



Published in final edited form as:

Inj Prev. 2012 February ; 18(1): 44–49. doi:10.1136/ip.2011.031724.

Alcohol-Induced Memory Blackouts as an Indicator of Injury Risk among College Drinkers

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Abstract

Objective—An alcohol-induced memory blackout represents an amnesia to recall events but does not involve a loss of consciousness. Memory blackouts are a common occurrence among college drinkers, but it is not clear if a history of memory blackouts is predictive of future alcohol-related injury above and beyond the risk associated with heavy drinking episodes. This analysis sought to determine if baseline memory blackouts can prospectively identify college students with alcohol-related injury in the next 24 months after controlling for heavy drinking days.

Methods—Data were analyzed from the College Health Intervention Project Study (CHIPS), a randomized controlled trial of screening and brief physician intervention for problem alcohol use among 796 undergraduate and 158 graduate students at four university sites in the US and one in Canada, conducted from 2004 to 2009. Multivariate analyses used generalized estimating equations (GEE) with the logit link.

Results—The overall 24-month alcohol-related injury rate was 25.6%, with no significant difference between males and females ($p=.51$). Alcohol-induced memory blackouts at baseline exhibited a significant dose-response on odds of alcohol-related injury during follow-up, increasing from 1.57 (95% CI: 1.13–2.19) for subjects reporting 1–2 memory blackouts at baseline to 2.64 (95% CI: 1.65–4.21) for students acknowledging 6+ memory blackouts at baseline. The link between memory blackouts and injury was mediated by younger age, prior alcohol-related injury, heavy drinking, and sensation-seeking disposition.

Conclusions—Memory blackouts are a significant predictor of future alcohol-related injury among college drinkers after adjusting for heavy drinking episodes.

Keywords

alcohol drinking; alcohol abuse; blackout; memory

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There are no conflicts of interest.

INTRODUCTION

Hazardous drinking and its consequences are pervasive on college campuses.[1] An estimated 599,000 college students were injured in 2001 as a result of alcohol use.[2] Approximately 1,825 college students died from alcohol-related unintentional injury in 2005.[2]

Despite the burden of injuries, the predictors of future alcohol-induced bodily harm among college drinkers are not well understood.[3] Notably, it is not clear from research to date whether a history of alcohol-induced memory blackouts predicts future alcohol-related injury among college drinkers.

An alcohol-induced memory blackout represents amnesia to recall events but does not involve loss of consciousness.[4] Research suggests that alcohol use can affect memory formation by altering nerve–cell communication in the hippocampus region of the brain (Givens et al. 2000; Tomberg, 2010). A rapid rise in blood alcohol concentration has been linked to increased incidence of memory blackout (Rose and Grant, 2010).

Memory blackouts are common on college campuses, with nearly half of drinking students reporting at least one memory blackout in their lifetime and one third reporting a memory blackout in the past year.[5–6] Approximately 5% of drinking students experienced alcohol-related amnesia in the past 7 days.[7] On US college campuses women are as likely to have a memory blackout as men despite consuming lower quantities of alcohol.[5]

Cross-sectional studies consistently show an association between heavy alcohol consumption and injuries for college students. Students who engage in heavy episodic drinking (5+drinks for men or 4+drinks for women) on 3 or more occasions in the past month suffer 8 times greater injury rates than other students.[8] Frequent (6+ occasions in the past 2 weeks) and heavy drinkers together have an odds ratio of injury more than 11 times that of non-heavy drinkers.[9] For male college students, injuries increase 19% with each additional day consuming 8 or more drinks, and for female students, injuries increase 10% with each day consuming 5 or more drinks.[10] Unfortunately, injury prevention screening based on quantity-frequency of alcohol consumption lacks specificity. For example, 55% of college students are identified as at-risk for injury with a 5/4 alcohol drinking measure.[8]

It would be beneficial to find a prospective marker of alcohol-related injury that is more discriminating in identifying students at highest risk for injury. No prior studies have assessed memory blackouts as a marker for future injury after adjusting for alcohol intake. To fill this gap in the literature, the present study examines data from the College Health Improvement Projects (CHIPS), a randomized controlled trial of brief physician alcohol intervention for college students. Alcohol use, alcohol-induced memory blackouts and alcohol-related injury rates were collected at baseline, 6, 12, 18, and 24 month follow-ups. The objective of this analysis is to determine if baseline memory blackouts can prospectively identify college students with alcohol-related injuries in the next 24 months after adjusting for alcohol quantities. This will be the first large prospective study examining memory blackouts as a predictor of future alcohol-related injuries among college students.

METHODS

This study analyzes data from the College Health Intervention Project Study (CHIPS), a randomized controlled trial of screening and brief physician intervention for problem alcohol use conducted at four university sites in the US and one in Canada. A more detailed study description is presented in 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 aged 18 years or older. At four sites, students were administered a Health Screening Survey (HSS) upon arrival for a regularly scheduled appointment with their primary care clinician. At a fifth site, recruitment was conducted at a college health class. The HSS embeds alcohol screening questions with questions on smoking, exercise, and weight control. Participation at all sites was voluntary.

A total of 12,900 students completed the HSS, with 4,532 screening positive for at-risk drinking, defined as 15+ drinks per week for men or 12+ drinks per week for women. Students screening positive were invited to participate in a face-to-face baseline eligibility interview for the intervention phase of the study.

A total of 2,090 students completed the face-to-face baseline interview for the randomized clinical trial. Eligibility criteria for entry into the randomized trial were 50 drinks or 8 or more heavy drinking days (5+ standard 14-g drinks) in the previous 28 days for male students and 40 drinks or 6 heavy drinking days (4+ standard 14-g drinks) in the previous 28 days for female students.

Overall, 986 high risk drinkers met the study inclusion criteria, provided informed consent, and were randomized into the study: 493 to the brief alcohol intervention group and 493 to the control group. Brief intervention subjects received personalized feedback focused on the adverse consequences of alcohol and development of risk reduction skills. Control group subjects were given a general health education booklet with advice on diet, exercise, tobacco, and alcohol use.

Telephone follow-ups were conducted by a trained researcher with all randomized subjects at 6, 12, 18, and 24 months post-randomization. Of the 986 subjects enrolled in the trial, 97% (n=955) took part in one or more follow-up interviews. One subject did not complete the baseline memory blackout question and was excluded from the analysis. The resulting sample size for the analysis reported here was 954 students.

Alcohol Consumption Measures

Students completed a 28-day Alcohol Timeline Follow-Back (TLFB).[12–13] Participants identified the days they drank alcohol and the number of standard drinks they consumed each day. The interviewer verified that the subject understood the definition of standard drink sizes in relation to drinks served in a bar setting. The standard drink size was defined as 14g of alcohol, corresponding to 12 ounces of beer, 5 ounces of wine, or 1.5 ounces of 80 proof liquor.

Alcohol-Related Injury Measure

The variable of interest in the analysis was bodily harm as a direct result of alcohol use. Students were asked the following questions at baseline and follow-up: ‘In the past 6 months, how many accidents or injuries have you had?’ and ‘Was alcohol a factor in any of your injuries?’ A positive response to both questions was defined as the affirmative for alcohol-related injury. The interviewer clarified for respondents that the intent of the former question was motor vehicle collisions or injuries requiring medical treatment.

Memory Blackout Measure

Memory blackout frequency was collected at baseline as part of the Rutgers Alcohol Problem Index (RAPI).[14] 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 memory 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 (never, 1–2 times, 3–5 times, more than 5 times). The RAPI has been extensively used with college students and has been validated for identifying alcohol-related problems.[15–18]

Sensation Seeking Measure

Sensation-seeking has been shown to be associated with alcohol use disorders among college students (Sher et al., 2000). Sensation-seeking was assessed with the 8-item Brief Sensation-Seeking Scale (BSSS) developed by Hoyle et al.[19] The items were measured on a 7-point scale with values ranging from “strongly disagree” to “strongly agree”.

Statistical Analyses

Statistical analyses were based on alcohol-related injury rates during the 24-month follow-up period of the randomized controlled trial. Memory blackout frequencies were compared by chi-square analysis across covariates. Pearson correlations were calculated to assess unadjusted bivariate associations between follow-up alcohol-related injury and memory blackout frequency at baseline.

Multivariate analyses used generalized estimating equations (GEE) with the logit link [20–21]. A first GEE model included only alcohol-induced memory blackouts as a predictor of unadjusted alcohol-related injury risk. A full GEE model then controlled for subject intervention group status, gender, age, class level, weight, total number of drinks in the past 28 days, heavy drinking days (≥ 5 drinks male, ≥ 4 drinks female), sensation-seeking disposition, and alcohol-related injury prior to study enrollment. Separate indicator variables were created and entered into the model for the 1–2 blackout, 3–5 blackout, and 6+ blackout categories. The odds ratios obtained from the model represent odds of alcohol-related injury in the 24 months of follow-up relative to the no blackout group. All multivariate analyses were conducted in SAS version 9.1 (SAS Institute Inc, Cary, NC).

RESULTS

Table 1 provides descriptive information by gender on the 954 randomized subjects who completed at least one follow-up and answered the baseline RAPI. The participants were equally divided between males (49%) and females (51%). The sample was predominantly non-Hispanic white (91%), and represented a wide range of ages and class levels, including graduate students (16%).

Table 2 gives alcohol use, memory blackout frequency, and injury rates for the study participants. Male subjects consumed 81.8 drinks on average in the past 28 days, while females consumed significantly less, averaging 58.7 drinks ($p < .001$). Men drank significantly more drinks on a typical drinking day than women (7.4 vs. 5.6, $p < .001$). Females in the study reported significantly fewer heavy drinking days, defined as 5+ drinks for men or 4+ drinks for women, than did males ($p = .01$). More than half of the subjects experienced one or more memory blackouts in the 12 months prior to the study. Seven percent reported 6 or more past year memory blackout episodes prior to study entry. Despite significant differences in amounts of alcohol consumed, males and females in the study reported similar frequencies of memory blackouts ($p = .94$). In addition, there were no

significant differences in alcohol-related injuries by gender at baseline ($p=.48$) or during 24-month follow-up ($p=.51$). The overall 24-month alcohol-related injury rate was 25.6%.

Memory blackouts were negatively associated with age ($r=-0.24$, $p<.001$). Students 24 years or older reported the lowest baseline memory blackout rates. Students 18 to 20 years of age reported the highest memory blackout rates. Memory blackout frequency was positively correlated with number of heavy drinking days ($r=0.19$, $p<.001$). Subjects reporting no heavy drinking days at baseline averaged 0 memory blackouts, while subjects reporting 9 or more heavy drinking days at baseline averaged 1–2 memory blackouts in past 12 months.

Figure 1 provides alcohol-related injury rates by baseline blackout frequency. The overall 24-month alcohol-related injury rates were 18% for subjects who reported no memory blackouts at study baseline, but jumped to 49% for drinkers reporting frequent (6+) memory blackouts at baseline. At the first 6-month follow-up post-randomization, injury rates were 6% for students reporting no memory blackouts, going up to 23% for study enrollees reporting frequent (6+) memory blackouts. At 12 months, alcohol injuries differed from 7% with no memory blackouts to 22% for frequent memory blackout sufferers. Eighteen-month rates were similar, varying from 6% for students with no memory blackouts to 22% for participants with frequent memory blackouts. Injury rates were lower at 24-month follow-up, but still showed a positive association with memory blackouts at baseline. The correlations between memory blackouts and alcohol-related injuries were highly significant at 6-month ($r=0.17$, $p<.001$), 12-month ($r=0.14$, $p<.001$), and 18-month ($r=0.14$, $p<.001$) follow-up, and statistically significant ($r=0.09$, $p=.04$) at 24-month assessment.

The multivariate GEE analysis results presented in Table 3 model odds of alcohol-related injury during 24-month follow-up. The blackout-only GEE model shows a strong association between memory blackouts and alcohol-related injuries before adjusting for covariates. In the full GEE model, memory blackouts at baseline still exhibited a significant dose-response on alcohol injuries. Statistically significant baseline covariates for predicting future injury were prior alcohol-related injury, younger age (18 to 20 years), sensation-seeking disposition, and heavy drinking days. Experimental group status was not a significant predictor of injury during follow-up. Odds of alcohol-related injury in the 24-month follow-up steadily increased from 1.57 (95% CI: 1.13–2.19) for subjects reporting at least one memory blackout to 2.64 (95% CI: 1.65–4.21) for students acknowledging 6+ memory blackouts at baseline. Heavy drinking days were associated with an 8% increase (95% CI 1.01–1.16) in injury risk for each reported day. Notably, the effect size for the memory blackout measure was larger than for the heavy drinking measure.

DISCUSSION

The objective of this analysis was to assess the link between baseline memory blackouts and alcohol-related injury in the following 24-month period among high risk college drinkers seen at university health services. The analysis allowed us to identify prospectively an independent main effect between history of memory blackouts and future college alcohol-related injury after adjusting for a range of covariates (gender, age, class level, weight, alcohol use, sensation-seeking, and prior alcohol-related injury). Frequent memory blackout sufferers were almost three times more likely to suffer an alcohol-related injury during the two year follow-up period than students who consumed the same amount of alcohol without experiencing memory blackouts. More than half of all high-risk drinkers in our sample suffered at least one memory blackout in the past 12 months. This suggests that fifty percent of these heavy drinkers are at increased risk of injury. Given that campus resources are

limited, our findings support further investigation of memory blackout sufferers in college injury prevention efforts.

Our results suggest that memory blackout screening at student health services could be a useful tool in college alcohol-related injury prevention. Memory blackout screening may accomplish several tasks at once: (1) identifying students at risk for alcohol-related injury; (2) recognizing drinking to the point of having a disruptive effect on cognitive function; (3) raising awareness about extreme levels of drinking and its consequences. As an example, consider a student who has experienced one alcohol memory blackout in the past 6 months and several heavy drinking days in the past 30 days, and who presents himself to student health services for a primary care appointment. A clinician armed with the heavy drinking measure screening alone may ask him about alcohol intake and suggest that the patient's injury risk is increased by 20–30%. On the other hand, under similar circumstances, a clinician equipped with the memory blackout screening tool may inquire about both heavy drinking and memory blackouts and advise this patient that his chances for injury rise by more than 50%. In both cases, the doctor will point to risky drinking behavior as increasing the likelihood for injury. The memory blackout injury risk information, however, may drive home the point about extreme levels of alcohol intoxication more strongly than the heavy alcohol drinking risk data. It may be easier for a student to dismiss general warnings on excessive alcohol drinking harms than to refute that his extreme alcohol drinking is causing impairment in brain function. Future studies may wish to examine the efficacy of memory blackout screening for college alcohol-related injury prevention.

As seen in other studies,[5, 22–23] the females in our study were equally likely to experience an alcohol-related memory blackout or an alcohol-related injury despite drinking at lower quantities and frequencies than the males. More than 50% of the women in the study experienced a memory blackout in the 12 months prior to study enrollment. This finding suggests tailoring injury prevention efforts by gender, since, at equivalent levels of alcohol consumption, women are likely to be at higher risk for injuries than men.

Alcohol-related injury in the 6 months prior to the study was also positively associated with injury during the follow-up period. This finding is in line with prior research that suggests that college students do not necessarily alter drinking behavior as a result of negative consequences (Mallett et al, 2006). Incorporating a history of alcohol-related injury into screening and injury prevention could improve specificity of risk prediction.

Sensation-seeking also was found to be a significant predictor of alcohol-related injury in the next 24 months. Several cross-sectional studies have identified an association between sensation-seeking and alcohol injuries.[24–26] Sensation seeking has been shown to be an independent predictor of alcohol traumatic injury in hospital ER patients.[27–28] Our study results suggest that campus alcohol-related injury prevention efforts may need to account for sensation-seeking nature when devising alternatives to heavy alcohol use. Future studies are needed to investigate this further.

Limitations

A potential limitation of the study is sample selection bias. Because the data were collected as part of a randomized controlled trial, only students who drank above at-risk drinking thresholds and who provided informed consent were included in this analysis. The students who participated in the study may not be representative of college students in general at the participating university sites. A comparison of eligible subjects who declined any further participation after the initial alcohol screen shows that study participants were younger and more likely to have experienced a recent alcohol-related injury. However, alcohol consumption levels and attribution of alcohol as an injury factor were similar between study

participants and non-responders. Also, enrollment took place at student health centers, so the study sample was limited to students obtaining routine university health services. However, studies on college health services indicate that almost all students have access to a campus health clinic, with utilization of approximately 2 visits per student per year.[29] While the study results may not generalize to college students as a whole, they may be pertinent to the set of college students who would be targeted for alcohol intervention through university health services.

Another potential study limitation is that respondents were asked to self-report whether alcohol use was a factor in their injuries and to assess the history of memory blackouts. Study participants could potentially minimize the role of alcohol with their injury and underestimate the frequency of memory blackouts. Future studies could examine whether self-reported attribution of alcohol-related injury and memory blackouts produces lower alcohol-related injury and memory blackout rates than objectively collected data.

The strengths of the study are the prospective design, large sample size, and detailed information on alcohol use and other explanatory variables. Since students were asked about alcohol-related problems at baseline and then followed prospectively for the next 24 months, the study does not suffer from the common temporal issues related to cross-sectional research.

CONCLUSION

Memory blackouts are a strong predictor of future alcohol-related injury among college drinkers. The link between memory blackouts and injury is mediated by younger age, prior alcohol-related injury, heavy drinking, and sensation-seeking disposition. Our findings may have implications for prevention and intervention efforts by health care professionals working with college students and other populations at high risk for alcohol-related injuries.

What is already known on this subject:

- Alcohol-related injury is a pervasive health problem on college campuses
- Alcohol-induced memory blackouts are common among college drinkers

What this study adds:

- Screening at-risk drinkers using a memory blackout question prospectively identifies college students at highest risk for alcohol-related injury
- Memory blackout screening provides more specificity in screening for alcohol-related injury risk than screening with traditional alcohol quantity-frequency measures

Acknowledgments

FUNDING

This work was supported by NIAAA 1R01 AA014685-01 and NIAAA 1K01 AA018410-01.

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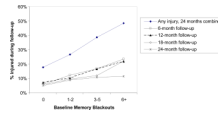


Figure 1.
Follow-Up Alcohol Injury Rates among High-Risk College Drinkers by Baseline Memory Blackouts from 2004 to 2009

Table 1

Baseline Characteristics of High Risk College Drinkers in CHIPS, a Brief Alcohol Intervention Trial (n=954)

	Males (n=471)	Females (n=483)
Intervention group status		
Experimental, %	49.7	48.7
Control, %	50.3	51.3
Race/Ethnicity		
Non-hispanic white, %	89.4	92.5
White hispanic, %	4.3	2.7
African American, %	0.6	0.6
Asian American, %	3.0	2.7
Other/refused, %	2.7	1.5
Age		
18–20 years, %	44.2	46.2
21–23 years, %	34.4	35.6
24 or older, %	21.4	18.2
Year in school		
Freshman, %	19.1	19.1
Sophomore, %	17.6	16.2
Junior, %	22.5	20.3
Senior, %	23.6	28.6
Graduate student, %	17.2	15.9
Sensation-seeking ^a , mean (sd)	3.60 (0.58) **	3.31 (0.65) **
Weight (lbs), mean (sd)	179 (28) **	146 (28) **

* p<.05,

** p<.01

^aBrief Sensation-Seeking Scale[19] score

Table 2

Alcohol Consumption, Memory Blackout Frequency, and Alcohol-Related Injury Among High-Risk College Drinkers (n=954)

	Males (n=471)	Females (n=483)
Baseline alcohol use		
Days drinking, past 28 days (sd)	12.0 (5.0)	11.5 (4.9)
Drinks per drinking day (sd)	7.4 (2.9)**	5.6 (2.4)**
Total drinks, past 28 days (sd)	81.8 (35.4)**	58.7 (28.0)**
Heavy drinking days ^a (sd)	7.5 (3.5)**	6.9 (3.4)**
Baseline memory blackouts, past 12 months		
0 memory blackouts, %	48.4	49.7
1–2 memory blackouts, %	29.5	28.2
3–5 memory blackouts, %	14.7	15.5
6+ memory blackouts, %	7.2	6.6
Alcohol-related injury ^b , past 6 months		
Baseline, %	15.9	14.3
6-month follow-up, %	10.4	10.9
12-month follow-up, %	11.2	10.0
18-month follow-up, %	8.9	9.0
24-month follow-up, %	8.3	6.7
All follow-ups combined, %	24.6	26.5

* p<.05,

** p<.01

^aDays of drinking ≥ 5 drinks for men or ≥ 4 drinks for women

^bPositive response to both: 'In the past 6 months, how many accidents or injuries have you had?' and 'Was alcohol a factor in any of your injuries?'

Table 3
Repeated Measures GEE Model for Alcohol-Related Injury during 24-Month Follow-Up among High-Risk College Drinkers

Covariate	Blackouts Only Model			Full Model with Covariates		
	OR	(95% CI)	p-value	OR	(95% CI)	p-value
Baseline memory blackouts						
1–2 memory blackouts ^a	1.79	(1.28–2.52)	0.001	1.57	(1.13–2.19)	0.01
3–5 memory blackouts ^a	2.55	(1.77–3.68)	<0.001	1.85	(1.27–2.77)	0.003
6+ memory blackouts ^a	3.85	(2.52–5.88)	<0.001	2.64	(1.65–4.21)	<0.001
Experimental group ^b				0.90	(0.68–1.18)	0.44
Prior injury at baseline ^b				1.67	(1.19–2.36)	0.003
Age 18 to 20 ^b				1.73	(1.10–2.73)	0.02
Age 21 to 23 ^b				1.09	(0.70–1.71)	0.69
Male ^b				0.98	(0.68–1.40)	0.89
Non-hispanic white ^b				1.97	(0.69–5.63)	0.20
White hispanic ^b				3.03	(0.93–9.90)	0.07
Asian ^b				2.12	(0.55–8.14)	0.27
Freshman ^b				0.82	(0.57–1.19)	0.29
Sensation seeking				1.29	(1.01–1.65)	0.04
Weight, per 10 lbs				1.02	(0.98–1.07)	0.31
Baseline drinks, per 10 drinks				0.97	(0.90–1.05)	0.50
Baseline heavy drinking days				1.08	(1.01–1.16)	0.02

^aThe reference group is no memory blackouts at baseline.

^bThe reference category for comparison is control group status, no alcohol-related injury at baseline, age 24 or more, female, African American or other race category, and non-freshman.