

# Higher Blood Alcohol Concentration is Related to Less Severe Injury Amongst Intoxicated Trauma Patients

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## Research article

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# Abstract

## Background

Previous studies show varied results regarding the protective effects of alcohol intoxication upon injury and mortality in the setting of trauma. Our study aimed to determine the effects of blood alcohol content (BAC) amongst trauma patients with alcohol ingestion, upon injury type and severity, as well as outcomes.

## Methods

This 4-year retrospective study (2013–2017) used an institutional trauma database to capture all Level 1 and 2 trauma patients ( $\geq 14$  years old) with BAC  $> 10$  mg/dL presenting to the emergency department at a Level 1 trauma center. Demographic variables including mechanism of injury (MOI) were collected. Patients' BAC was compared to their calculated injury severity scores (ISS) and abbreviated injury scale (AIS) scores. Analysis included linear regression, T-tests and ANOVAs with Tukey's post-hoc analysis for continuous variables and Fisher's exact test for binary variables. Multivariate regression analysis was performed to determine independent predictors of injury severity.

## Results

332 intoxicated patients were identified (mean BAC:  $210.2 \pm 87.14$  mg/dL, range 12.7–460.0; 74.1% male; median age 35; range: 16–90). The median ISS was 6 (range: 1–48). Patients in motor vehicle collisions had lower BACs ( $186.0 \pm 5.59$  mg/dL) than those who fell ( $233.8 \pm 10.42$  mg/dL,  $p = 0.0002$ ), were assaulted ( $230.4 \pm 14.04$  mg/dL,  $p = 0.0261$ ), or were pedestrians struck ( $259.4 \pm 14.17$  mg/dL,  $p = 0.004$ ). Overall, patients with higher BAC had lower GCS, lower ISS, and shorter intensive care unit (ICU) length of stay, but no differences in hospital stay, or ventilator days.

## Conclusions

Trauma patients with higher BAC have lower ISS, less severe chest injury, and shorter ICU stays. These findings suggest that higher levels of alcohol ingestion may portend a protective effect in the setting of trauma with respect to severity of injury that does not mitigate the importance of education and injury prevention but warrants further study into the physiology of alcohol and trauma.

## Introduction

Alcohol intoxicated patients represent a significant proportion of trauma patients presenting to the emergency department (ED).<sup>1</sup> This phenomenon represents a sizeable burden on hospital resources

leading to increased costs and interventions when compared to non-intoxicated patients.<sup>2,3</sup> Improving our understanding of how alcohol affects trauma patients can help guide management and improve outcomes in these patients. However, it is still unclear as to the role that alcohol ingestion plays in the mechanisms and physiology of trauma.

Several studies have examined the effects of alcohol on injury type and severity, but results have varied between study cohorts.<sup>4-7</sup> Some studies suggest that intoxicated patients have worse injuries. For example, one group found that pedestrians who had consumed alcohol were more injured (as determined by their Injury Severity Score (ISS)) and had longer hospital length of stay (LOS).<sup>8</sup> Other studies argue that alcohol has a protective effect in trauma. Although a recent study showed that ISS decreased with increasing levels of intoxication,<sup>5</sup> a separate study found no differences in injury severity stratified by levels of intoxication.<sup>9</sup> These studies, however, only examined patients who had been in motor vehicle collisions (MVC). Valdez et al. demonstrated that these associations observed between alcohol levels and injury exist, but only within a specific mechanism of injury (MOI).<sup>4</sup> They found that falls and bicycle accidents were associated with higher blood alcohol content (BAC), but only falls had a negative correlation between level of intoxication and injury severity. Across MOI, there was no difference in injury severity.

Even when focusing on specific injury types, studies lack consensus on the effects of alcohol.<sup>5,10</sup> For instance, studies examining the relationship between alcohol and traumatic brain injury (TBI) show conflicting data between injury severity and alcohol ingestion.<sup>9-14</sup> One study found that patients with higher BAC had less severe injury and correlated with a better survival rate.<sup>12</sup> A meta-analysis looking at outcomes of TBI after alcohol consumption, argues that while ingestion increases the incidence of brain injury, it is not related to the overall outcome.<sup>14</sup>

Despite intoxicated patients comprising a considerable fraction of trauma patients, the role of alcohol in this population remains a poorly understood area. Whereas several studies have compared intoxicated versus non-intoxicated patients, our study examines the impact of BAC upon injury severity and outcomes amongst trauma patients with known alcohol ingestion, with alcohol content as a continuous variable. We hypothesized that patients will be more severely injured with increasing BAC.

## **Methods**

### **Study Design and Setting**

This retrospective cohort study was performed at Westchester Medical Center in Valhalla, New York, using scanned patient charts of an American college of Surgeons/Committee on Trauma verified Level 1 regional trauma center. This study was approved by the Institutional Review Board of New York Medical College.

### **Selection of Participants**

Adult trauma patients (defined as patients age 14 or older presenting to the ED between 5/1/2013 and 4/30/2017) were identified by ICD 9 and 10 codes related to acute alcohol ingestion and intoxication (Table S1). Acute alcohol ingestion was determined by BAC > 10 mg/dL as this was the lowest limit of detection. Only patients with a level 1 or level 2 trauma activation were included in this study in order to ensure that included patients were evaluated and under the care of the trauma service from the time of patient arrival. Patients who were pregnant, transferred from another medical facility, or with incomplete charts were excluded.

## Measurements

Data were abstracted concurrently between June 2017 and August 2017 by two trained and monitored abstractors (MKM and NK) using an explicit protocol and the same precisely defined variables and standardized abstraction instrument. Approximately 50 charts were reviewed by both abstractors concurrently to ensure consistent measurement. Study variables were collected from patient medical records and the institutional trauma registry. Data were manually and independently checked for errors by searching for outliers and issues were resolved using the patient chart.

## Outcomes

The primary outcome of this study was the calculated Injury Severity Score (ISS) at time of admission to the ED as determined by our hospital trauma registry. Data collected included age, sex, race/ethnicity, mechanism of injury (MOI), Abbreviated Injury Scale (AIS), hospital and intensive care unit (ICU) length of stay (LOS), Glasgow coma scale (GCS), first systolic blood pressure (SBP), ventilator days, and in-hospital mortality. ISS, AIS, hospital and ICU LOS and ventilator days were obtained from the hospital's trauma registry database.

## Statistical Analysis

Analysis was performed using Prism 7.0a (GraphPad Software, Inc. La Jolla, CA). T-test and ANOVA (with Tukey's post-hoc analysis) were used for continuous variables and a Fisher's exact test was used for binary variables. Multivariable regression analysis was performed. We defined significance at  $P < 0.05$  and all variance is shown using standard error of the mean. Except for 2x2 analysis, the median and interquartile range (IQR) is shown for continuous variables and number (%) is shown for categorical values. For the 2x2 analysis, the %value is shown with the calculated 95% confidence interval. Covariates included in the model were chosen based upon their clinical relevance and a p-value of  $< 0.2$  in univariate analysis.

# Results

## Characteristics of Study Participants

Of the 1,347 patients that were found to have had alcohol ingestion, 437 of these patients presented to the ED as Level 1 or Level 2 trauma activations; and of these, 332 had complete data with all variables,

and were therefore included as the study population (Figure 1). Demographics of the study population are represented in Table 1. The mean age was 39.1 (range: 16-90), 246 (74.1%) were male, and 188 (56.6%) were white (Table 1). The mean BAC was 210.2 mg/dL (SD: 87.14) and the median ISS was 6 (range: 1-48). Overall, the majority of injuries (53.3%) were a result of motor vehicle accidents, followed by falls (24.7%), assaults (11.4%), pedestrians struck (5.4%), and other mechanisms (5.1%; Table 1).

## Main Results

To understand the effect of BAC on the severity of injury, linear regression was performed, examining the correlation between BAC and ISS across all mechanisms of injury (MOI). This analysis showed that those with a higher BAC had a lower ISS (mean ISS:  $9.87 \pm 9.41$ ,  $p=0.035$ ,  $R^2=0.013$ ). A positive correlation was found between the patient's age and their BAC ( $p = 0.005$ ,  $R=0.154$ , Table 2), however there was no association with a patient's sex or race. When examining the effect of BAC on injury patterns (each body region individually as determined by the AIS), we found there was a negative, linear relationship between BAC and thoracic AIS (mean thoracic AIS:  $2.43 \pm 0.90$ ,  $p=0.024$ ,  $R^2=0.232$ ), but no significant relationships between BAC and other body regions (Table 3).

Given that there may be inherent differences in patients based upon mechanism of injury (MOI), and to therefore determine the relationship of BAC to the MOI, a comparison between MOI was performed using an ANOVA. Patients who were in motor vehicle accidents had lower BACs ( $186.0 \pm 5.59$ ) than patients who fell ( $233.8 \pm 10.42$ ,  $p = 0.0002$ ), were assaulted ( $230.4 \pm 14.04$ ,  $p = 0.0261$ ), or were struck as pedestrians ( $259.4 \pm 14.17$ ,  $p = 0.004$ , Figure 2). When controlling for variables such as age, ethnicity, sex, insurance status, drug use, GCS, and SBP, and when taking into account MOI, regression analysis demonstrated that BAC is an independent negative predictor of ISS ( $p < 0.05$ ).

In addition to the severity and mechanism of injury, we also studied the relationship of BAC and in-hospital outcomes. Amongst all patients included in the study (across all MOI), on arrival to the emergency department, patients with a higher BAC had a lower GCS (mean GCS  $13.3 \pm 3.72$ ,  $p=0.021$ ,  $R^2=0.018$ ), but no significant differences in systolic blood pressure (SBP). BAC levels were also compared between patients admitted to the ICU and non-ICU patients (Table 2). There was no significant difference between groups ( $218.4 \pm 83.61$  vs  $204.8 \pm 89.14$  respectively,  $p=0.1655$ ). Of the patients who were admitted to the ICU ( $n=130$ , 39.1%), those with a higher BAC had shorter ICU stays ( $5.68 \pm 7.80$ ,  $p=0.009$ ,  $R^2=0.048$ ). There were no differences in overall hospital LOS or ventilator days, or mortality between patients.

Interestingly, 6 of 7 deaths in our cohort had a BAC greater than 200 mg/dL (Table S2). Of these 7 patients, 5 patients died secondary to injuries related to falls and the other 2 were a result of MVCs. When comparing these patients, there were no significant differences in ISS or secondary outcomes as compared with their BAC. In addition, when removing these patients from analysis, a high BAC was still associated with a lower ISS, ICU LOS, and GCS.

Because the MOI varied significantly among patients in this study, the effect of BAC upon injury type and severity were compared within each MOI (Table 4). Patients who were assaulted were the only subgroup

in which a higher BAC (mean: 230.4±86.55 mg/dL) correlated with a lower ISS (mean 4.6±4.93, p=0.046, R<sup>2</sup>=0.106). In the MVC cohort, BAC (mean: 186.0±74.23 mg/dL) was positively correlated with age (mean: 35.4±14.68, R=0.179, p=0.017) and higher BAC was associated with a shorter ICU LOS (6.7±9.45 days, p=0.088, R<sup>2</sup>=0.043). In the cohort of patients who were injured secondary to a fall (n=82), patients with higher BAC (mean: 233.8±94.36) had lower GCS (mean: 12.7±3.89, p=0.011, R<sup>2</sup>=0.093). Sixty two (75.6%) of these patients had documented loss of consciousness (LOC), and 57(69.5%) had a head AIS of <sup>3</sup> 1 (mean AIS=2.6±1.28), however there was no association between BAC and head AIS (p=0.86). Finally, in the cohort of patients that were struck as pedestrians, patients with a higher BAC (mean = 259.4±60.13) had less severe lower extremity injury (mean AIS=2.0±0.89, p=0.048, R<sup>2</sup>=0.665). In all other comparisons within MOI subgroups, BAC had no correlation with outcomes.

There were 48(14.4%) patients who had concurrent drug use in addition to alcohol ingestion. Cannabinoids (5.4%), benzodiazepines (2.4%), cocaine (1.8%) were the most common drugs. 3.9% of patients had multiple polysubstance use. BAC was not a predictor of ISS in this subgroup, however, a higher BAC (mean:198.6±89.52 mg/dL) was associated with an older age (mean: 35.9±12.75, R=0.137, p=0.021), and longer ventilator days (mean: 3.1±3.17 days, p=0.006, R<sup>2</sup>=0.164, Table 5a). There were no differences between those who had used drugs and those who had not (Table 5b). Overall, when including concurrent drug use in multivariable regression, BAC was still associated, amongst all MOI, as a negative predictor of ISS.

## Discussion

From a public health standpoint, the dangers of alcohol ingestion and intoxication are well known with respect to the impact on a wide range of mechanisms of trauma – motor vehicle accidents, assault, domestic violence and falls to name a few. The emphasis on preventing trauma related injuries due to alcohol cannot be underscored enough. However, various studies have shown conflicting results regarding the effects of alcohol on trauma related outcomes. One study found that a higher BAC was associated with more unintentional injury and increased head trauma; however, it was also associated with decreased extremity injury and no significant difference between ISS.<sup>15</sup> In contrast, Dultz et al. found that intoxicated pedestrians struck by motor vehicles had higher ISS than non-intoxicated patients.<sup>8</sup> Yet another study found that patients with blunt head injuries from MVCs with a BAC from 8 to 100 mg/dL had increased mortality rates compared to those with higher BAC levels.<sup>11</sup> They found that patients with a BAC < 8mg/dL had lower ISS and mortality rates compared to all intoxicated groups. Additionally, patients with a BAC from 100 to 230 mg/dL and patients with a BAC <sup>3</sup> 230 mg/dL had lower mortality rates than the BAC 8 to 100 mg/dL group. Interestingly, they failed to find significant differences in ISS between intoxicated groups. All of these studies add to the literature of trauma related to alcohol ingestion but fail to come to a consensus.

In contrast, our study focuses on the trauma patient population that has ingested alcohol, and examines the impact of blood alcohol content (BAC) upon injury severity and in-hospital outcomes. In examining

the severity of injury in relation to the level of intoxication of patients presenting to the ED, we found that, across all mechanisms of injury, those with higher BAC tended to have less severe injuries and shorter ICU stays. With respect to in-hospital outcomes, in our study, BAC was a negative predictor of ISS, and ICU LOS across all mechanisms of injury when controlling for ISS and MOI. Multivariate analysis of our cohort also demonstrated that BAC was one of five independent predictors of ISS, along with GCS, drug use, MOI, and race. These results suggest that alcohol may have a protective role in trauma.

Given that the mechanism of injury can determine the severity or pattern of injury by itself, we performed a subgroup analysis within each MOI. Here, we found that there were significant differences in BAC when comparing between MOI. While MVCs were the most frequent overall cause of injury in this cohort, patients in MVCs had significantly lower BACs than those who fell, were assaulted, or were pedestrians struck. This suggests that the BAC alone cannot account for injury severity, and in fact, MOI was shown to be an independent predictor of injury severity as well. MVCs and falls represented the majority of the causes of injury (53.3% and 24.7%, respectively). One could postulate that the level of intoxication may impair function to a level that favors certain mechanisms over others. Valdez et al. found that BAC was highest in patients who fell from standing, fell from heights, or were in bicycle collisions and lowest in assaults and pedestrians struck.<sup>4</sup> It is possible that these findings are a result of the intoxication status of patients, in that those who are more intoxicated are more likely to fall before they could even make it to a car, but this hypothesis would need to be tested in future studies.

Similar studies have found differing results in terms of the incidence and severity of injury as a whole (as determined by ISS) and in different body regions (as determined by Abbreviated Injury Scores or AIS). In a large retrospective study of Los Angeles County, Liou et al. found that intoxicated patients brought to the ED after MVCs had fewer abdominal, pelvic, and chest injuries, suggesting that the mechanism of injury alone may not account for differences between groups.<sup>5</sup> Similarly, Plurad et al. found that BAC was not associated with injury severity in MVCs, those with a lower BAC had increased incidence of spinal injury.<sup>9</sup> In subgroup analysis, we found that a higher BAC was associated with a lower ISS only in patients who were assaulted, suggesting that MOI may be a major factor involved in determining injury severity. We then looked at the location of injury to see if there were increased incidence or severity within a specific body region. In the entire cohort, higher BAC was associated with less severe chest trauma as determined by the AIS. Within MOI, a higher BAC was associated with less severe lower extremity injury in pedestrians struck by cars. All other comparisons between BAC and injury location or severity were not statistically significant.

After determining the severity and location of injuries, we looked at the hospital course of these patients in total, and within each MOI. Upon arrival, patients with a higher BAC had a lower GCS. This finding is likely a result of BAC affecting the neurological assessment. DiGiorgio et al., for instance, suggests that alcohol and drug use can interfere with initial GCS assessment, by showing that there is a greater change in GCS score in impaired patients in follow up GCS assessments.<sup>16</sup> We found that there was no difference in BAC between patients who were later admitted to the ICU and those who were not. However, it is also interesting that, in those admitted to the ICU, patients with higher BAC had shorter ICU LOS, but

no difference in hospital LOS. This is in contradiction to Rau et al., who showed that intoxicated patients have decreased initial GCS, but shorter hospital LOS in patients with an ISS < 16. These data suggest that alcohol may acutely cloud the assessment of severity of patient's injury in those admitted to the ICU, leading to quicker discharge specifically from the ICU, but does not affect their overall hospital course. Interestingly, patients who fell had lower GCS with increasing BAC. There are conflicting reports regarding the influence of alcohol on GCS, but this supports various studies that show that GCS assessment is affected by alcohol.<sup>16-18</sup> There were no other significant relationships between BAC within MOI in respect to hospital course.

The mechanisms underlying alcohol's potential protective effect remain poorly understood. Functionally, a patient is less capable to perform tasks the more intoxicated they are, and thus may lead to a change in the MOI of trauma. Popular belief also alludes to the "floppy patient" that is less injured because they are more relaxed throughout the course of a traumatic event, however no studies have fully investigated this as a potential mechanism.<sup>4</sup> Several studies suggest that underlying physiology of alcohol metabolism may play a role in injury severity both during and after trauma.<sup>6,19,20</sup> Animal studies show decreased inflammatory cytokines after brain injury in intoxicated rats.<sup>19</sup> One clinical study demonstrates that acutely intoxicated patients have decreased white blood cells and IL-6, which would normally play a role in the inflammatory response to an injury.<sup>20</sup> This was confirmed in another study which looked specifically at the neuroprotective effects of alcohol in traumatic brain injury.<sup>6</sup> It is unlikely that these mechanisms play a major role in injury severity, but further investigation is required to better understand these trends.

Several limitations exist within this study that should be acknowledged. As a retrospective cohort study, our study is subject to biases that have been previously described in the literature.<sup>21</sup> For instance, factors that may affect general outcomes such as frailty and anticoagulant use were not available to be studied. A prospective study would allow concurrent collection of such data, and shed light upon the interaction of BAC with other pre-hospital variables. Furthermore, initial identification of patients was based purely on ICD 9 and 10 codes related to alcohol intoxication. This may have excluded patients who were intoxicated but did not have appropriate ICD coding. Additionally, during our study, ICD codes changed, which may have affected our initial patient identification. However, comparing BAC levels of trauma patients between years demonstrated that there were no significant differences ( $p = 0.1845$ ).

Variations in findings between this study and others that examine the effect of alcohol on injury severity may result from local variations among study populations and the utilization of our tertiary care center versus community hospitals. Relevant studies looked at diverse demographic and geographic communities, from our own study in the suburbs of New York City, to LA county<sup>5</sup> and even Taiwan<sup>7,22</sup>. Meta-analysis of these studies should be performed to normalize the demographic and geographical differences to more accurately determine alcohol's effect on injury.

## Conclusions

In this study we aimed to further elucidate alcohol's relationship with injury severity. Increased blood alcohol concentration was associated a lower severity of injury. The public health concerns of alcohol abuse remain a significant concern. However, the physiologic effects of alcohol as it pertains to injury warrants further investigation on both a clinical and basic science level. While we demonstrated that increased BAC is associated overall with decreased ISS, shorter ICU LOS, and less severe chest injury, further investigation in the form of prospective cohort trial or meta-analysis, is needed to confirm these findings.

## Abbreviations

BAC  
Blood Alcohol Concentration  
MOI  
Mechanism of Injury  
AIS  
Abbreviated Injury Score  
ISS  
Injury Severity Score  
GCS  
Glasgow Coma Scale  
ICU  
Intensive Care Unit  
ED  
Emergency Department  
LOS  
Length Of Stay  
MVC  
Motor Vehicle Collisions  
SBP  
Systolic Blood Pressure  
IQR  
Interquartile Range

## Declarations

### Author Contributions

NK conceived of the presented idea, NK and MKM extracted and analyzed data. DJS and EHT verified the analytical methods. NK designed figures for the manuscript. NK and MKM wrote the initial draft. KP and RL provided oversight of study design, data analysis, critical revisions and insight to the article. All authors discussed the results and contributed to the final manuscript.

### Conflict of Interest:

None of the authors have any conflicts of interest to declare

### Ethical Standards:

All human and animal studies have been approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments. This study was approved by an institutional review board (IRB).

### Acknowledgements:

None

### Consent to Participate:

De-identified, retrospective data was used and a waiver for consent was obtained from our institutional review board.

### Availability of data and materials:

The data and analysis are stored in our institutional repository.

### Competing Interests and Funding:

None

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## Tables

**Table 1: Patient Demographics**

Characteristic		Total (n = 332)
Median Age (range)		35 (16-90)
Male Sex		246 (74.1%)
Trauma Level 1		80 (24.1%)
Trauma Level 2		252 (75.9%)
Race/Ethnicity	White	188 (56.6%)
	Hispanic	83 (25.0%)
	Hispanic White	26 (7.8%)
	Hispanic Black	2 (0.6%)
	Black	17 (5.1%)
	Other/missing	44 (13.3%)
	Mechanism of Injury	
MVC	177 (53.3%)	
Falls	82 (24.7%)	
Assault	38 (11.4%)	
Pedestrian Struck	18 (5.4%)	
Other	17 (5.1%)	

BAC = blood alcohol content; MVC = motor vehicle collision

**Table 2: BAC as a predictor of injury severity and in-hospital outcomes**

Characteristic	Average (SD)	B	R <sup>2</sup>	p-value
Age*	39.1 (16.6)	0.154	0.154	<b>0.005</b>
ISS	9.87 (9.41)	-0.013	0.013	<b>0.035</b>
GCS	13.3 (3.72)	-0.006	0.018	<b>0.021</b>
SBP (mmHg)	133.6 (21.29)	-0.017	0.005	0.2
Hospital LOS (d)	4.16 (6.96)	-0.008	0.01	0.07
ICU LOS (d)	5.68 (7.80)	-0.02	0.048	<b>0.009</b>
Ventilator Days (d)	7.00 (8.55)	-0.007	0.006	0.074

\*Correlation

BAC = blood alcohol content; ISS = injury severity score; GCS = Glasgow coma scale; SBP = systolic blood pressure; LOS = length of stay; ICU = intensive care unit

### Table 3: Injury Location

AIS scores as determined by the trauma team. Chest injuries were more common with lower BAC. There were no other differences in injury location.

AIS Region	n (%)	Average (SD)	B	R <sup>2</sup>	p-value
Head	159 (47.9)	2.48 (1.17)	-0.001	0.003	0.372
Face	136 (41.0)	1.31 (0.51)	0.000	0.001	0.747
Neck	15 (4.5)	2.20 (0.86)	0.002	0.026	0.563
Chest	94 (28.3)	2.44 (0.90)	-0.002	0.232	<b>0.024</b>
Abdomen	43 (13.0)	2.07 (0.96)	-0.002	0.021	0.348
Spine	61 (18.4)	2.44 (0.83)	0.000	0.001	0.832
Upper Extremity	96 (29.0)	1.66 (0.63)	0.000	0	0.864
Lower Extremity	97 (29.2)	1.64 (0.72)	0.000	0.001	0.813
External	45 (13.6)	1.02 (0.15)	< -0.001	0.002	0.79

AIS = abbreviated injury severity; BAC = blood alcohol content; OR = odds ratio

### Table 4: BAC compared with injury severity and hospital course within MOI

BAC	Age		ISS		GCS		SBP		Hospital LOS		ICU LOS		Ventilator Days	
	R	p	R <sup>2</sup>	p	R <sup>2</sup>	p	R <sup>2</sup>	p	R <sup>2</sup>	p	R <sup>2</sup>	p	R <sup>2</sup>	p
186.0 (74.43)	<b>35.4</b> <b>(14.68)</b>		10 (10.37)		13.6 (3.68)		<b>134.4</b> <b>(20.64)</b>		4.4 (8.07)		6.7 (9.45)		8.7 (10.33)	
	<b>0.18</b>	<b>0.02</b>	<b>0.01</b>	<b>0.19</b>	<b>0.00</b>	<b>0.54</b>	<b>0.02</b>	<b>0.05</b>	<b>0.01</b>	<b>0.27</b>	<b>0.04</b>	<b>0.09</b>	<b>0.02</b>	<b>0.09</b>
233.8 (94.36)	49.4 (19.33)		12.1 (8.64)		<b>12.7</b> <b>(3.89)</b>		132.2 (24.63)		4.7 (5.73)		5.1 (5.97)		5.9 (6.85)	
	-0.07	0.55	0.00	0.58	<b>0.09</b>	<b>0.01</b>	0.00	0.91	0.02	0.22	0.04	0.16	0.01	0.54
230.4 (86.55)	33.2 (10.04)		<b>4.6</b> <b>(4.94)</b>		13.6 (3.38)		134.6 (19.08)		1.7 (4.42)		4.6 (8.05)		3.8 (5.50)	
	0.27	0.11	<b>0.11</b>	<b>0.05</b>	0.00	0.73	0.01	0.64	0.02	0.45	0.21	0.44	0.00	0.89
259.4 (60.13)	38.1 (14.40)		10.1 (7.61)		13.6 (3.72)		132.9 (21.56)		5.1 (6.30)		4.7 (5.52)		7.0 (7.61)	
	0.28	0.26	0.08	0.26	0.03	0.56	0.03	0.50	0.02	0.54	0.09	0.39	0.00	0.90
249.9 (123.42)	43.2 (13.99)		9.8 (7.84)		12.5 (4.12)		130.1 (15.79)		3.4 (3.84)		2.3 (1.50)		2.0 (0)	
	-0.02	0.95	0.10	0.02	0.04	0.57	0.17	0.21	0.14	0.26	0.21	0.44	0.01	0.80

**Table 5: Drug Use** a) Linear regression within cohort b) comparison of drug users and non-drug users

5a					5b			
Characteristic	Average (SD)	B	R <sup>2</sup>	p-value	Characteristic	Drug Use n=48 avg (SD)	No Drug Use n=284 avg (SD)	p-value
Age*	35.9 (12.75)		0.258	0.077	BAC	198.6 (89.5)	212.1 (86.7)	0.3224
ISS	8.9 (8.24)	-0.014	0.023	0.301	Age	35.88 (12.8)	39.69 (17.1)	0.1415
GCS	12.6 (4.52)	-0.009	0.034	0.257	ISS	8.875 (8.2)	10.04 (9.6)	0.4276
SBP (mmHg)	137.8 (17.87)	-0.005	0.001	0.864	GCS	12.63 (4.5)	13.42 (3.6)	0.2098
Hospital LOS (d)	3.5 (5.73)	-0.003	0.002	0.74	SBP (mmHg)	137.8 (17.9)	132.9 (21.8)	0.1365
ICU LOS (d)	3.6 (4.95)	-0.002	0.002	0.827	Hospital LOS (d)	3.479 (5.7)	4.278 (7.2)	0.4629
Ventilator Days (d)	3.1 (3.17)	0.002	0.164	<b>0.006</b>	ICU LOS (d)	3.583 (5.0)	6.151 (8.3)	0.1458
					Ventilator Days (d)	3.071 (3.2)	8.1 (9.3)	0.051

## Figures

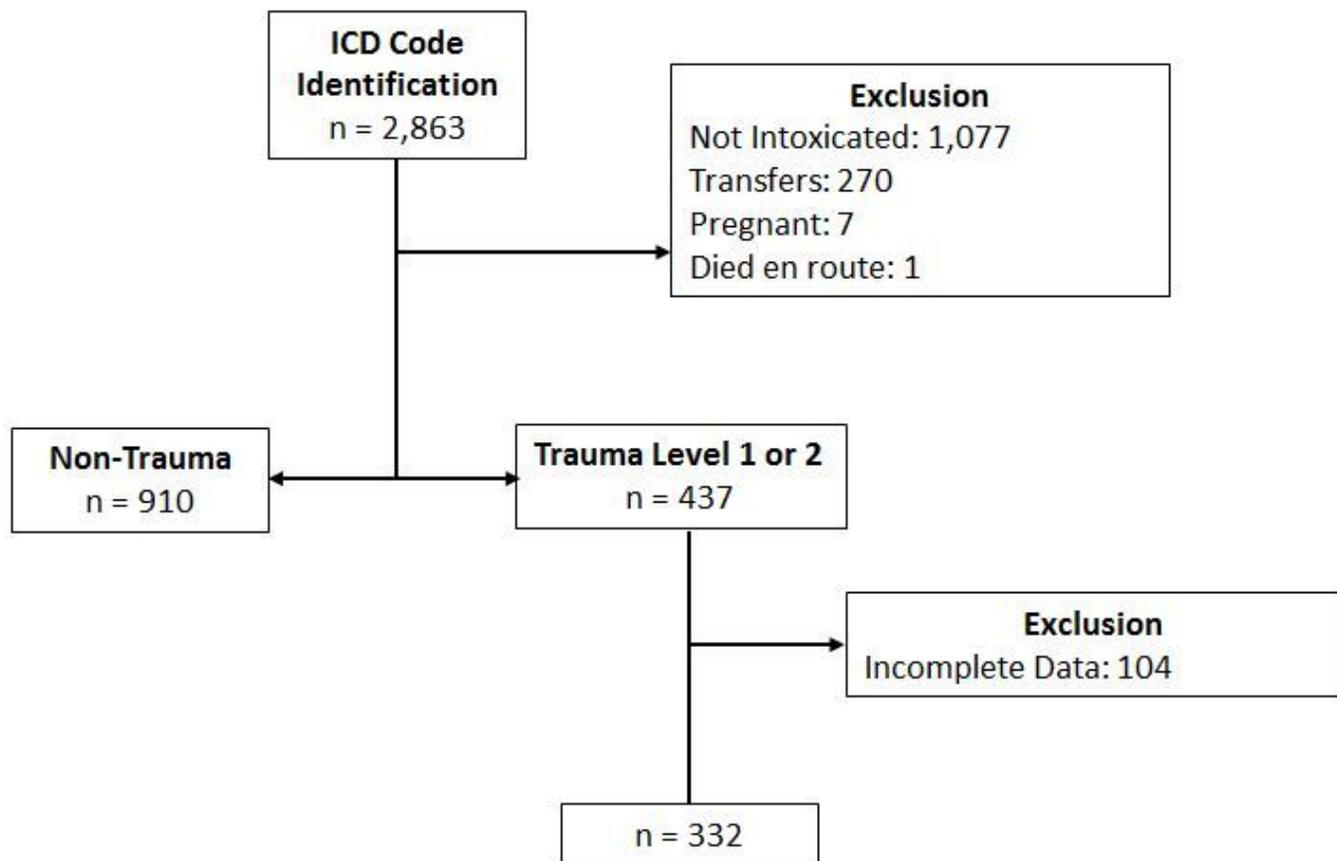


Figure 1

Participant Selection

# Mechanism of Injury

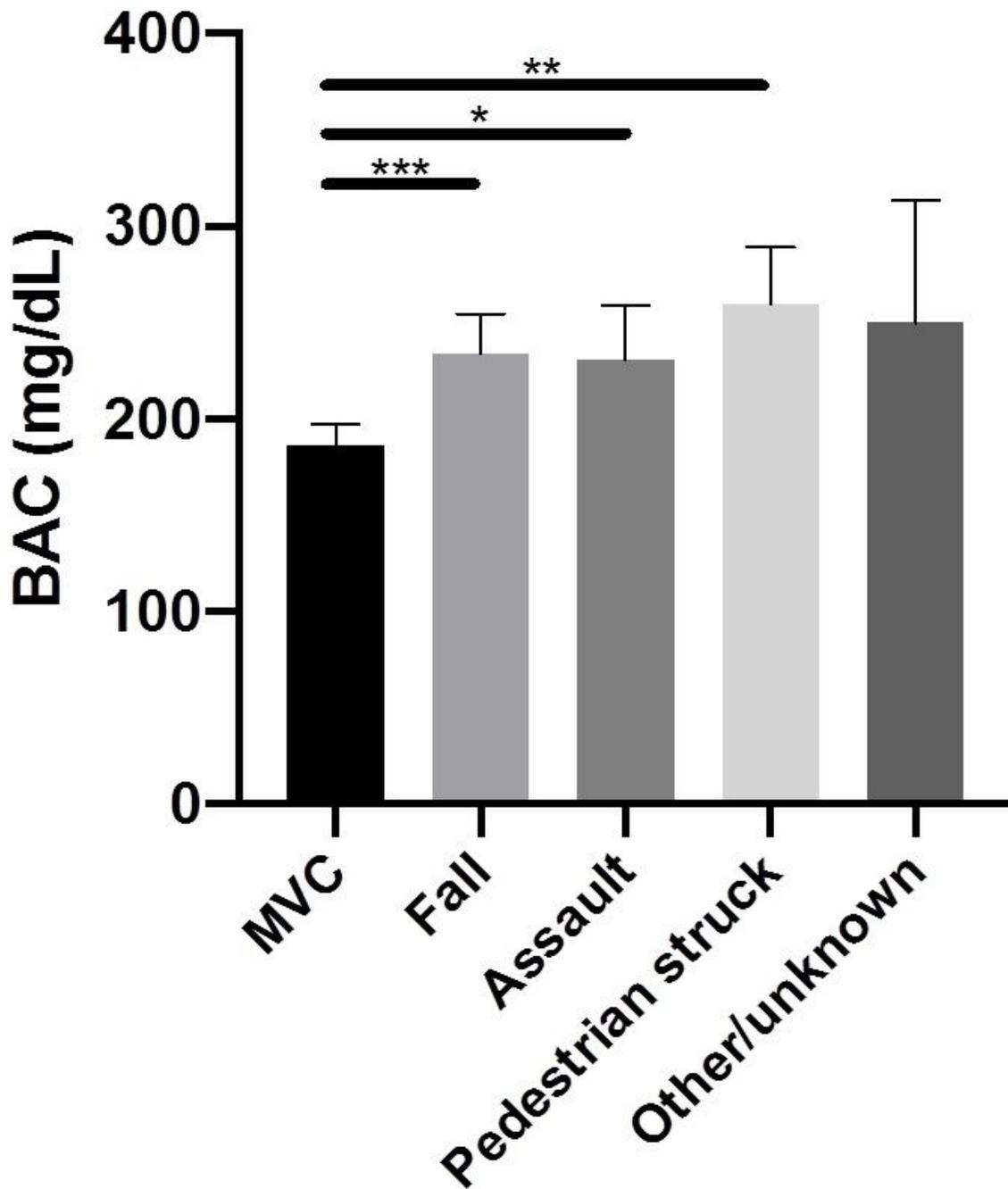


Figure 2

MOI ANOVA The BAC among different mechanisms of injury were compared using an analysis of variance (ANOVA). There were significant differences between MVC and falls; MVCs and assaults; and MVCs and pedestrians struck. BAC = blood alcohol content; MVC = motor vehicle collision. Error bars are shown as SEM. \*  $p < 0.05$ ; \*\*\*  $p < 0.001$ ; \*\*\*\*  $p < 0.0001$