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Prevention for College Students Who Suffer Alcohol-Induced Blackouts Could Deter High-Cost Emergency Department Visits

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Abstract

Fifty percent of college students who drink report alcohol-induced blackouts, and alcohol abusers in general put a heavy burden on the medical care system. Using data drawn from a randomized, controlled alcohol intervention trial at five university sites, our study quantified the costs of visits to emergency departments by college students who experienced blackouts from drinking alcohol. Of 954 students in the study, 52 percent of males and 50 percent of females at the outset of the study had experienced an alcohol-induced blackout in the past year. Of 404 emergency department visits among the study participants over a two-year observation period, about one in eight were associated with blackout drinking. Injuries ranged from broken bones to head and brain injuries requiring computed tomography. We calculate that on a large university campus having more than 40,000 students, blackout-associated emergency department visit costs would range from \$469,000 to \$546,000 per year. We conclude that blackouts are a strong predictor of emergency department visits for college drinkers and that prevention efforts aimed at students with a history of blackouts might reduce injuries and emergency department costs.

Heavy alcohol use among college students is a pervasive public health problem. Eighty percent of students report drinking alcohol and 44 percent of all college students binge drink, defined as consuming 5 or more drinks in a row for men or 4 or more drinks in a row for women.¹ As a result, an estimated 599,000 college students suffered alcohol-related injuries in 2001.² Approximately 1,825 college students died from unintentional alcohol-related injury in 2005.²

Previous college alcohol studies have used the quantity-frequency alcohol consumption measure (a commonly used method to measure consumption of alcohol based on two questions: (1) the overall frequency of alcohol consumption within a defined reference period, and (2) the usual number of drinks consumed on days when the respondent drank alcohol). to identify students who are at most risk for serious injury. Research shows that students binge drinking on 3 or more occasions in the past month suffer 8 times greater injury rates than other students.³ Frequent (6 or more occasions in the past 2 weeks) binge drinkers are 11 times more likely to be injured than non-binge drinkers.⁴ For male college students, injury rates rise 19 percent with each additional day of drinking 8 or more drinks. For female students, injuries increase 10 percent with each day consuming 5 or more drinks.⁵

It should be noted, however, that quantity-frequency alcohol intake measures define roughly half of the college student population as at-risk drinkers. Due to limited campus resources and the sheer number of alcohol abusers on college campuses, it would be valuable to find a screening tool which could identify a subset of college drinkers who are prone to injury. This study will evaluate whether a history of alcohol-induced blackouts is a predictor of future injury among college students, operationalized here as injury which leads to seeking medical care at an emergency department (ED).

An alcohol-induced blackout corresponds to an inability to recall events (amnesia) but not a loss of consciousness.⁶ Blackout sufferers are capable of walking, talking, driving a car, having sex, but they are not able to form new, long-term memories of their actions. Blackouts are a common occurrence on college campuses, with nearly half of drinking students reporting at least one blackout in their lifetime and 30 percent of drinkers reporting a blackout in the past year.⁷⁻⁸ Overall, roughly one out of every four college students has experienced an alcohol-induced blackout in the past year.¹ On U.S. college campuses women are as likely as men to have a blackout despite lower levels of alcohol consumption by females.⁷

Research indicates that alcohol quantities alone may not fully explain blackout rates. Prenatal alcohol exposure is linked to increased numbers of blackouts at similar quantity of alcohol consumed.⁹ College students with a particular genetic variation, aldehyde dehydrogenase ALDH2*2 allele, experience a lower number of lifetime blackouts after adjusting for alcohol quantities and race.¹⁰ Other factors (e.g. environmental and genetic predisposition), in addition to alcohol amount consumed may contribute to blackout incidence and subsequent health care costs.

It would be beneficial to put a dollar value on health care costs associated with a history of alcohol-induced blackouts among college drinkers. These cost estimates would inform policy makers and school administrators in their decision making process on cost-effective ways to combat alcohol injury on college campuses.

To the best of our knowledge, no prior studies have assessed alcohol-induced blackouts as a marker for future ED treatment among college students or evaluated the ED costs associated with blackouts. To fill this gap in the literature, the present study examines data from the College Health Intervention Projects (CHIPS) study, a randomized controlled trial of brief physician alcohol intervention targeting college students seen in college health services for routine primary care visits. Alcohol use, alcohol-induced blackouts and ED utilization were collected at baseline, 6, 12, 18, and 24 month follow-ups. The objectives of this analysis are twofold: (1) to evaluate blackouts as a predictor of future ED visits among college students; and (2) to determine the costs of ED visits associated with alcohol-induced blackouts.

Data Sources and Methods

The College Health Intervention Projects study was conducted from October 2004 to February 2009 at four U.S. university and one Canadian university sites. A more detailed study description is presented in Michael Fleming et al.¹¹ The study was approved by the Institutional Review Boards for the Protection of Human Subjects in Research at the participating sites.

Study Sample

Study enrollment was limited to full time students ages 18 years or older. Students were screened for problem alcohol use with a brief Health Screening Survey (HSS), and, if screening positive, were then invited to complete a face-to-face baseline eligibility interview for the intervention study.

A total of 986 high risk drinkers met the study inclusion criteria, provided informed consent, and were randomized into the study. Eligibility criteria were (1) 12+ drinks for women or 15+ drinks for men in the past 7 days; (2) 40+ drinks for women or 50+ drinks for men in the past 28 days; or (3) 5+ drinks on 8 or more occasions during the past 28 days. Brief intervention subjects received personalized feedback focused on raising awareness of hazardous drinking behavior and development of risk reduction skills. Control group

subjects, in conjunction with usual care, were given a general health education booklet with advice on diet, exercise, tobacco, and alcohol use.

Telephone follow-ups were conducted with all randomized subjects by a trained researcher at 6, 12, 18, and 24 months post-randomization. Analyses included all subjects (n=954, 97% of enrolled) who completed one or more follow-up interviews.

Measures

Frequency of emergency department visits was evaluated at baseline and at each of four 6-month follow-up interviews over the 24-month study period. Students responded to the question: 'In the past 6 months, how many times have you visited the emergency department.' For each emergency department visit, subjects self-reported if the visit included surgical procedures, the reason for the visit, and treatments they received.

Frequency of alcohol-induced blackout was collected at baseline as part of the Rutgers Alcohol Problem Index (RAPI).¹² Respondents were prompted with the sentence 'How many times has this happened to you while you were drinking or because of your drinking during the last year?' Students were then asked to reply to the blackout item, which read 'Suddenly found yourself in a place that you could not remember getting to.' Responses were given on a 4-point scale (0=never, 1=1 or 2 times, 2=3 to 5 times, 3=more than 5 times). This index has been extensively used with college students and has been validated for identifying alcohol-related problems.¹³⁻¹⁶

Students completed a drinking calendar recalling drinking over the past 28 days.¹⁷⁻¹⁸ Participants were asked to identify the days on which they drank alcohol and the number of standard drinks they consumed. The standard drink size was defined as 14g of alcohol, which corresponds to 12 ounces of beer, 5 ounces of wine, or 1.5 ounces of 80 proof liquor. Data on age, gender, race, and weight were also collected.

Statistical Analysis

Multivariate analyses used generalized estimating equations (GEE). An unadjusted generalized estimating equations model considered blackouts as the only predictor of emergency department visits. The full adjusted generalized estimating equations model controlled for subject gender, age, weight, total number of drinks and heavy drinking days (5 drinks male, 4 drinks female) in the past 28 days, sensation-seeking disposition, and alcohol-related injury prior to study enrollment. Separate indicator variables were included for 1-2 blackouts, 3-5 blackouts, and 6+ blackouts in the 12 months prior to study enrollment. Students with no history of blackouts were the comparison group. The GEE model's rate ratios represented the frequency of ED visits over the 24 month follow-up period in contrast to the reference group.

The attributable risk (AR) of blackout associated emergency department visits over the 24-month follow-up was estimated. The attributable risk is the difference in rate of emergency department visits between subjects with no history of blackouts and students reporting low, moderate and high numbers of blackout experiences.

Average payments for ED visits for 18-44 year olds come from the 2006 Medical Expenditure Panel Survey (MEPS) which is a nationally representative survey of the US civilian population.²²⁻²⁴ Respondents report on their health care utilization, treatments, payments for health services, health status, and demographic characteristics. The 2006 mean ED visit from the national panel survey costs were adjusted to 2010 dollars using the Consumer Price Index (CPI) for medical care.²⁵

In addition, average ED visit billing costs were derived from the Wisconsin Hospital Association.²⁶ Statewide, 125 Wisconsin hospitals provide patient-level billing data on approximately 1.5 million emergency department visits per year. Wisconsin Hospital Association mean emergency department billing costs for 2003 were adjusted to 2010 dollars using the medical care consumer price index.²⁵

The Wisconsin and national data sets on costs of emergency department visits do not include ambulance transport costs. It is estimated that 14 percent of all emergency department visits arrive by air or ground transport, with an average ambulance transport charge of \$415 in 2004 dollars, or \$486 in 2010 dollars.²⁷⁻²⁸ Assuming that 14 percent of all College Health Intervention Projects subjects arrived by ambulance to the emergency department, \$68 (14 percent of \$486) was added to each ED visit dollar value.

The national and Wisconsin data average costs per emergency department visit were multiplied by the number of emergency department visits associated with blackouts in the college sample to produce a total dollar amount of emergency department costs related to blackouts over a 24-month period. Next, the total emergency department visit costs associated with blackouts were adjusted by the survey follow-up rates to estimate per year emergency department utilization costs. Finally, this dollar amount was divided by number of blackout sufferers in the college study to determine the per-blackout-drinker per-year costs of blackout-associated emergency department visits. All analyses were performed using SAS version 9.1.²⁹

LIMITATIONS

There are several limitations to this study. First, to infer blackout costs, we relied on average ED costs. Although these estimates were the best available at the time of the analysis, the ED cost data sources are not current and are subject to both reporting and measurement error. Direct charges for all our ED visits would have been preferable.

Second, estimates of ED visit costs associated with blackouts based on average national ED payments and mean regional charges may have underestimated the CHIPS ED costs. ED visits involving surgery are known to cost more than twice as much as visits that do not involve surgical procedures.³⁴ Over 15% of the CHIPS ED visits included surgical procedures, compared to only 7% of all MEPS ED visits.³⁴ From this perspective, our analysis may underestimate ED costs related to blackouts. Furthermore, this analysis focuses specifically on the ED costs of the students who experience blackouts. The analysis does not take into account potential ED medical costs of victims exposed to acts of physical violence or motor vehicle crashes created by blackout drinkers.

Third, the analysis did not adjust for medical conditions or insurance status. University health services provide primary care for all enrolled students, but ED visits are not typically covered by student health services. Although insurance status or prior medical conditions are likely to influence whether a student seeks emergency or primary care in an ED,³⁵ there is no evidence to suggest that this would affect blackout drinkers more than alcohol abusers with no history of blackouts.

Fourth, the sample of college students enrolled in the study may not be representative of college students nationally. However, a prior report comparing alcohol consumption rates at the participating universities to nationally representative samples of college students found drinking rates at the study sites to be comparable to national rates.³⁶ The validity of self-reported blackouts has not been tested among college students, but the rates of blackouts reported by the study sample are in line with prior research.⁷

Lastly, the analysis does not provide standard errors around the cost estimates due to the secondary nature of the ED cost data. Readers are cautioned about the potentially great degree of variability in ED visit costs, in general, and the blackout ED costs varying substantially from the reported estimates, in particular.

Findings

The sample was nearly evenly divided between males (49 percent) and females (51 percent). The participants were predominantly non-Hispanic white (91 percent), and represented both undergraduate (84 percent) and graduate students (16 percent). All but one of the study subjects was in the 18-41 year old age range, with 44 percent ages 18 to 20.

Exhibit 1 provides baseline alcohol use, baseline blackout frequency, and emergency department visits by gender. At baseline, male subjects consumed an average of 81.8 drinks over the past 28 days, while females averaged 58.7 drinks over the prior 28 days. Males drank significantly more drinks on a typical drinking day than females (7.4 vs. 5.6, $p<.001$). Males in the study reported significantly more heavy drinking days, defined as days with 5+ drinks for men or 4+ drinks for women, than did females ($p=.008$). More than half of the subjects experienced one or more blackouts in the 12 months prior to the study. Seven percent reported 6 or more blackout episodes in the year prior to study entry. Males and females in the study reported similar frequencies of baseline blackouts ($p=.936$).

As indicated in Exhibit 1, 30 percent of the males and 27 percent of the females in the study visited the ED at least once during the 24-month follow-up. Overall, there were 404 ED visits among the 954 study participants over a 2-year observation period. The severity of ED visits varied, from stitches and broken bones, to CT scans for head or brain injury. A prior examination of the study sample revealed that 25 percent of subjects reported an alcohol-related injury during 2-year follow-up.³⁰ Students were not asked to specify if alcohol was a factor in their ED visits, but the correlation between ED visit rates and self-reported alcohol-related injury rates was strong ($r=0.15$, $p<.001$).

The multivariate general estimating equation analyses results are presented in Exhibit 2. The outcome variable is the rate ratio of emergency department visits among students who experienced alcohol-induced blackouts compared to subjects who did not. In the unadjusted model, blackouts at baseline were strongly associated with the rate of emergency department visit during follow-up, increasing from 1.21 (95 percent CI: 1.06-1.37) for subjects reporting 1-2 blackouts at baseline to 1.96 (1.48-2.50) for students acknowledging 6+ blackouts at baseline. After adjusting for age, race/ethnicity, gender, weight, sensation-seeking, experiment group status, alcohol quantity and heavy drinking day frequency in the full generalized estimating equations model, the rate ratios of emergency department visits were 1.09 (95 percent CI: 0.94-1.27) for subjects reporting 1-2 blackouts, 1.39 (95 percent CI: 1.12-1.71) for students reporting 3-5 blackouts, and 1.75 (95 percent CI: 1.31-2.36) for participants acknowledging 6+ blackouts in the 12 months prior to the trial.

The proportion of emergency department visits during follow-up was also related to baseline blackout frequency. Subjects reporting no blackouts at baseline made up roughly 50 percent of the sample, but reported less than 40 percent ($n=160$) of the total ED visits. On the other hand, participants with 6+ blackouts comprised 7 percent of the sample, but experienced 11 percent ($n=45$) of the total emergency department visits. The group with the largest contribution to blackout-associated ED visits was the 3-5 blackout group, where 15 percent of the subjects were responsible for 21 percent ($n=83$) of all ED visits. The total attributable risk from all blackout categories combined was 12.8 percent. This indicates that out of 404 total ED visits in the sample, 52.7 of these visits (95% CI: 27.9-69.4) were emergency department visits associated with blackout drinking.

Exhibit 3 provides the breakdown of ED costs associated with blackouts based on various estimates of ED unit value cost. The mean Medical Expenditure Panel Survey '06 payment per emergency department visit was \$638. Adjusting for inflation and adding \$68 per visit for ambulance transport cost generates an average ED visit cost of \$809 from the MEPS '06 data set. The Wisconsin Hospital Association average billing cost per emergency department visit was \$675 in 2003 dollars. Adjusting to 2010 dollars and adding ambulance transport costs yields an average of \$950 per emergency department visit from the 2003 Wisconsin data set.

Applying average emergency department utilization costs to the blackout associated visits (52.7), the ED medical expenditures associated with blackouts were \$43,000 over a 24-month period using national MEPS estimates and \$50,000 using Wisconsin data figures. On a per blackout drinker, per year basis in this sample of high-risk college drinkers, blackout costs averaged \$46.92 per blackout drinker per year in the national data and \$54.55 in the Wisconsin data. To put the results in perspective, on a campus-wide basis at a university of 40,000 students, with 25percent of students experiencing blackouts,¹ emergency department costs due to blackouts would range from \$469,000 (MEPS) to \$546,000 (Wisconsin Hospital Association) per year.

Discussion

Our data show that emergency department visits are a common occurrence among heavy college drinkers. Nearly 30percent of the heavy drinkers in the study visited the emergency department at least once during 24-month follow-up. Alcohol abusers put a heavy burden on the medical care system.

Student drinkers who experienced alcohol-induced blackouts made up 50 percent of the sample, but were responsible for 60 percent of all emergency department visits. Frequent blackout sufferers (6+ blackouts in the prior year) were 70 percent more likely to be treated at the emergency department during the two year follow-up period than students who consumed the same amount of alcohol but did not experience blackouts. Our data indicate that 13 percent of all ED visits in this sample are associated with blackout drinkers.

The study also demonstrates an independent effect of a history of alcohol-induced blackouts on future emergency department visits after adjusting for covariates (gender, age, weight, alcohol use, sensation-seeking, and prior alcohol-related injury). Notably, blackouts are linked to future emergency department utilization even after alcohol intake is taken into consideration. This finding is in line with previous studies which show that blackout experience is not directly tied to alcohol quantities among adult alcohol drinkers.³¹⁻³³

Our results illustrate that gender did not moderate frequency of alcohol-induced blackouts and ED visits. In spite of the fact that the females in the study drank 30 percent less alcohol than the males, both groups were equally likely to experience an alcohol-induced blackout at baseline. In addition, gender was not significantly associated with emergency department visits in the full model.

The Rutgers Alcohol Problem Index blackout measure which was used in this study may prove to be useful as a screening tool to identify students most prone to injury. In comparison to quantity-frequency measures, it is easier to administer, it identifies 25 percent of the student body as at-risk drinkers, and it is independently linked to emergency department visits. Future studies may be needed to explore blackout history as a screening measure for alcohol injury in a clinical setting.

Given limited campus resources, the study results support targeting alcohol injury prevention efforts on students with a history of blackouts. This focused intervention may reduce alcohol injury and limit emergency department medical expenditures. In our cost estimate, close to half a million dollars could potentially be saved in emergency department utilization costs on a large university campus, if interventions targeting blackout sufferers were successful. Our cost calculations may inform stakeholders' budgetary decisions and cost-effectiveness analyses targeting college alcohol injury prevention efforts. Future studies are warranted to identify the direct effect of interventions focused on blackout sufferers on injury reduction and medical expenditures.

Conclusion

Blackouts are a strong predictor of emergency department visits among college drinkers. Alcohol prevention efforts targeting college students with a history of blackouts may potentially reduce alcohol injury and limit ED medical utilization costs. Our cost estimates will inform policy makers on structuring of alcohol injury prevention efforts in a cost-effective manner.

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Exhibit 1**Alcohol Consumption, Blackout Frequency, and Emergency Department (ED) Visits Among High-Risk College Drinkers (n=954)**

	Males (n=471)	Females (n=483)
Baseline alcohol use, past 28 days		
Days drinking (sd)	12.0 (5.0)	11.5 (4.9)
Drinks per drinking day (sd)	7.4 (2.9) **	5.6 (2.4) **
Total drinks (sd)	81.8 (35.4) **	58.7 (28.0) **
Heavy drinking days (sd)	7.5 (3.5) **	6.9 (3.4) **
Baseline blackouts, past 12 months		
0 blackouts, %	48.4	49.7
1-2 blackouts, %	29.5	28.2
3-5 blackouts, %	14.7	15.5
6+ blackouts, %	7.2	6.6
ED visits during 24-month follow-up		
Number of participants with ED visit (%)	142 (30.1)	130 (26.9)
Total number of ED visits	218	186

*p<.05

SOURCE: Authors' analysis. NOTES: Heavy drinking days defined as drinking 5 drinks for men or 4 drinks for women

**
p<.01

Exhibit 2

Repeated Measures GEE Model for Emergency Department Visits during 24-Month Follow-Up among High-Risk College Drinkers

Covariate	Reduced Model (Blackouts Only)		Full Model (Covariates added)	
	RR	95% CI	RR	95% CI
Baseline blackouts				
1-2 blackouts	1.21	1.06-1.37	1.09	0.94-1.27
3-5 blackouts	1.66	1.34-1.90	1.39	1.12-1.71
6+ blackouts	1.96	1.48-2.50	1.75	1.31-2.36
Experimental group			1.21	0.91-1.60
Prior injury at baseline			1.27	0.89-1.80
Age 18 to 20			1.39	0.96-2.00
Age 21 to 23			1.08	0.71-1.62
Male			1.23	0.88-1.73
Non-hispanic white			1.30	0.84-2.01
Sensation seeking			1.03	0.81-1.31
Weight, per 10 lbs			1.00	0.95-1.04
Baseline drinks, per 10 drinks			0.97	0.91-1.04
Baseline heavy drinking days			1.03	0.97-1.11
				.317

SOURCE: Authors' analysis. NOTES: RR=Relative Risk of Emergency Department visit compared to no blackout group. The reference group for the baseline blackout categories is no blackouts at baseline. The reference category for comparison in the full model is control group status, no alcohol injury at baseline, age 24 or more, female, African American or other race category, and non-freshman.

Exhibit 3

Costs of Blackout Associated Emergency Department (ED) Visits

	MEPS	WHA
Cost of ED visit (year)	\$638 (2006)	\$675(2003)
2010 Adjusted Cost of ED visit	\$741	\$882
Ambulance transport cost (2010 dollars)	\$68	\$68
Total 2010 cost per ED visit	\$809	\$950
ED visit costs associated with blackouts in CHIPS study over 2 years	\$43,000	\$50,000
Annual ED cost per blackout drinker per year in CHIPS	\$46.92	\$54.55
University-wide ED costs due to blackouts on a large campus (>40,000 students) with 25% reporting blackouts, in 1 year	\$469,000	\$546,000

SOURCE: Authors' analysis of data from the College Health Intervention Project Study, the Medical Expenditure Panel Survey, and the Wisconsin Hospital Association. NOTES: