related harms. Without a systematic approach to routine alcohol screening, student health centers must rely on episodic alcohol-history

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information, often obtained after a significant harm has occurred, thereby missing the majority of students in need of identification and intervention. Despite recommendations for routine screenings of high-risk drinking, only 32% of student health centers conduct them, and only 12% use standardized screening instruments (Foote, 2004). There is a crucial need for development and increased use of empirically supported alcohol screening at student health centers (Foote, 2004).

There is limited information on alcohol screening tests specifically used in college populations (Task Force of the National Advisory Council on Alcohol Abuse and Alcoholism, 2002). Alcohol screening instruments such as the CAGE (Ewing, 1984) and the 10-question Alcohol Use Disorders Identification Test (AUDIT; Saunders et al., 1993) have been advocated for routine use in primary health care settings, and their psychometric properties are based on general adult samples. A review of alcohol screening studies in primary care by Fiellin et al. (2000) concluded that the AUDIT was effective for detecting at-risk drinking and the CAGE was effective for detecting alcohol abuse and dependence. Multiple-question screens that require scoring are challenging to implement, and rates of use are low (Seale et al., 2006). Time, cost, and other competing health care priorities are barriers to effective alcohol screening in student health centers (Fleming, 2001), and simpler and more efficient screening instruments are needed. Single question screening has been studied (Taj et al., 1998; Williams and Vinson, 2001), and the NIAAA (Task Force of the National Advisory Council on Alcohol Abuse and Alcoholism; 2002) concludes that single quantity, frequency, and heavy episodic drinking questions are most applicable to detect high-risk drinking by college students.

The 5/4 definition was used in this study, because it meets the NIAAA recommendation for an efficient single-question screen and it has been extensively used in large-scale studies to identify high-risk drinkers (Wechsler et al., 2002). It has a high sensitivity for identifying persons with the potential to experience alcohol-related problems but has low specificity (Seale et al., 2006).

Researchers have advocated for a screening tool with improved specificity to identify college students with the highest prevalence of alcohol-related harms (Presley and Pimentel, 2006). Presley and Pimentel proposed categorizing students by both the amount and frequency of alcohol consumption. They grouped student drinkers into three categories: (1) nonheavy, (2) heavy—having five or more drinks at least once in the past 2 weeks, and (3) heavy and frequent—having five or more drinks at least once in the past 2 weeks *and* drinking 3 or more days per week. They found that heavy and frequent drinkers were three times more likely to experience alcohol-related harms than heavy drinkers and concluded that assessing the frequency of drinking in addition to the five-drink screen improved specificity for identifying those at highest risk for harms (Presley and Pimentel, 2006).

The present study aims to (1) characterize the group of students who present to a student health center and screen positive for the 5/4 definition of high-risk drinking, (2) assess alcohol-related harms in this group, and (3) determine if the classification of students into categories similar to those proposed by Presley and Pimentel (2006) assists in stratifying their risk for experiencing alcohol-related harms. The goal of this article is to assist in identifying the best rapid, routine, student health center screen to detect high-risk drinking and, ultimately, to reduce alcohol-related harms.

Method

Participants

The study was conducted at the university health services of a large public southeastern university. The university health services is a high-volume student health center, with approximately 50,000 total patient visits annually, and approximately half of the student population use the university health services annually. At initial registration to the university health services, students complete an 11-item health history and preventive health screen referred to as the patient-information form.

This study is a secondary analysis of data from a longitudinal randomized controlled trial testing the effectiveness of brief interventions administered by primary care providers at the university health services to a sample of college students who screened positive for the 5/4 definition of high-risk drinking (Schaus et al., 2009—this supplement). All students who sought care at the university health services between November 2005 and November 2006 were considered for inclusion in the study. Students were eligible for inclusion in the study if they answered (1) “yes” to the patient-information form alcohol screening question (“Men, during the past 2 weeks have you had 5 or more drinks containing alcohol [beer, wine, or liquor] in a row on at least one occasion?” or “Women, during the past 2 weeks have you had four or more drinks containing alcohol [beer, wine, or liquor] in a row on at least one occasion?”), and (2) “yes” to the patient-information form research question, “May we contact you to participate in a research study?” Exclusion criteria included an estimated BAC greater than .35 on any single occasion in the past 30 days and consumption of more than 200 drinks in the past 30 days. These exclusion criteria aimed to identify students currently drinking at very extreme levels and at possible imminent risk of a serious alcohol-related harm. These students were referred outside the student health center for immediate intense evaluation and treatment. Other exclusion criteria were pregnancy, plan to leave the university within 12 months (12-month follow-up data collection in the intervention trial), younger than 18 years of age, or current enrollment in an alcohol or other drug treatment program.

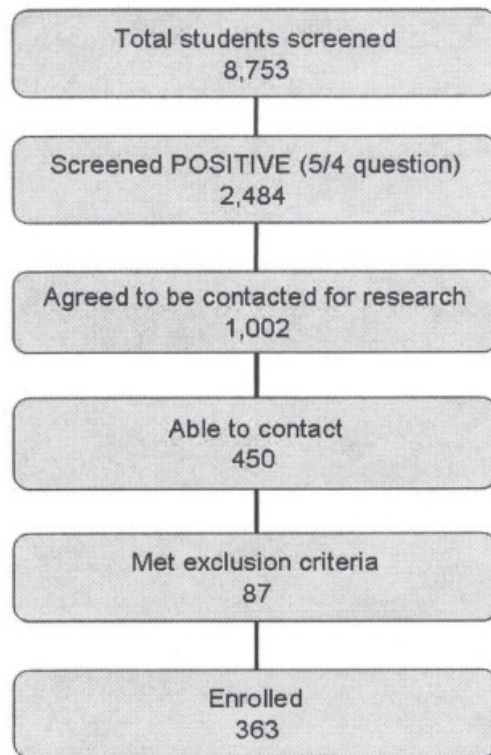


FIGURE 1. Enrollment of students into study

Figure 1 shows the flowchart of enrollment of participants into the study. During the 12-month recruitment period, 8,753 patient-information forms were completed. Using the 5/4 screening question, 28% of students screened positive for high-risk drinking ($n = 2,484$). Of students who screened positive, 40% agreed to be contacted to inquire about participation in a research project ($n = 1,002$). Study personnel attempted to contact these students via telephone and email to invite them to participate in a “Healthy Lifestyle Study” and successfully contacted 450 eligible students. Of those contacted, 87 students met exclusion criteria (including 6 who met exclusion criteria requiring immediate referral for intervention), resulting in the final sample ($n = 363$). A \$30 incentive was offered for completing the baseline data, and \$70 additional compensation was offered for completing follow-up activities over a 12-month period.

Measures

Several instruments were used to obtain baseline data. The majority of data were collected via a Web-based survey tool.

Healthy Lifestyle Questionnaire. Baseline data were collected using a 280-question, Web-based, healthy lifestyle survey. The Healthy Lifestyle Questionnaire contained 55 questions related to alcohol consumption behaviors, harms, and protective factors. The remaining items asked for in-

formation related to demographic characteristics, healthy behaviors, alcohol expectancies, tobacco and drug use, and readiness-to-change behaviors.

Rutgers Alcohol Problem Index (RAPI). The RAPI (White and Labouvie, 1989) is a frequently used measure of alcohol-related consequences in adolescents and college students. It contains 23 items identifying the frequency at which certain harms occur as they relate to alcohol consumption. All RAPI items were imbedded into the Healthy Lifestyle Questionnaire. Participants were asked to identify the number of times an event occurred in the past year versus checking a category, thereby providing an opportunity to analyze harms with greater precision. Counts were grouped into five response categories (0: 0 times, 1: 1-2 times, 2: 3-5 times, 3: 6-10 times, and 4: more than 10 times), and a RAPI sum score was computed (range: 0-61; Cronbach’s $\alpha = .89$).

Other harms. Study participants were asked eight additional items related to harms that were derived from the Drinker Inventory of Consequences-2L (DrInC-2L; Miller et al., 1995). These items included driving under the influence of alcohol, riding with someone under the influence, risk taking, regrets, legal consequences, and physical injury. Study participants reported the frequency of these harms in the past year.

Timeline Followback (TLFB) drinking measure. The TLFB procedure was used to establish an alcohol consumption pattern for the 30-day period preceding the intervention. Participants were instructed on the definition of a *standard drink* (Task Force of the National Advisory Council on Alcohol Abuse and Alcoholism, 2002) and recorded their drinking on an electronic calendar with self-identified historical reference points to enhance recall. This method has well-established psychometric properties and allows for the collection of reliable drinking data over a specified period (Sobell and Sobell, 1992). From the TLFB data, typical and peak estimated BAC levels were calculated for each participant using the following equation: $BAC = [(number\ of\ drinks / 2) \times (GC / weight\ in\ lb)] - (.016 \times hours\ of\ drinking)$, where GC is a gender constant: 9.0 for women and 7.5 for men (Turner et al., 2004).

Procedures

The university institutional review board approved the study. Each prospective participant met with the project coordinator upon enrollment to review and sign the informed consent form, receive random assignment to either the treatment or control condition (for the experimental intervention component of the study), and complete baseline measurements. Participants were instructed how to complete the Web-based tools and the 30-day alcohol recall diary. Participants completed the instruments at a private office in the university health services and took approximately 30 minutes to complete the baseline assessment tools.

Data analysis

Data were entered into SPSS Version 15.0 (SPSS Inc., Chicago, IL) and were analyzed using SPSS and SAS Version 9.1.3 (SAS Institute, Cary, NC). Frequencies and percentages were computed for categorical data, and descriptive statistics were computed for continuous data. Difference tests between groups were analyzed with analysis of variance (ANOVA) (using SPSS Version 15.0; SPSS Inc., Chicago, IL). Because the harms data showed evidence of skewness and nonnormality, rank ANOVA was performed for these data. The level of significance was set at .05 (two tailed) for all analyses and was adjusted (Bonferroni correction) for multiple comparisons of the harms data (.002 significance level for RAPI items and .006 for DrInC-2L items). Post hoc analyses were conducted for equal (least significant difference, LSD) and unequal (Tamhane) variances as relevant to the variable. Categorical data were analyzed with chi-square tests.

Results

Characteristics of students positive for 5/4 screen

Table 1 provides data regarding the participants' demographic characteristics; history of drinking, tobacco use, and marijuana use; and current drinking behaviors.

Demographic data. Participants ranged from 18 to 36 years of age (mean = 20.6; median = 20), and more than half (58%) were 18-20 years of age; 52% were female; and 78% identified themselves as white. All levels of education, including graduate students, were represented in the sample. The percentage of freshmen, sophomore, and junior students in the study was higher than the overall university academic class data, whereas the percentage of seniors and graduate students was less than the overall data ($\chi^2 = 78.9$, 4 df, $p = .000$). Most students (79%) lived in off-campus housing, and only 3% lived in fraternity or sorority housing.

History of drinking. The average age of first drink for study participants was 15.8 years. In addition, these participants met the 5/4 definition for high-risk drinking an average of 3 days per month during their last year of high school.

Tobacco and marijuana history. Seventy-nine percent of study participants smoked tobacco and 79% smoked marijuana at least once in their lifetime. Thirteen percent rated themselves as daily tobacco smokers, and 55% reported smoking marijuana at least once in the past 30 days.

Drinking behaviors. On average, study participants met the 5/4 screen for high-risk drinking 5.2 days per month. The average estimated typical BAC was .08, with an average peak BAC of .15. The average response to the question, "In a typical week, how many days do you get drunk?" (O'Brien et al., 2006) was 1.1 (1.2) (range: 0-5) days per week. Seventy-six percent of participants responded affirmatively to the question, "Do you participate in drinking games?"

TABLE 1. Demographic and drinking behavior characteristics of students classified as high-risk drinkers by the initial 5/4 screening ($n = 363$)

Variable	<i>n</i> (%)	University overall, ^a %
Gender		
Male	174 (47.9)	44.9
Female	189 (52.1)	55.1
Educational level		
Freshman	95 (26.2)	17.4
Sophomore	76 (20.9)	13.9
Junior	103 (28.4)	21.8
Senior	62 (17.1)	31.7
Graduate/postbaccalaureate	27 (7.4)	15.1
Ethnicity		
White	281 (77.8)	70.7
Hispanic	41 (11.4)	12.0
Black	17 (4.7)	8.4
Asian	8 (2.2)	5.0
Other	14 (3.9)	3.6
Participate in drinking games, yes	276 (76.0)	
Ever smoked tobacco, yes	286 (79.0)	
Ever used marijuana, yes	285 (78.9)	
	Mean (SD)	Range
Age, years	20.6 (2.7)	18-36
Cumulative GPA, self-report	3.2 (0.5)	0.9-4.0
Age first used alcohol, years	15.8 (2.1)	8-30
Days met 5/4 criteria in a typical 30-day period during last year in high school	3.3 (4.2)	0-30
Drinking measures from TLFB calendar		
No. days met 5/4 in past 30 days	5.2 (4.7)	0-26.0
No. days drinking in past 30 days	8.6 (5.6)	0-29.0
Avg. no. days/week drinking	1.7 (1.1)	0-5.8
Avg. no. drinks/sitting	4.8 (2.3)	0-15.0
Avg. no. drinks/week	9.0 (7.9)	0-39.8
Typical BAC ^b	.08 (.05)	0-.24
Peak BAC ^b	.15 (.08)	0-.35

Notes: GPA = grade-point average; TLFB = Timeline Followback; BAC = blood alcohol concentration. ^aUniversity population figures from University Current Facts Institutional Research office, 2006; ^bBAC = estimated BAC g/percent.

Drinking-related harms and consequences

Harms data are shown in Table 2. The RAPI 23 sum score ranged from 0 to 61, the mean (SD) was 15.1 (12.9), and the median was 12.

Classification of drinkers on amount and frequency. Based on the TLFB data, participants were categorized into one of three relative risk groups using criteria adapted from Presley and Pimentel (2006): nonheavy, heavy, and heavy and frequent. Our category method differed from Presley and Pimentel, as our method was gender specific to correlate with the 5/4 gender-specific screening question. Participants were classified as heavy drinkers if male participants reported drinking five or more drinks in a row in the past 2 weeks or if female participants reported drinking four or more drinks in a row in the past 2 weeks. Those participants in the heavy group who also reported an average frequency of drinking 3 or more days per week were classified as heavy and frequent drinkers. Nineteen percent of respondents were classified as

TABLE 2. Rutgers Alcohol Problem Index (RAPI) 23 and other harms data

	<i>n</i>	Minimum	Maximum	Mean (SD)	Median
RAPI 23 sum score	363	0	61	15.1 (12.9)	12
RAPI items					
Not able to do homework or study for a test	361	0	57	3.2 (6.0)	1
Got into fights, acted badly, or did mean things	361	0	30	2.0 (3.5)	0
Missed out on other things because spent too much money on alcohol	362	0	100	2.2 (7.1)	0
Went to work or school high or drunk	360	0	300	6.2 (29.3)	0
Caused shame or embarrassment to someone	362	0	20	1.4 (2.9)	0
Neglected responsibilities	356	0	60	5.2 (8.9)	2
Relatives avoided you	362	0	15	0.2 (1.3)	0
Felt that needed more alcohol to get the same effect	357	0	100	3.0 (7.7)	0
Tried to control drinking by trying to drink only at certain times of day or places	344	0	365	4.8 (22.0)	0
Had withdrawal symptoms; felt sick because stopped or cut down on drinking	362	0	25	0.4 (2.2)	0
Noticed a change in personality	351	0	115	3.6 (9.3)	0
Felt had a problem with alcohol	360	0	365	4.6 (33.8)	0
Missed a day (or part of a day) of school or work	360	0	40	3.0 (5.4)	0
Tried to cut down or quit drinking	354	0	70	1.6 (4.9)	0
Suddenly found self in a place could not remember getting to	361	0	30	1.8 (3.7)	0
Passed out or fainted suddenly	362	0	13	0.7 (1.7)	0
Had a fight, argument or bad feelings with a friend	361	0	200	2.4 (11.1)	1
Had a fight, argument or bad feelings with a family member	362	0	150	0.9 (8.1)	0
Kept drinking when you promised yourself not to	360	0	50	1.4 (4.5)	0
Felt you were going crazy	359	0	365	2.1 (19.9)	0
Had a bad time	360	0	30	3.1 (5.1)	1
Felt physically or psychologically dependent on alcohol	361	0	365	1.8 (19.9)	0
Was told by a friend or neighbor to stop or cut down drinking	359	0	50	0.9 (3.6)	0
Other harms					
I have driven a motor vehicle after having three or more drinks.	351	0	100	6.3 (13.9)	1
I have ridden in a motor vehicle with someone I knew had three or more drinks.	350	0	100	7.1 (12.3)	3
I have taken foolish risks when I have been drinking.	352	0	100	6.0 (11.0)	2
When drinking, I have done impulsive things that I regretted later.	355	0	100	4.3 (8.4)	2
I have been arrested for driving under the influence of alcohol.	362	0	1	0.0 (0.1)	0
I have been in trouble with the law (other than driving while intoxicated) because of my drinking.	362	0	4	0.1 (0.4)	0
While drinking or intoxicated, I have been physically hurt, injured or burned.	359	0	25	1.2 (3.0)	0
While drinking or intoxicated, I have injured someone else.	362	0	8	0.3 (0.9)	0

nonheavy, 61% heavy, and 20% heavy and frequent. Results from analyses comparing harms among the categories are shown in Table 3.

Harms. Respondents in the nonheavy group experienced 12% of harms. Heavy drinkers reported 57% of harms, and those in the heavy and frequent group experienced 31% of harms.

Table 4 summarizes the analyses (rank ANOVA) for the RAPI 23 sum score and the individual items. A significant difference in the mean number of harms on the RAPI 23 sum score was found among those students classified as nonheavy drinkers (mean = 10 harms), heavy drinkers (mean = 14 harms), and heavy and frequent drinkers (mean = 23 harms) ($F = 21.26, 2/361$ df, $p < .001$). Data are also depicted in

TABLE 3. Drinking outcomes by classification ($n = 363$)

Variable	Classification	N	Mean (SD)	95% CI for mean	
				Low	High
Typical BAC $F = 17.13, 2/358$ df, $p = .000^a$	Nonheavy	66	.05 (.04)	.04	.06
	Heavy	222	.08 (.05)	.08	.09
	Heavy and frequent	73	.09 (.05)	.08	.10
Peak BAC $F = 38.16, 2/358$ df, $p = .0001^b$	Nonheavy	66	.09 (.07)	.07	.10
	Heavy	222	.15 (.08)	.14	.16
	Heavy and frequent	73	.20 (.08)	.18	.22
Mean no. drinks/sitting $F = 31.02, 2/358$ df, $p = .000^a$	Nonheavy	66	3.00 (1.79)	2.56	3.44
	Heavy	222	5.03 (2.23)	4.74	5.33
	Heavy and frequent	73	5.70 (2.14)	5.20	6.20
No. days drinking $F = 294.21, 2/358$ df, $p = .000^c$	Nonheavy	66	4.59 (4.03)	3.60	5.58
	Heavy	222	6.98 (2.78)	6.61	7.35
	Heavy and frequent	73	17.23 (4.64)	16.15	18.31
No. days met 5/4 $F = 198.03, 2/358$ df, $p = .000^b$	Nonheavy	66	1.06 (1.24)	0.76	1.37
	Heavy	222	4.39 (2.82)	4.01	4.76
	Heavy and frequent	73	11.58 (5.25)	10.35	12.80
Peak no. drinks/sitting $F = 49.04, 2/358$ df, $p = .000^b$	Nonheavy	66	4.64 (2.70)	3.98	5.31
	Heavy	222	8.64 (4.09)	8.10	9.18
	Heavy and frequent	73	11.14 (4.19)	10.16	12.11
Mean no. drinks/week $F = 179.88, 2/358$ df, $p = .000^b$	Nonheavy	66	2.60 (2.11)	2.08	3.12
	Heavy	222	7.45 (5.11)	6.78	8.13
	Heavy and frequent	73	19.45 (8.42)	17.48	21.41
Met 5/4 criteria past 30 days (HLQ) $F = 143.72, 2/359$ df, $p = .000^b$	Nonheavy	67	0.61 (0.49)	0.49	0.73
	Heavy	222	5.47 (3.45)	5.02	5.93
	Heavy and frequent	73	10.73 (5.06)	9.55	11.91
Most no. drinks in a row past 30 days (HLQ) $F = 52.71, 2/360$ df, $p = .000^b$	Nonheavy	68	4.18 (2.57)	3.55	4.80
	Heavy	222	7.97 (3.65)	7.49	8.46
	Heavy and frequent	73	11.00 (5.56)	9.70	12.30
Hours drank most no. (HLQ) $F = 15.72, 2/360$ df, $p = .000^b$	Nonheavy	68	3.24 (2.97)	2.52	3.95
	Heavy	222	4.23 (1.83)	3.98	4.47
	Heavy and frequent	73	5.33 (2.48)	4.75	5.91
Days drunk in a typical week (HLQ) $F = 57.45, 2/360$ df, $p = .000^b$	Nonheavy	68	0.26 (0.66)	0.10	0.42
	Heavy	222	1.07 (1.00)	0.94	1.20
	Heavy and frequent	73	2.10 (1.31)	1.79	2.40
Readiness-to-change (HLQ) $F = 0.25, 2/360$ df, $p = .783$	Nonheavy	68	5.28 (3.53)	4.42	6.13
	Heavy	222	5.00 (2.84)	4.63	5.38
	Heavy and frequent	73	5.15 (2.76)	4.51	5.80

Notes: CI = confidence interval; BAC = blood alcohol concentration; HLQ = Healthy Lifestyle self-report questionnaire. ^aNon-heavy significantly different from heavy, and heavy and frequent; ^ball groups significantly different from each other; ^cnonheavy and heavy significantly different from heavy and frequent.

Figure 2. Post hoc analysis found that the means for each group were statistically different from each other. Statistically significant differences were noted among groups for 17 of the 23 individual RAPI harms.

Other alcohol-related harms from the DrInC-2L are noted in Table 5. Significant differences were noted among the classification of drinkers on five of these eight harms, including driving under the influence, riding with someone who is under the influence, taking foolish risks, doing impulsive things, and being injured while intoxicated.

Discussion

This study found that college students screened with the 5/4 screen have a broad range of drinking behaviors and

associated harms. Upon study enrollment, 19% of students initially positive for the 5/4 screen were categorized as nonheavy, demonstrating that the 5/4 screen lacks some specificity. Measuring alcohol consumption is a dynamic process, and patterns of drinking by college students constantly change throughout the academic year. The initial 5/4 screen detects high-risk behavior during a specific 2-week interval, and re-assessing drinking behavior by the TLFB at a later time may indicate a drinking pattern less than the 5/4 definition.

There is a direct dose-response relationship between higher levels of drinking and many alcohol-related harms (Wechsler et al., 2000). Further categorizing students by the frequency of alcohol consumption (drinking 3 or more days per week) enhanced the recognition of those at highest risk

TABLE 4. Harms from the 23-item Rutgers Alcohol Problem Index (RAPI),* by classification

Variable	Classification	N	Mean (SD)	95% CI mean	
				Low	High
RAPI 23 sum score $F^{\dagger} = 21.26, 2/360$ df, $p < .001^{*a}$	Nonheavy	68	10.01 (12.28)	7.04	12.99
	Heavy	222	14.06 (11.23)	12.57	15.54
	Heavy and frequent	73	22.86 (15.00)	19.36	26.36
Not able to do homework/ study for test $F = 15.48, 2/358$ df, $p < .001^{*a}$	Nonheavy	68	1.22 (2.47)	0.62	1.82
	Heavy	222	3.01 (5.96)	2.23	3.80
	Heavy and frequent	71	5.83 (7.54)	4.05	7.61
Got into fights, acted badly, or did mean things $F = 11.76, 2/358$ df, $p < .001^{*a}$	Nonheavy	68	1.19 (3.27)	0.40	1.98
	Heavy	221	2.00 (3.48)	1.53	2.46
	Heavy and frequent	72	2.86 (3.58)	2.02	3.70
Missed out on things because spent money on alcohol $F = 11.44, 2/359$ df, $p < .001^{*b}$	Nonheavy	68	0.90 (3.02)	0.17	1.63
	Heavy	221	1.63 (3.79)	1.13	2.13
	Heavy and frequent	73	5.32 (13.68)	2.12	8.51
Went to work or school high or drunk $F = 9.21, 2/357$ df, $p < .001^{*a}$	Nonheavy	68	4.15 (22.76)	-1.36	9.66
	Heavy	220	5.91 (29.92)	1.94	9.89
	Heavy and frequent	72	9.06 (32.91)	1.32	16.79
Caused shame or embarrassment to someone $F = 7.48, 2/359$ df, $p = .001^{*a}$	Nonheavy	68	0.62 (1.52)	0.25	0.98
	Heavy	221	1.38 (2.98)	0.98	1.78
	Heavy and frequent	73	2.00 (3.40)	1.21	2.79
Neglected responsibilities $F = 12.34, 2/353$ df, $p < .001^{*a}$	Nonheavy	68	2.85 (7.07)	1.14	4.56
	Heavy	218	4.78 (7.93)	3.72	5.84
	Heavy and frequent	70	8.67 (11.97)	5.82	11.53
Relatives avoided you $F = 1.26, 2/359$ df, $p = .29$	Nonheavy	68	0.29 (1.58)	-0.09	0.68
	Heavy	222	0.14 (1.23)	-0.02	0.30
	Heavy and frequent	72	0.17 (1.20)	-0.11	0.45
Needed more alcohol to get the same effect $F = 7.69, 2/354$ df, $p = .001^{*a}$	Nonheavy	68	1.69 (6.57)	0.10	3.28
	Heavy	220	3.11 (8.59)	1.97	4.26
	Heavy and frequent	69	4.04 (5.19)	2.80	5.29
Control drinking by drink only at certain times of day or places $F = 3.98, 2/341$ df, $p = .020$	Nonheavy	66	2.30 (8.21)	0.29	4.32
	Heavy	210	5.30 (26.91)	1.63	8.96
	Heavy and frequent	68	5.85 (12.42)	2.85	8.86
Had withdrawal symptoms $F = 7.32, 2/359$, $p = .001^{*c}$	Nonheavy	68	0.35 (1.45)	0.00	0.70
	Heavy	222	0.13 (0.67)	0.04	0.21
	Heavy and frequent	72	1.17 (4.51)	0.11	2.23
Noticed a change in personality $F = 2.84, 2/348$ df, $p = .060$	Nonheavy	68	2.69 (5.17)	1.44	3.94
	Heavy	214	3.07 (7.24)	2.09	4.05
	Heavy and frequent	69	6.22 (15.64)	2.46	9.97
Felt had a problem with alcohol $F = 5.13, 2/357$ df, $p = .006$	Nonheavy	68	5.84 (44.24)	-4.87	16.55
	Heavy	222	2.57 (24.64)	-0.69	5.83
	Heavy and frequent	70	10.03 (45.27)	-0.77	20.82
Missed a day of school or work $F = 12.99, 2/357$ df, $p < .001^{*b}$	Nonheavy	68	1.01 (2.92)	0.31	1.72
	Heavy	222	3.13 (5.84)	2.36	3.90
	Heavy and frequent	70	4.73 (5.40)	3.44	6.02
Tried to cut down or quit drinking $F = 6.26, 2/351$ df, $p = .002$	Nonheavy	67	0.81 (2.80)	0.12	1.49
	Heavy	217	1.01 (2.40)	0.69	1.33
	Heavy and frequent	70	4.29 (9.28)	2.07	6.50
Found self in a place could not remember getting to $F = 9.11, 2/358$ df, $p < .001^{*b}$	Nonheavy	68	0.71 (2.11)	0.20	1.22
	Heavy	222	2.05 (4.32)	1.47	2.62
	Heavy and frequent	71	1.94 (2.67)	1.31	2.57
Passed out or fainted suddenly $F = 0.30, 2/359$ df, $p = .74$	Nonheavy	68	0.51 (1.22)	0.22	0.81
	Heavy	222	0.72 (1.64)	0.50	0.94
	Heavy and frequent	72	0.85 (2.01)	0.37	1.32

Continued

TABLE 4. (Continued)

Variable	Classification	N	Mean (SD)	95% CI mean	
				Low	High
Fight/argument/bad feelings with a friend <i>F</i> = 9.23, 2/358 df, <i>p</i> < .001* ^a	Nonheavy	68	0.85 (1.81)	0.41	1.29
	Heavy	222	2.93 (14.00)	1.08	4.78
	Heavy and frequent	71	2.41 (2.87)	1.73	3.09
Fight/argument/bad feelings with a family member <i>F</i> = 1.35, 2/359 df, <i>p</i> = .26	Nonheavy	68	0.25 (1.24)	-0.05	0.55
	Heavy	222	1.09 (10.23)	-0.26	2.45
	Heavy and frequent	72	0.79 (2.59)	0.18	1.40
Kept drinking when you promised yourself not to <i>F</i> = 1.36, 2/357 df, <i>p</i> = .26	Nonheavy	68	1.04 (2.52)	0.43	1.65
	Heavy	221	0.96 (2.84)	0.58	1.34
	Heavy and frequent	71	3.35 (8.11)	1.43	5.27
Felt you were going crazy <i>F</i> = 5.71, 2/356 df, <i>p</i> = .004	Nonheavy	68	0.99 (2.74)	0.32	1.65
	Heavy	222	2.66 (25.15)	-0.66	5.99
	Heavy and frequent	69	1.36 (3.15)	0.61	2.12
Had a bad time <i>F</i> = 10.41, 2/357 df, <i>p</i> < .001* ^a	Nonheavy	68	1.62 (3.88)	0.68	2.56
	Heavy	222	2.84 (4.29)	2.28	3.41
	Heavy and frequent	70	5.46 (7.31)	3.71	7.20
Felt physically or psychologically dependent on alcohol <i>F</i> = 2.23, 2/358 df, <i>p</i> = .11	Nonheavy	68	5.79 (44.28)	-4.92	16.51
	Heavy	222	0.30 (1.78)	0.06	0.53
	Heavy and frequent	71	2.68 (10.92)	0.09	5.26
Was told by a friend or neighbor to stop/cut down drinking <i>F</i> = 5.20, 2/356 df, <i>p</i> = .006	Nonheavy	68	0.74 (2.71)	0.08	1.39
	Heavy	222	0.65 (2.34)	0.34	0.96
	Heavy and frequent	69	1.77 (6.45)	0.22	3.32

Notes: CI = confidence interval. *Bonferroni correction; statistical significance = .002; †all *F* test statistics are from rank analysis of variance (ANOVA) except for the RAPI 23 sum scale score (ANOVA *F*). ^aAll groups significantly different from each other; ^bnonheavy and heavy significantly different from heavy and frequent; ^cheavy significantly different from heavy and frequent.

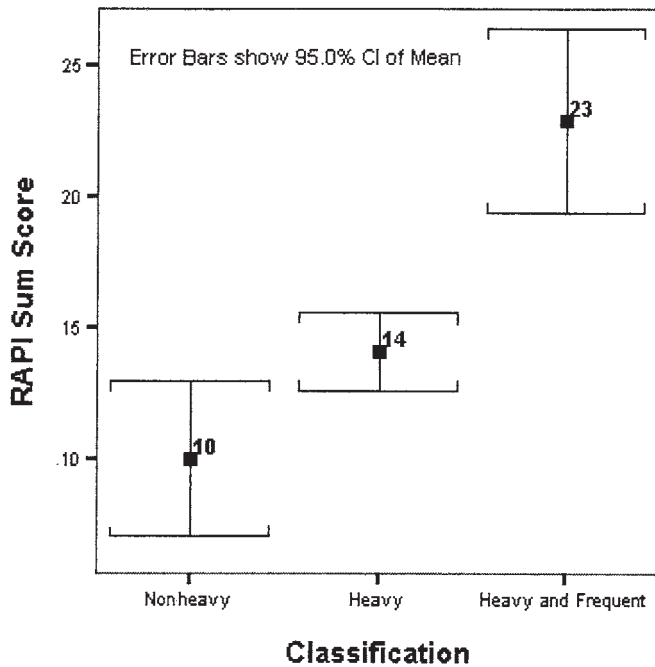


FIGURE 2. Harms, by drinking classification; CI = confidence interval; RAPI = Rutgers Alcohol Problem Index

for alcohol-related harms. Like Presley and Pimentel (2006), the current study found a direct relationship between various consumption measures and the occurrence of alcohol-related harms. The heavy and frequent drinking group comprised 20% of the sample but experienced 31% of the harms. Most of the students were in the heavy group (61%), where the majority of the total harms occur (57%), although their individual level of harm was lower than those in the heavy and frequent group. From a public health perspective, it is important to target interventions to those with the greatest burden of disease, much of which would be missed if interventions were limited only to the highest risk heavy and frequent group. Identifying those in the heavy and frequent group is important (1) if a resource-limited intervention program confines the potential treatment group and (2) to target more accurately those students who may benefit from a more intense intervention or referral.

The number of students (28%) who screened positive for the 5/4 screen at the university health services was lower than that reported in the overall university population (35% in University CORE 2006 data, and 40%-44% in national studies; Wechsler et al., 2002). Students who present to the university health services are primarily female (67%), and more men than women answered affirmatively to the 5/4

TABLE 5. Other harms, by classification

Variable	Classification	N	Mean (SD)	95% CI mean	
				Low	High
Driven a vehicle after having ≥ 3 drinks $F^\dagger = 19.19, 2/348$ df, $p < .001^{*a}$	Nonheavy	67	1.46 (4.02)	0.48	2.44
	Heavy	217	6.30 (13.21)	4.53	8.07
	Heavy and frequent	67	10.90 (19.66)	6.10	15.69
Ridden in a vehicle with someone I knew had ≥ 3 drinks $F = 23.85, 2/347$ df, $p < .001^{*a}$	Nonheavy	67	1.84 (3.57)	0.96	2.71
	Heavy	217	7.18 (11.94)	5.58	8.77
	Heavy and frequent	66	11.97 (16.71)	7.86	16.08
Taken foolish risks when drinking $F = 19.84, 2/349$ df, $p < .001^{*a}$	Nonheavy	67	2.07 (6.43)	0.51	3.64
	Heavy	218	6.36 (11.59)	4.82	7.91
	Heavy and frequent	67	8.79 (11.63)	5.95	11.63
When drinking, done impulsive things regretted later $F = 15.73, 2/352$ df, $p < .001^{*a}$	Nonheavy	67	1.88 (4.72)	0.73	3.03
	Heavy	221	4.39 (8.91)	3.21	5.57
	Heavy and frequent	67	6.24 (9.03)	4.04	8.44
Arrested for driving under the influence of alcohol $F = 4.42, 2/359$ df, $p = .013$	Nonheavy	68	0.00 (0.00)	0.00	0.00
	Heavy	222	0.00 (0.00)	0.00	0.00
	Heavy and frequent	72	0.03 (0.17)	-0.01	0.07
Trouble with the law because of drinking $F = 2.98, 2/359$ df, $p = .052$	Nonheavy	68	0.00 (0.00)	0.00	0.00
	Heavy	222	0.07 (0.29)	0.03	0.11
	Heavy and frequent	72	0.24 (0.74)	0.06	0.41
While drinking, I have been physically hurt, injured or burned $F = 12.39, 2/356$ df, $p = .001^{*b}$	Nonheavy	67	0.18 (0.55)	0.05	0.31
	Heavy	221	1.32 (3.16)	0.90	1.74
	Heavy and frequent	71	1.70 (3.47)	0.88	2.52
While drinking, I have injured someone else $F = 2.93, 2/359$ df, $p = .055$	Nonheavy	67	0.06 (0.30)	-0.01	0.13
	Heavy	222	0.31 (1.01)	0.18	0.44
	Heavy and frequent	73	0.38 (1.10)	0.13	0.64

Notes: CI = confidence interval. *Bonferroni correction; statistical significance = .006; † all F test statistics are from rank analysis of variance (ANOVA). a All groups significantly different from each other; b nonheavy significantly different from heavy, and heavy and frequent.

screen, resulting in approximately equal gender representation in the study (52% female). The relatively lower 5/4 prevalence at the university health services could be related to these gender differences.

In comparison with overall university data (Table 1), more freshmen, sophomores, and juniors were represented in the sample, and fewer seniors and graduate students were enrolled in the study. A primary reason for this difference is that inclusion criteria specified that students had to plan to be enrolled at the university for 1 year, thereby excluding many senior and graduate students. Also, graduate students may seek health care from private physicians because many have full-time jobs and attend the university part-time. However, these data show that the 5/4 screen identified students of various ages and education levels. Study participants were predominately white, and the number of minority students in the study (22%) was less than the overall university enrollment (30%). These data reflect the typical lower rate of high-risk drinking among minority groups (Wechsler et al., 2002).

Both the mean and median age of the sample were below the legal drinking age of 21 years. A contributing factor to this young age may have been the exclusion of those who planned to leave the university within the next year. The data show that many high-risk drinking students had an early onset of drinking (mean = 15.8 years) and continue to drink heavily when they enter college. Students engaging in high-risk drinking in high school are more likely to experience alcohol-related problems in college (Hingson et al., 2003), supporting recommendations for targeting intervention efforts to freshman students (Sher and Rutledge, 2007; Valliant and Scanlan, 1996).

College students often participate in episodic heavy drinking associated with various events throughout the academic year, leading to wide fluctuations in drinking patterns and discrepancies between single point-in-time drinking assessments. On average, our study participants met the legal definition of intoxication when they drank (mean typical BAC = .08). Participant drinking behavior was often extreme (mean peak BAC = .15, almost double the legal limit). One possible

reason for the high typical and peak BAC levels may be the reported high participation rate in drinking games (76%). Drinking games have increased in popularity, with intoxication a common goal of participation (Borsari, 2004; Borsari et al., 2003; Engs, 1993). Asking students whether they participate in drinking games should be part of a comprehensive alcohol evaluation.

Our findings confirmed the previously observed dose-response relationship between current high-risk drinking and lifetime use of cigarettes, marijuana, and other drugs (Jones et al., 2001). Participants reported using both tobacco and marijuana at levels approximately twice as high as the national average (American College Health Association, 2008). Screening students for high-risk drinking identifies those with high participation rates in other unhealthy behaviors, such as tobacco and marijuana use, which is important when planning a multifaceted prevention program designed to target other high-risk behaviors in addition to heavy episodic drinking.

Several limitations of this study were identified. Data were collected from one college campus, which may limit the generalizability of findings to other campuses. Data were collected based on self-report and recall. The 5/4 screen may be misinterpreted by students who do not understand the context of “drinks in a row” or “at least once in the past two weeks.” We did not define *standard drink* (Task Force of the National Advisory Council on Alcohol Abuse and Alcoholism, 2002) with the 5/4 screening question on the patient information form but did define it for study participants at enrollment, which could contribute to some discrepancy between the initial screening question and subsequent alcohol consumption data.

Another limitation concerns the issue of possible participation bias; students who did not participate (because they declined to participate, could not be contacted, or met exclusion criteria) may have different alcohol-use patterns and related harms compared with the study participants. The initial patient-information form question regarding agreement to participate in research was required by the university institutional review board. Only those initially responding “yes” to both the 5/4 screen and the research participation question were eligible to be contacted about possible study participation (1,002). Of those eligible to be contacted, the successful contact rate was 45% (450/1,002). After applying exclusion criteria to those contacted, the participation rate was 81% (363/450). This study involved the secondary analysis of baseline data collected as part of another longitudinal randomized control trial to test the effectiveness of brief interventions delivered in a student health center to a sample of college students screened for high-risk drinking and was, therefore, not designed to collect and analyze data on nonparticipants. Further research on screening instruments in a student health center should address this

limitation and attempt to characterize the demographic and alcohol-use behavior of all students screened.

The student health center is a unique but underused venue to perform routine alcohol screening and to identify students participating in high-risk drinking and at risk of experiencing alcohol-related harms. This study provides a better understanding of the target population presenting to the student health center and suggests that the 5/4 screen identifies high-risk drinkers quickly, efficiently, and accurately. The addition of the “3 or more days per week” frequency of drinking question achieves increased specificity and the ability to identify the group of students at highest risk and in greatest need of intervention and treatment.

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