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Correlation between Alcohol Use Disorders, Blood Alcohol Content, and Length of Stay in Trauma Patients

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Abstract

Background: Patients with an alcohol use disorder (AUD) have an increased risk of developing complications during their hospital stays; however, how AUD impacts the length of stay (LOS) and the utilization of hospital resources remains inconclusive. **Aim:** This study aimed to identify the associations between AUD, defined by self-reported alcohol consumption, blood alcohol content (BAC), and hospital LOS (HLOS) including intensive care unit (ICU) LOS in the trauma patient population. **Study Design:** We conducted a retrospective study analyzing data obtained from 2010 to 2018 at a university-based, level-one trauma emergency department. We identified 1689 adult trauma patients who completed the AUDs identification test (AUDIT) and were admitted to the hospital. We retrieved BAC, age, gender, LOS, and injury severity score (ISS) from the patient charts. The independent samples' median test was used to assess the association of HLOS and ICULOS with ISS, BAC levels, or AUDIT scores. **Results:** ISS was directly associated with higher HLOS ($P < 0.001$) and ICULOS ($P < 0.001$); however there was no statistically significant association between AUDIT scores and ICULOS ($P = 0.21$) or HLOS ($P = 0.86$). There was also no statistically significant association between BAC and HLOS ($P = 0.09$) or ICULOS ($P = 0.07$). **Conclusions:** Our study found no associations between AUDIT, BAC, and both hospital and ICU LOS in trauma patients even though the literature supported an increased risk of medical complications in the AUD patients.

Keywords: Alcohol use disorder, alcohol, blood alcohol, length of stay, trauma

INTRODUCTION

Alcohol-related emergency department (ED) visits have significantly increased within the past decade. White *et al.*^[1] reported that the number of ED visits related to alcohol consumption increased from 3,080,214 visits in 2006 to 4,976,136 visits in 2014. These ED visits demonstrated that acute and chronic alcohol use not only causes individual health issues but also further strains health-care systems in time, resources, and cost.^[2]

Alcohol is responsible for approximately half of all traumatic fatalities and nonfatal injuries in the United States.^[3,4] Specifically, at the time of admission, up to 50% of trauma patients have a positive blood alcohol content (BAC). Within the same year, more than 10% of the same patients would visit the same hospital for a new injury.^[5] Traumatic injuries are classified by their severity using the injury severity

score (ISS). The ISS scores range from 1 to 75, and the risk of death increases with a higher score. An ISS of 1–15 is minor or moderate; 16–24 is severe; and >24 is very severe. The American College of Surgeons (ACS) trauma registry found that patients with positive BAC screenings have significantly higher incidence of admission and mortality compared to negative BAC screenings.^[3,4]

Since 2006, the ACS Committee of Trauma mandated that all trauma patients should receive alcohol screening and

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intervention as part of the screening, brief intervention, and referral to treatment (SBIRT) program. The alcohol use disorders identification test (AUDIT) is a self-reporting alcohol use survey which is recommended by the National Institute on Alcohol Abuse and Alcoholism. AUDIT is a ten-question survey that inquires about individual alcohol use within the past year. Available from: <https://www.drugabuse.gov/sites/default/files/files/AUDIT.pdf>. The AUDIT score ranges from 0 to 40 and is divided into three categories according to associated health risk and recommended intervention. Patients with scores of 0–7 are considered not at-risk for alcohol-related health issues and do not require any intervention. Patients with AUDIT scores of 8–19 are considered as hazardous users and a brief negotiated intervention is recommended. The patients with AUDIT scores of 20 and over are considered as dependent alcohol users and require long-term intervention with social worker referral. The routine method for alcohol screening in a standard clinical setting is the BAC level; however, its detection window is small and does not account for patients' habitual drinking patterns. Although certain self-reporting biases may exist, AUDIT is a well-validated and reliable measure of habitual consumption for the majority of patients.^[6]

Previous literature has established an increased risk of developing medical complications in patients with positive BAC, chronic alcoholism, and alcohol use disorders (AUD).^[7–14] Many studies also found a significant increase in the number of procedures for patients with positive BAC and alcohol dependence, but reports on the associations between hospital length of stay (HLOS), intensive care unit length of stay (ICULOS), and BAC were inconclusive, especially in the trauma population.^[8,15] Therefore, our study aimed to identify whether an association between AUDIT scores and BAC with hospital or ICULOS in the trauma patient population exists. To increase the homogeneity of our sample, we specifically targeted trauma patients who were admitted to the hospital. We hypothesized that patients with higher AUDIT scores will have longer HLOS and ICULOS due to their increased chance of medical complications and rehabilitation needs.

MATERIALS AND METHODS

Study setting and design

We conducted a retrospective, chart review study on databases that were obtained at a level one trauma center, tertiary care, university-based ED between 2010 and 2018. The databases included data from both English and Spanish-speaking trauma patients aged 18 and over. Subjects were classified as trauma patients if they met the trauma activation criteria and were evaluated by a trauma surgeon [Supplemental Document 1]. All of these patients completed the AUDIT. The study was reviewed and approved by the university's Institutional Review Board as an exempt category. Patient informed consent was not applicable to this study.

Study protocol

The data were obtained from two databases: the trauma registry and the computerized alcohol screening and

intervention (CASI) program. The trauma registry database compiles patient information from patients who met trauma activation criteria as part of quality assurance. Data analysts obtained patient demographics; nurse abstractors obtained patient injuries, treatments, BAC, and diagnoses/outcomes. This study obtained LOS, BAC, and ISS from this database. Trauma-activated patients received venous blood draws to calculate BAC as part of the trauma evaluation protocol when the trauma surgeons deemed appropriate. Approximately 12% of the data sample did not have BAC documented.

The AUDIT scores analyzed were extracted from the CASI database. The database was obtained by trained research associates (RAs). Implementation of this screening protocol was standard of care for trauma patients from 8:00 AM to midnight in the ED and 8:00 AM to noon in the inpatient units. The RAs asked patients to complete the AUDIT on a CASI tablet privately, unless the patient specifically requested assistance from the RAs. Responses to each question were kept confidential. The AUDIT score is shared with the patient and a printout of the score is attached to the patient's medical record. We excluded patients who were on a psychiatric hold, incarcerated, pregnant, or refused the screening. For patients with cognitive impairments such as acute intoxication, altered mental status, and critical illness, the RAs approached the patients once their conditions were resolved. AUDIT results and demographic information were electronically recorded and automatically stored in a secured hospital database. We extracted patient demographic data and AUDIT scores from this database.

We linked the two databases by a unique identifier for each patient using Python software (Van Rossum, G., & Drake Jr, F. L. (1995). Python reference manual. Centrum voor Wiskunde en Informatica Amsterdam). The HLOS and ICULOS were considered as outcome measures.

Statistical analysis

Data were analyzed by IBM SPSS Statistics for Windows, Version 25.0. (Armonk, NY: IBM Corp). The distribution of categorical variables is presented as count (percentage) and the distribution of continuous variables as mean \pm standard deviation (SD).

The distribution of age across groups was compared using Student's *t*-test. The association between BAC and AUDIT was analyzed using the independent samples Kruskal–Wallis test. The independent samples' median test was used to assess the association of HLOS and ICULOS (as dependent variables) with ISS or BAC levels or AUDIT scores (as independent variables). $P < 5\%$ was considered statistically significant.

RESULTS

We identified 1689 trauma patients who completed the AUDIT questionnaire and were admitted to the ICU. Four records were excluded because of extreme outlier LOS. About 1147 patients (68.1%) were male with the mean age of 47.0 ± 20.83 , and 538 (31.9%) were female with the

mean age of 58.9 ± 24.71 ($P < 0.001$). According to the AUDIT, 1454 patients (86.3%) were at low risk for hazardous drinking behaviors [Table 1]. Of the total sample, 845 (50.1%) patients had an ISS between 1 and 15, 494 (29.3%) patients had an ISS between 16 and 25, and 346 (20.5%) patients had an ISS >25 [Table 1]. About 1477 (87.7%) patients had BAC records on file [Table 1]. BAC ranged from 0.0 to 596.0 mg/dl (mean: 45.5, SD: 97.1, median: 0). There was an association between BAC and AUDIT scores in our patient population ($P < 0.001$) [Figure 1].

Figure 2 shows the association of HLOS with AUDIT scores adjusted for ISS. The association of ICULOS with AUDIT scores adjusted for ISS is shown in Figure 3.

While ISS was directly associated with higher HLOS ($P < 0.001$) and ICULOS ($P < 0.001$), there was no statistically significant association between AUDIT and ICULOS ($P = 0.21$) or HLOS ($P = 0.86$) [Table 1].

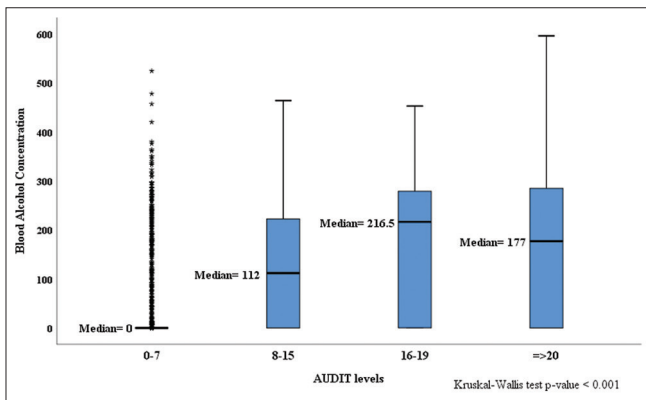


Figure 1: Association of blood alcohol content with alcohol use disorders identification test scores

The associations of HLOS and ICULOS with BAC adjusted for ISS levels are shown in Figures 4 and 5, respectively. There was no statistically significant association between BAC and HLOS ($P = 0.09$) or ICULOS ($P = 0.07$) [Table 1].

DISCUSSION

Since the ACS Committee on Trauma mandates for SBIRT, AUDIT has been routinely used by health-care personnel to determine which trauma patients were at risk for AUD. Further research has found that alcohol causes impairments in the human host immune system and delays the healing process.^[16-21] However, we found no significant difference in LOS between trauma patients who were at risk for alcohol dependence and those who reported alcohol abstinence. HLOS

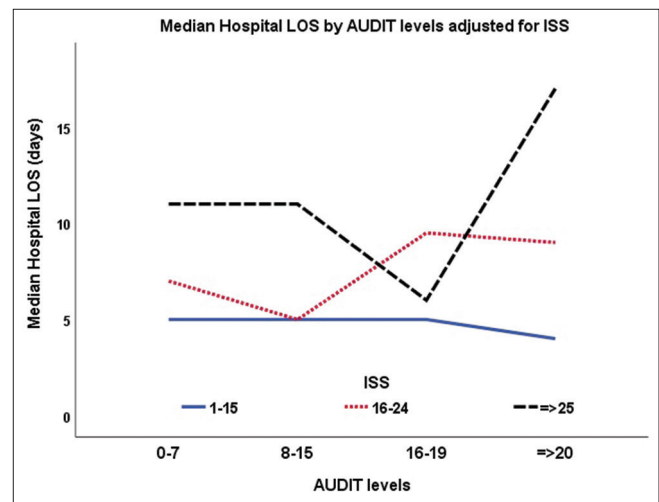


Figure 2: Association of hospital length of stay with alcohol use disorders identification test and injury severity scores

Table 1: Intensive care unit length of stay and hospital length of stay by alcohol use disorders identification test scores and injury severity score levels

	n	Hospital LOS					ICU LOS				
		Minimum	Maximum	Mean±SD	Med	P	Min	Max	Mean±SD	Med	P
ISS											
1-15	845	1	51	6±6	5	<0.001	1	21	3±2	2	<0.001
16-24	469	2	73	9±8	7		1	26	4±3	3	
≥25	371	2	163	14±14	11		1	39	6±6	4	
BAC											
0.0	1074	1	64	8±7	6	0.09	1	6	4±3	3	0.07
0.1-100.0	131	1	163	11±17	7		1	39	4±5	3	
101.1-250	172	1	61	9±9	6		1	25	3±3	2	
>250.0	100	1	47	8±8	5		1	35	4±4	3	
AUDIT											
0-7	1454	1	163	9±10	6	0.86	1	39	4±4	3	0.21
8-15	136	1	39	8±6	5		1	24	3±3	3	
16-19	39	1	30	8±6	5		1	11	3±2	3	
≥20	56	2	33	9±8	6		1	17	3±3	3	

LOS: Length of stay, SD: Standard deviation, med: Median, ISS: Injury severity score, BAC: Blood alcohol concentration, AUDIT: Alcohol use disorders identification test

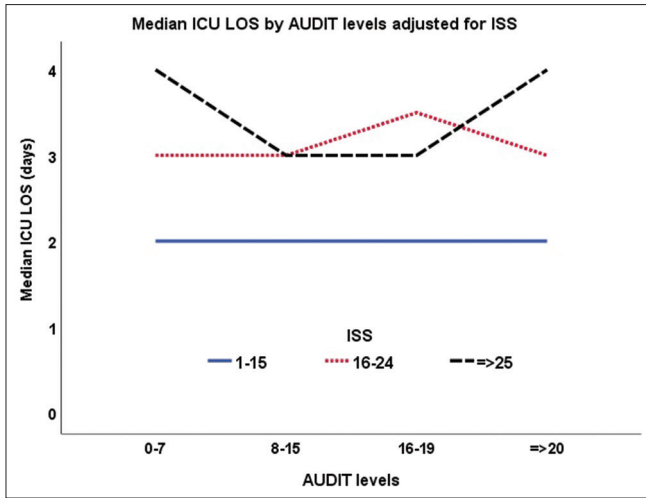


Figure 3: Association of intensive care unit length of stay with alcohol use disorders identification test and injury severity scores

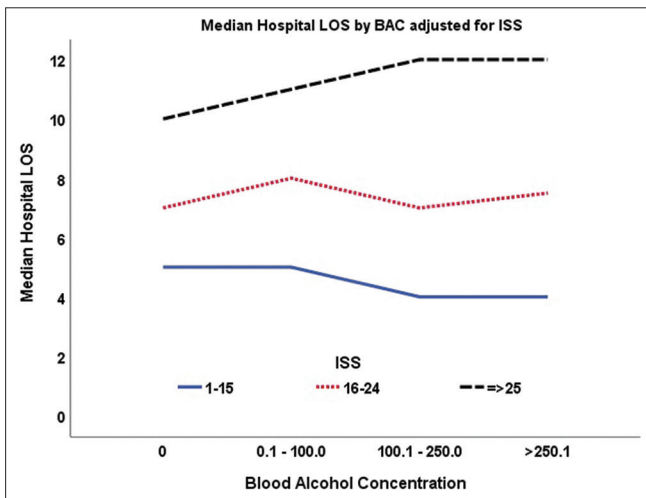


Figure 4: Association of hospital length of stay with blood alcohol concentration and injury severity scores

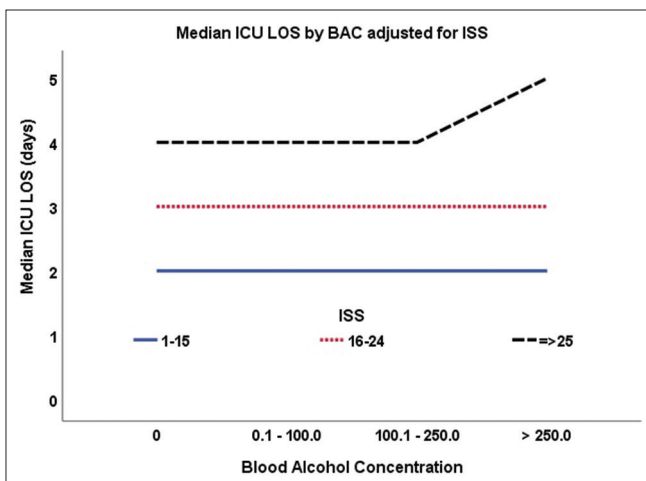


Figure 5: Association of intensive care unit length of stay with blood alcohol concentration and injury severity scores

could be affected by multiple factors including severity of disease, frequency of procedures, insurance type, bed status, and delayed discharge process and transfer.^[22] We noticed that the severity of disease or ISS in this case would be a major confounding factor; therefore, we adjusted the ISS in our analysis. Furthermore, we limited bed status to those admitted to the ICU in order to ensure subject homogeneity. Yet, we did not find any significant correlation between the AUDIT categories and ICULOS.

With extensive research in AUD patients indicating that this population require more procedures, operations and have increased complications and LOS either from the disease itself or from alcohol withdrawal syndrome,^[7,23] our results call into question whether patients with AUDIT scores suggestive of high risk for alcohol dependence were in fact patients with AUD.

Our findings contradict previous research that was performed in elective surgical patients. The study reported a significantly increased LOS in the AUD patients classified from AUDIT-C screening.^[11] AUD patients required rehabilitation, had an increased risk of returning to the operating room after surgery, and decreased functional independence at the time of discharge.^[7,23-25] This contradiction is another example of how one system does not fit all patients. The AUDIT tool may work well in controlled settings such as a clinic but could provide different results in trauma patients. This discrepancy may arise from the fast-paced care in high acuity patients, causing delays in implementation, impaired recall after a traumatic incident, or altered mental status that restricts a patient from completing the survey. The inaccuracy of AUDIT could result in the insignificance of our results.

At our institution, an AUDIT score above 20 in trauma patients prompts the involvement of social workers who arrange outside facility resources and facilitate discharge procedures. This equalizes HLOS between high and low AUDIT score groups; however, this process should not affect ICULOS in both groups.

BAC is the second alcohol screening tool that is available to health-care providers. As part of the trauma protocol at a level-one trauma center, the majority of trauma patients are tested for the BAC level upon ED arrival. Previous studies have established that intoxicated trauma patients received more investigation tests and procedures, including intubation, due to their uncooperativeness and inability to accurately assess the severity of injury from their history and physical examination.^[15,26,27] A study conducted in Korea on minimally injured patients found that the median ED LOS of intoxicated patients was higher than those of nonintoxicated patients due to an increased number of tests and procedures in the ED.^[28] While this may increase accrued cost, acute BAC levels should not alter healing time nor injury severity, and therefore might underlie the inconclusiveness of the effect of BAC on LOS in previous literature. At our institution, the trauma

team extubated intoxicated patients in the ED after no injury was identified; therefore, increased number of intubation in intoxicated patients did not increase ICU admission rate or ICULOS. This could be one of the reasons why we did not find any association between ICULOS and BAC level.

There is further complexity when analyzing whether alcohol can affect outcomes from trauma. Studies have shown that alcohol can cause greater cardiac contractile dysfunction and mortality in model organisms of hemorrhagic shock.^[29,30] Intoxicated patients also have greater odds of suffering a severe head injury following a motor vehicle collision.^[31] On the contrary, other research reported that acute moderate alcohol consumption provided neuroprotective effects in traumatic brain injury and reduced mortality rates.^[32,33] However, in summary, increased LOS or not, intoxicated patients had a significantly increased total expenditure, cost of operations, examination, and pharmaceuticals even in a matched sample of patients.^[34]

Limitations

Alcohol use has been heavily implicated with an increased risk of injury.^[35,36] However, once hospitalized, our results indicated that there were no statistically significant associations between either BAC or AUDIT score and HLOS or ICULOS. It is important to note that our study did not analyze patient consumption of hospital resources by assessing the number or types of associated procedures. The performed procedures' data were not available within our database. Furthermore, due to the study's retrospective nature, we were unable to assess trauma recidivism or repeat admission to the hospital.

We can administer the AUDIT questionnaire only to cognitive patients. Patients with prolonged, altered mental status due to various reasons including intoxication and being intubated completed the AUDIT at a later stage of their hospital stay or were excluded from our study. The attention to provide accurate responses to AUDIT might diminish if the patients completed the AUDIT closer to the time of discharge. Trauma patients with the inability to read due to limitations from their injuries completed the AUDIT with assistance from research personnel. The presence of others might cause social desirability response bias in some patients.

CONCLUSIONS

AUD patients who were classified by high AUDIT (score 20 and above) did not have associations with increased HLOS and ICULOS. Although high AUDIT scores might be the closest diagnosis to alcohol dependence or alcoholism in patients with first-time visits to the hospital, we cannot assume that high AUDIT patients would have longer LOS. Future research should explore different screening tools that can detect alcohol dependence or alcoholic patients to allow us to arrange resources to decrease complications and LOS in this population.

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Conflicts of interest

There are no conflicts of interest.

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