Research Article

Changes in alcohol use after the onset of spinal cord injury

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Objective: Identify the prevalence of alcohol consumption and binge drinking at time of spinal cord injury (SCI) onset, compare these rates to data from the general population, and identify changes in alcohol use at an average of 17 months post-injury.

Design: Cross sectional, mailed self-report assessment.

Setting: A specialty hospital in the southeastern United States.

Participants: Five hundred sixty-six inpatients completed the baseline measure. After eliminating those under age 18, there were 524 participants at baseline. 410 were approached for follow-up, with 201 of those responding.

Interventions: N/A.

Outcome Measures: Self-reported assessments were completed during inpatient rehabilitation and at follow-up approximately 17 months later. The two primary outcomes were the number of days consuming 5 or more drinks (binge drinking) and the number of days consuming any alcoholic beverages within the 30 days prior to the assessment. Comparison data were taken from the Behavioral Risk Factor Surveillance System.

Results: At SCI onset, the prevalence of alcohol use, particularly binge drinking, was substantially higher than the general population (SCI = 44.9%; general population = 13%). Drinking rates decreased by 17 months post-injury.

Conclusion: Alcohol use and binge drinking are elevated over the general population at the time of injury. Drinking patterns reflect a decrease following injury but remain slightly elevated, signifying a need for interventions to minimize long-term health consequences.

Keywords: Spinal cord injury, Alcohol, Mortality, Rehabilitation

Alcohol is a known risk factor among persons with spinal cord injury (SCI). Therefore, minimizing behaviors such as excess alcohol consumption post-injury would increase longevity and improve quality of life. Persons with SCI are particularly vulnerable to adverse medical outcomes.^{1,2} Literature has established that alcohol consumption heightens complications following traumatic SCI, and alcohol use prior to onset of injury may signify an elevated health risk, although the mechanisms are not understood.³ Persons with a pre-injury history of heavy alcohol use tend to spend less time in rehabilitation activities.^{4,5} Limited participation in rehabilitation activities may hamper their ability to cope with the many physical and psychological

challenges associated with SCI, thereby increasing the risk of medical complications.³ Identifying persons at risk for alcohol use is essential for rehabilitation centers at the time of admission and for clinicians who treat persons with SCI.

Some adverse consequences of alcohol consumption have been well documented. For instance, drinking is associated with an increased risk of pressure ulcers,^{6,7} which engenders life-threatening infections⁸ and begets significant morbidity and mortality.^{9,10} Alcohol misuse, in general, increases the overall risk of mortality.^{11–13} Other negative health outcomes associated with excess alcohol consumption are increased risk of depression, elevated stress, and an inability to maintain weight.^{4,14–16} When compared to persons with SCI who did not abuse alcohol, those who did reported decreased satisfaction in life and perceived their overall health to be worse.¹⁶

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Relatively little research has been conducted in recent years to compare pre-injury and post-injury drinking behaviors in the same study. Literature indicates the prevalence of pre-injury drinking rates exceed that of the general population.¹⁶ Kolakowsky *et al.*¹⁷ observed pre-injury drinking rates to be as high as 96%, and of that sample, at least 57% were heavy alcohol users. Of significance, pre-injury drinking patterns serves as an important predictor of post-injury drinking trends, as individuals who are known to be heavy drinkers before their injury are more likely to continue the same trend post-injury.¹³ In a study of recently injured patients with SCI, Heinemann *et al.* found 73% of persons return to drinking within 7 ± 18 months post-injury.⁷ Research indicates post-injury drinkers are not light or social drinkers, and therefore, choose to abstain or drink frequently.¹³ The high rates of recidivism and elevated drinking frequency may reflect methods for coping with the stress, anxiety, and depression that can occur after experiencing a traumatic injury.¹³ These findings underscore the time sensitive nature of interventions and strongly suggest a critical window of opportunity to maximize the benefits of campaigns aimed at reducing alcohol consumption. In support of the “critical window” concept, Bombardier and Rimmle¹⁸ suggest rehabilitation settings present an excellent opportunity to implement an alcohol prevention program as it grants access to large numbers of participants who indicate a readiness to change.

In sum, the existing literature indicates pre-injury drinking rates are elevated among persons with long-standing SCI, and short- and long-term consequences, such as excess mortality, are related to excess alcohol consumption. Yet, there is a void in recent literature comparing pre-injury alcohol drinking rates to that of the general population and investigating changes in drinking patterns after injury. Our objectives were to (a) identify the rate of alcohol consumption, including binge drinking, and the proportion of individuals who consumed alcohol and engaged in binge drinking among a cohort of recently injured participants with SCI, (b) compare the rate with that from the general population and the rate prior to injury in the same geographic area, and (c) identify factors such as sex and race-ethnicity that may influence behavior. There were three study hypotheses:

1. The rate of alcohol consumption and episodes of binge drinking for persons with SCI will be higher than that of the general population at the time of injury.
2. The proportion of individuals with SCI who consume alcohol and engage in binge drinking will decrease from the time prior to injury.
3. Sex will be predictive of alcohol consumption, with higher rates of binge drinking among males.

These objectives serve to facilitate the awareness of drinking patterns prior to or at the time of SCI onset, how they differ from the general population, and how patterns change over time in an effort to better address the needs of this population.

Methods

Participants

Participants were recruited between January 2002 and September 2006 from the inpatient census of a large specialty hospital in Southeastern United States. The inclusion criteria were (a) traumatic SCI, (b) currently hospitalized, (c) at least 16 years of age at assessment, (d) some residual deficits (AIS A-D), and (e) assessed within first 6 months after SCI onset. Of the 707 patients consented for the study, 566 participants met inclusion criteria and completed baseline research materials prior to discharge, an average of 50 days after SCI onset. Forty-two participants under the age of 18 were eliminated, reducing the sample to 524 participants. The follow up was initiated 12 months after discharge, resulting in a final follow-up sample of 201 participants.

Procedures

The SCI peer support coordinator met with all new patients, described the study, and obtained informed consent during the initial visit. If necessary, a staff member assisted participants with completing the baseline questionnaire, and a questionnaire was left for those who did not. All assessments were completed during inpatient rehabilitation. Participants were offered \$25 remuneration.

An average of 17 months after SCI onset, approximately 410 participants were sent follow-up questionnaires that included additional questions regarding alcohol use. This represents a subset of just over 78% of the original participants who were eligible for follow-up during the data collection window (the others fell outside of the funding cycle for becoming eligible based on time since injury). Those who responded were again offered \$25 in remuneration to complete the materials by mail.

Measures

Participants completed the self-report instrument, which included demographic and alcohol use related questions before the onset of injury and after rehabilitation. Two variables were taken directly from the Behavioral Risk Factor Surveillance System (BRFSS)¹⁹ and included the number of occasions within the past 30 days that the individual had at least one drink and the number of occasions of having five or more drinks. We used

identical language to that used with the BRFSS at the time. The BRFSS was later changed to define binge drinking differently for men and women (5 for men, 4 for women). At baseline, the items were modified to reflect the 30 days before SCI onset.

The following demographic variables were assessed: (a) sex, (b) race-ethnicity, and (c) age at injury onset. Race-ethnicity was categorized based on a combination of race and ethnicity, forming two groups: (a) non-Hispanic White and (b) others. The cohort was stratified by the following ages at the time of injury: 18–24, 25–34, 35–44, 45–54, and 55–64.

Analysis

Descriptive statistics of participant characteristics were analyzed. We then calculated the percentage of participants who had at least one drink within the past 30 days, those who engaged in binge drinking, and the associated 95% confidence intervals among participants. We compared it to the 2003 Georgia BRFSS for the general population data, as our participants were identified in Georgia and assessed between 2002 and 2006.²⁰ If the 95% confidence interval of two percentages did not overlap with each other, we determined they were statistically different at the 0.05 level. Separate analyses were conducted for the full sample and for subsamples based on sex, age at injury, and race-ethnicity.

For the longitudinal comparison between pre-injury and post-injury, we first performed the McNemar's test to identify the significant changes of binary outcomes. Because average days consuming alcohol and times of binge drinking are not normally distributed, we used the non-parametric method, the Wilcoxon signed rank sum test, to compare their values of pre- and post-injury. The same statistical tests were applied to each subsample.

Results

Participant characteristics

The majority of participants were male (75.1%) and non-Hispanic white (74.1%), followed by other racial ethnic groups (25.9%) (Table 1). Most participants were non-ambulatory (82.1%), and, of those non-ambulatory, 45.8% were non-cervical injuries, followed by 36.3% cervical injuries. Primary etiology was motor vehicle accidents (47.3%), followed by other causes (42.3%), and acts of violence (10.5%). Average age at injury was 33.5 (± 11.5).

Alcohol consumption prevalence rate and comparisons with the general population

The prevalence rate of consuming at least one drink within the past 30 days at the time of SCI onset was

Table 1 Demographics.

	Frequency	%
Sex		
Male	151	75.1
Female	50	24.9
Age at injury		
18–24	48	23.9
25–34	49	24.4
35–44	49	24.4
45–54	41	20.4
55–64	10	5.0
≥ 65	4	2.0
Race-ethnicity		
Non-Hispanic White	149	74.1
Others	52	25.9
Injury severity		
Ambulatory	36	17.9
Non-ambulatory C1–4	24	11.9
Non-ambulatory C5–8	49	24.4
Non-ambulatory and non-cervical	92	45.8
Injury causes		
Motor vehicle	95	47.3
Violence	21	10.4
Others	85	42.3
Education		
Less than H.S.	33	16.5
H.S. or G.E.D.	63	31.5
Some post-H.S.	40	20.0
College graduate	64	32.0

68.6%, significantly higher than the general population (Table 2). After classification by sex and race, females were observed consuming more alcohol than the general population, also significantly higher than the general population. No significant differences were identified between males with SCI and those in the general population at baseline. Both non-Hispanic white and other racial-ethnic groups in the SCI group consumed significantly more alcohol than the general population, differences of 18.4% and 12.4% respectively.

Binge drinking prevalence and comparison with the general population

Binge drinking at the time of SCI onset showed similar trends (Table 3). 44.9% reported binge drinking prior to SCI onset, compared with only 13% in the general population. The prevalence rates of binge drinking for males and females were 50.5% and 23.6% respectively (both higher than the general population). The significant differences in binge drinking also held as a function of race-ethnicity and for some, but not all, age groups.

Alcohol consumption pre and post-injury comparisons

Alcohol consumption dropped from pre-to post injury. Compared to 69.7% at baseline, 51.2% reported having at least one drink in the past 30 days of follow-

Table 2 Alcohol consumption prevalence and comparison with general population (GP).

	N	SCI %	GP %	Difference %	Comparison*
All	524	68.6	50.9	17.7	P < 0.05
Sex					
Male	416	71.2	59.4	11.8	NS
Female	107	59.4	42.9	16.5	P < 0.05
Age at injury**					
18–24	164	72.5	53	19.5	NS
25–34	134	70.5	61.1	9.4	NS
35–44	127	63.8	58.4	5.4	NS
45–54	78	72.4	51.6	20.8	NS
55–64	17	52.9	41.9	11.0	NS
Race-ethnicity					
Non-Hispanic White	364	71.0	52.6	18.4	P < 0.05
Others	160	63.3	50.9	12.4	P < 0.05

*Comparing the 95% confidence interval.

**Only four cases in the SCI group over age 65, so no comparisons are presented.

GP, general population; NS, not statistically significant at P < 0.05.

Table 3 Binge drinking prevalence and comparison with general population (GP).

	N	SCI %	GP %	Difference %	Comparison*
All	524	44.9	13	31.9	P < 0.05
Sex					
Male	416	50.5	20.7	29.8	P < 0.05
Female	107	23.6	5.9	17.7	P < 0.05
Age at injury**					
18–24	164	59.6	21.3	38.3	P < 0.05
25–34	134	48.1	19.2	28.9	NS
35–44	127	28.2	14.9	13.3	NS
45–54	78	42.3	10.9	31.4	P < 0.05
55–64	17	23.5	5.5	18.0	NS
Race-ethnicity					
Non-Hispanic White	364	44.6	14.5	30.1	P < 0.05
Others	160	45.5	13.0	32.5	P < 0.05

*Comparing the 95% confidence interval.

**Only four cases in the SCI group over age 65, so no comparisons are presented.

GP, general population; NS = not statistically significant at P < 0.05.

Table 4 Alcohol consumption pre- and post-injury.

	N	Baseline %	Follow-up %	Difference %	Comparison*
All	201	69.7	51.2	18.5	P < 0.05
Sex					
Male	151	71.6	51.7	20.0	P < 0.05
Female	50	64.0	50.0	14.0	NS
Age at injury**					
18–24	48	80.4	66.7	13.8	NS
25–34	49	71.4	51.0	20.4	P < 0.05
35–44	49	63.3	49.0	14.3	NS
45–54	41	72.5	39.0	33.5	P < 0.05
55–64	10	60.0	50.0	10.0	NS
Race-ethnicity					
Non-Hispanic White	52	72.1	53.7	18.4	P < 0.05
Others	149	62.8	44.2	18.5	P < 0.05

*McNemar Test.

**Only four cases in the SCI group over age 65, so no comparisons are presented.

NS = not statistically significant at P < 0.05.

Table 5 Binge drinking pre- and post-injury.

	N	Baseline %	Follow-up %	Difference %	Comparison*
All	201	42.9	17.4	25.5	P < 0.05
Sex					
Male	151	50.3	19.9	30.5	P < 0.05
Female	50	20.4	10.0	10.4	NS
Age at injury**					
18–24	48	67.4	31.3	36.1	P < 0.05
25–34	49	46.9	18.4	28.6	P < 0.05
35–44	49	20.8	16.3	4.5	NS
45–54	41	41.5	7.3	34.1	P < 0.05
55–64	10	40.0	0	40.0	—
Race-ethnicity					
Non-Hispanic White	52	43.2	15.4	27.8	P < 0.05
Others	149	42.0	23.1	18.9	P < 0.05

*McNemar Test.

**Only four cases in the SCI group over age 65, so no comparisons are presented.

— No binge drinking at follow-up, and P value is not presented for McNemar test.

NS = not statistically significant at P < 0.05.

Table 6 Comparison of mean number of days drinking alcohol pre- and post-injury.

	N	Baseline		Follow-up		Difference	Comparison*
		Mean	SD	Mean	SD		
All	201	7.04	9.05	2.67	4.59	4.4	P < 0.05
Sex							
Male	151	7.62	9.38	2.93	4.99	4.7	P < 0.05
Female	50	5.32	7.81	1.89	2.98	3.4	P < 0.05
Age at injury**							
18–24	48	6.63	7.29	3.19	3.85	3.4	P < 0.05
25–34	49	8.39	10.50	2.55	4.29	5.8	P < 0.05
35–44	49	5.88	8.49	2.49	5.30	3.4	P < 0.05
45–54	41	8.23	10.00	2.21	4.50	6.0	P < 0.05
55–64	10	6.10	8.60	4.50	6.69	1.6	NS
Race-ethnicity							
Non-Hispanic White	52	7.29	9.32	2.82	4.67	4.5	p < 0.05
Others	149	6.31	8.28	2.27	4.37	4.0	p < 0.05

*Wilcoxon signed rank sum test.

**Only four cases in the SCI group over age 65, so no comparisons are presented.

NS = not statistically significant at P < 0.05.

up (Table 4). The decrease was significant for males, but not for females. Significant differences were observed for the non-Hispanic white and other racial-ethnic groups, with the prevalence rate for both groups lower at follow-up than at baseline.

Binge drinking pre- and post-injury comparisons

The percentage of participants who endorsed binge drinking decreased from 42.9% prior to injury to 17.4% at 17 months post-injury (Table 5). The portion of males who reported binge drinking significantly decreased, whereas no differences were observed for females. Similarly, both non-Hispanic whites and other racial-ethnic groups were observed to have a significant decrease in participants who engaged in binge drinking.

Mean number of days and frequency of binge drinking pre and post-injury comparisons

The mean number of days of consuming alcohol within the past month prior to assessment was 7.0 days at baseline, but decreased to 2.7 days at follow-up (Table 6). When classified by sex, age, and race-ethnicity, all cohorts were observed to decrease in average number of days of alcohol consumption. The frequency of binge drinking episodes within the past 30 days followed similar trends (Table 7).

Discussion

Our findings fill an important gap in the literature by identifying the prevalence of alcohol consumption, including binge drinking, at the time of SCI onset and

Table 7 Frequency of binge drinking pre- and post-injury.

	N	Baseline		Follow-up		Difference	Comparison*
		Mean	SD	Mean	SD	%	
All	201	3.11	6.50	0.64	2.57	2.5	P < 0.05
Sex							
Male	151	3.75	6.94	0.76	2.91	3.0	P < 0.05
Female	50	1.14	4.45	0.26	0.92	0.9	NS
Age at injury**							
18–24	48	4.07	6.92	1.08	2.50	3.0	P < 0.05
25–34	49	4.35	7.80	0.59	1.43	3.8	P < 0.05
35–44	49	1.42	4.91	0.86	4.31	0.6	NS
45–54	41	3.24	6.54	0.12	0.51	3.1	P < 0.05
55–64	10	1.40	3.10	0.00	0.00	1.4	NS
Race-ethnicity							
Non-Hispanic White	52	3.26	6.81	0.64	2.87	2.6	P < 0.05
Others	149	2.66	5.53	0.63	1.44	2.0	P < 0.05

*Wilcoxon signed rank sum test.

**Only four cases in the SCI group over age 65, so no comparisons are presented.

NS = not statistically significant at P < 0.05.

immediately following injury. The substantially higher prevalence of alcohol consumption and binge drinking at injury onset among those with SCI confirms hypothesis 1 and is a significant concern given the established negative health outcomes associated with alcohol use among persons with SCI. Because current definitions of binge drinking for women are four or more drinks per episode, and we used the earlier definition (i.e. five drinks), the percentage of binge drinking among women should be considered a conservative estimate. Depression, anxiety, anger, urinary tract infections, decubitus ulcers, increased risk of seizures, poor rehabilitation outcomes, obstacles to rehabilitation correlated with longer lengths of stay, and impaired self-care up to 18 months after the onset of injury have been associated with heavy alcohol use.^{7,12,21–24} Higher prevalence rates also have future implications. Although not investigated in this study, establishing a causal relationship between alcohol, SCI, and level of injury has the potential to minimize the incidence of SCI and maximize SCI prevention efforts in the future. High risk activities, such as alcohol intoxication, have contributed to SCI etiology,^{23,25} and as much as 35% to 40% of persons with SCI may have sustained their injury as a direct result of alcohol involvement.^{18,26,27}

Overall, post-injury alcohol consumption decreased after SCI onset, confirming hypothesis 2. The decrease in alcohol use, particularly heavy drinking, is consistent with research on both SCI and TBI.¹³ Although the studies are not directly comparable, previous research had indicated that only 29% of those who were heavy drinkers at injury with SCI or TBI remained heavy drinkers at follow-up, with fully 40% abstinent by follow-up.

We found a dramatic decrease in binge drinking from 42.9% at SCI onset to 17.4% at follow-up. Since binge drinking was the primary indicator of potentially problematic drinking, comparison of these rates would indicate that only about 41% of those who were binge drinkers at onset remained binge drinkers. Therefore, there is a clear pattern of decreasing use after SCI onset.

Reasons for this decrease are not entirely clear but may be attributed to several factors. First, individuals may maintain their desire to drink, but have less access to alcohol due to physical, economic, or transportation limitations that impede their ability to obtain alcohol or participate in the social situations in which their binge drinking previously occurred. Other SCI-related factors that may limit alcohol consumption might include: increased presence of caregivers who might discourage alcohol use, residence in a new location in which alcohol is not as readily available, or medical advice against alcohol use because of potentially harmful interactions with other medications. Second, the findings also support Bombardier's "critical window" theory, as participants, immediately following injury, may indicate a readiness to change that is bolstered by a strong social support system. Lastly, the rehabilitation center did provide participants with some general alcohol education, although fairly limited. However, there is no evidence, for or against, this being a factor in the reduced drinking rates.

Sex differences were observed among binge drinkers (using five drinks per episode as the indicator of binge drinking for both men and women), as the rate of men who engaged in binge drinking was significantly higher than women, confirming hypothesis 3. It is

important to note that there were significantly less women who participated in the study, so the sample size for women is smaller and may be less stable. Sex disparities within the SCI community are not unexpected and continue to exist, thereby supporting prior research in terms of differences in risk factors and consequences associated with alcohol use among women. Women report drinking less alcohol and having fewer alcohol related problems than men.²⁸ They are also less likely to have characteristics associated with excess drinking including aggressiveness and behavior that may precipitate SCI onset,²⁸ which may account for smaller sample sizes.

Clinical implications

Interventions that focus on the cessation of alcohol consumption among persons with SCI, if successful, have promise for reducing secondary complications. Understanding the changes in pre- and post-injury alcohol consumption patterns is especially important in identifying persons with SCI at risk for alcohol abuse, since persons with excessive alcohol use are more likely to have higher mortality rates and a greater chance of physical deterioration after injury. Medical complications that arise from alcohol use such as pressure ulcers and associated infections are of particular concern due to an increase in re-hospitalization,^{10,29} increased duration of stay,³⁰ and increased morbidity and mortality.³¹ Primary care providers may find this information useful in their efforts to develop routine screening methods and abstinence-focused treatment plans for persons with SCI to reduce health risks and increase life expectancy. Persons with SCI would benefit tremendously from physician and healthcare professional recommendations regarding abstinence or responsible use of alcohol.

Limitations

There are several limitations within this study. Data were self-report and could be subject to recall bias, and, due to the sensitive nature of the information being reported, there is the possibility of under-reporting. Second, the data were collected in 2003–2006, so the prevalence rate could have changed over time. However, our data and that of the general population were collected during the same time frame, so the differences found between the general population and those with SCI are likely stable. Third, some participants were lost to follow-up, thereby causing a significant decrease in the response rate at follow-up. We only attempted follow-up on a subsample of participants, yet the cases were consecutive, so this should not have added to any bias.

Fourth, the definition of binge drinking for women was somewhat more conservative for our SCI sample and this may have made it more difficult to obtain significant findings. This was based on using the definitions provided within the BRFSS at the time. Lastly, our subsamples by sex and race were small, so we lacked statistical power for some comparisons, and our study is limited to a particular geographic region that would have unknown generalizability to other areas of the country.

Future research

More research is needed to identify how rates of alcohol consumption and binge drinking change over time in an effort to capture behaviors beyond the “critical window” as persons with SCI adjust to their injury outside of a rehabilitative setting. Population-based studies are needed that are not tied to clinical settings, so that alcohol behaviors reflect the full population of people with SCI. A longitudinal study using a population-based cohort over an extended period of time would provide a larger and more varied sample in which behavior changes could be observed as persons adjust to living with SCI. This research should include assessment of the underlying reasons for the decrease in alcohol consumption, as the current study could not address this. This may include investigation of readiness to change, functional status, and the availability of programs to assist in change. More importantly, there is a need to develop and test interventions promoting alcohol cessation. Promoting efforts that attenuate risky behavior such as alcohol consumption would result in positive health outcomes among those with SCI.

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Ethics approval None.

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