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Blood Ethyl Alcohol Level, Clinical Outcomes and Number of Injured Body Regions in Young Adults after Traffic Accidents: A Retrospective Cohort Study

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Abstract

Aim: To evaluate the association of blood ethyl alcohol concentration (BAC) with clinical outcomes, the number of injured anatomical regions and laboratory parameters in emergency department patients aged 20-40 years after traffic accidents.

Materials and Methods: This single-center retrospective cohort study included 451 patients whose BAC was measured between October 2022 and October 2023. BAC was categorized as 0, >0-50, or >50 mg/dL (legal limit). Group comparisons were assessed using the chi-square test, Fisher's exact test, the Mann-Whitney U test; correlations were assessed using Spearman's rho. Extremity involvement was analyzed with logistic regression adjusted for age and sex. All analyses were exploratory, with false discovery rate correction applied.

Results: Measurable alcohol was detected in 131 patients (29.0%), and 79 patients (17.5%) were above the legal limit. Males predominated in the above-limit group (93.7% vs. 78.0%; p=0.002). No statistically significant associations were observed for mortality [1.3% vs. 2.2%; odds ratio (OR) 0.58, 95% confidence interval (CI) 0.07-4.73], hospital admission (OR 1.59, 95% CI 0.93-2.73), surgical intervention (OR 1.31, 95% CI 0.64-2.67), or extremity involvement (adjusted OR 1.71, 95% CI 0.99-2.97). BAC was correlated weakly with the number of injured regions (rho=0.204, 95% CI 0.114-0.291), alanine aminotransferase (rho=0.297), and aspartate aminotransferase (rho=0.341) (all q<0.001). The number of injured regions increased across alcohol categories (Jonckheere-Terpstra p<0.001), driven mainly by differences between patients with and without measurable alcohol.

Conclusion: In young adults following traffic accidents, BAC was not significantly associated with mortality, admission, surgery, or extremity involvement, although the statistical power to detect an association with mortality was limited. Measurable alcohol was weakly associated with a greater number of injured regions and higher liver enzyme levels. These exploratory findings require prospective confirmation with validated injury-severity scores.

Keywords: Clinical outcome, emergency department, ethyl alcohol, traffic accidents, wounds and injuries

Introduction

Ethyl alcohol consumption remains a serious public health concern, given its significant impact on traffic accidents, which are among the leading causes of death and disability worldwide (1,2). Research in this field aims to clarify the relationship between ethanol consumption and traffic accidents. Alcohol consumption is known to reduce attention, prolong reaction times in response to unexpected situations, and delay motor responses. It is also thought to increase the risk of traffic accidents by promoting behaviors such as non-compliance with traffic regulations (3). Previous studies support this relationship, showing that individuals who consume alcohol are at higher risk of being involved in accidents (4-6).

The frequency of alcohol-related traffic accidents varies across age

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groups, with younger individuals being more susceptible to such accidents, and younger age being more strongly associated with fatal traffic accidents (4,7,8). According to Erik Erikson's theory of psychosocial development, individuals aged 20-40 years are in young adulthood, the first period of adulthood. During this period, individuals may engage in risky behaviors while trying to overcome the challenges of the transition from adolescence to adulthood (9,10). Despite the existing body of knowledge, studies evaluating the relationship between ethyl alcohol use and traffic accidents specifically in young adulthood (20-40 years) - at the level of clinical outcomes, the distribution of injuries and laboratory parameters - remain limited, and recent registry-based studies have reported inconsistent associations between alcohol, injury severity and mortality (11,12).

The aim of this study was to evaluate the association between blood ethyl alcohol level and mortality, hospital admission, need for surgical intervention, length of hospital stay, number of injured anatomical regions, and laboratory parameters in patients aged 20-40 years presenting to the emergency department after traffic accidents. We hypothesized that blood ethyl alcohol level would not be associated with mortality in this population but might be associated with the number of injured regions and with liver function tests.

MATERIALS AND METHODS

Study Design and Setting

This single-center retrospective cohort study reviewed the records of patients presenting to the Emergency Medicine Department of Niğde Ömer Halisdemir University after traffic accidents. Data on patients aged 20-40 years presenting with a diagnostic code of traffic accident (ICD-10: V01-V99) between 01.10.2022 and 01.10.2023 were retrieved from the Hospital Information Management System (Karmed). All eligible patients during the study period were included; no a priori sample size calculation was performed, and, therefore, the precision of the main estimates is reported with 95% confidence intervals. The study protocol was not registered in advance, and all analyses are considered exploratory.

This study was approved by the Niğde Ömer Halisdemir University Non-interventional Clinical Research Ethics Committee (decision date: 28.12.2023, protocol no: 2023/113). As this study was a retrospective chart review, informed consent was not obtained from patients.

Inclusion and Exclusion Criteria

All patients aged 20-40 years who presented to the emergency department after a traffic accident during the specified date range and had blood ethyl alcohol levels measured were included in the study. The following were excluded: (1) patients who refused examination or work-up or who left the emergency department against medical advice (n=3); (2) a record with no clinical or laboratory data (n=1); (3) a patient who presented solely for forensic blood alcohol testing and was not a traffic-accident victim (n=1); and (4) patients whose blood ethyl alcohol level was not measured (n=8). Of the 464 patients initially identified, 13 were excluded on these grounds, resulting in a final analysis cohort of 451 patients (Figure 1).

Variables

Sex, age, blood ethyl alcohol level, hospital admission, length of hospital stay, need for surgical intervention, in-hospital mortality, involvement of six anatomical regions (head/brain, cervical spine, thorax, abdomen, pelvis, and extremities), and baseline laboratory parameters [hemoglobin, alanine aminotransferase (ALT), aspartate aminotransferase (AST), urea, creatinine] were recorded. Ethyl alcohol concentration was measured quantitatively in blood samples obtained in the emergency department; a value of 0 mg/dL indicated no detectable ethanol. Patients were classified into three mutually exclusive categories: no measurable alcohol (0 mg/dL); below the legal limit (>0-50 mg/dL); and above the legal limit (>50 mg/dL; 0.5‰). For two-group comparisons, patients above the legal limit were compared with all patients at or below the limit (≤50 mg/dL, including those with no measurable alcohol).

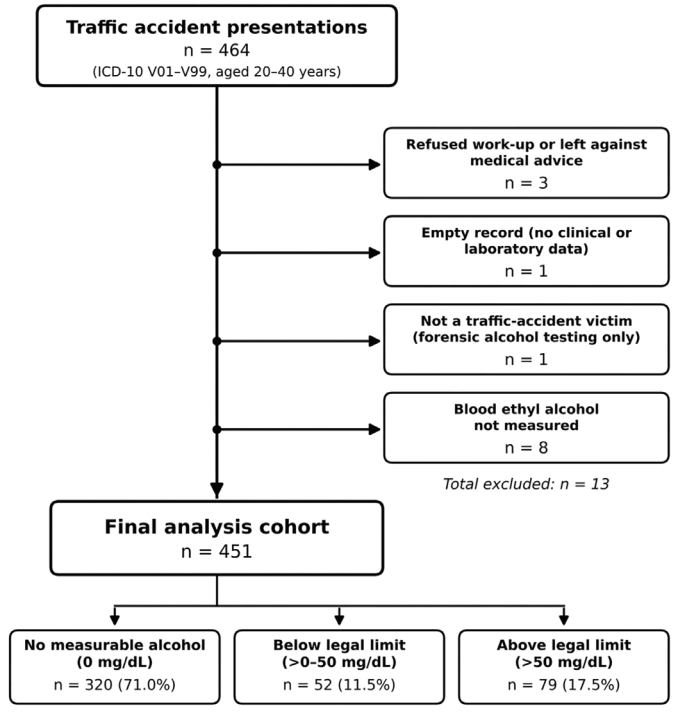


Figure 1. Patient flow diagram

Ascertainment of Injured Regions

Involvement of each anatomical region was determined from the documented clinical and/or radiological evaluations of the region in the medical record. Evaluation was at the discretion of the treating physician and was not protocolized. Regions without a documented evaluation were coded as not involved. This coding was used for both region-specific comparisons and the total number of injured regions, so all region-level analyses include the full cohort (n=451). No regional evaluation was documented for 78 patients (17.3%). The number of injured regions (range 0-6) is a descriptive count of affected body regions and not equivalent to validated injury-severity measures such as the Injury Severity Score (ISS) or the New Injury Severity Score (NISS). As a sensitivity analysis, region-specific comparisons were repeated among patients with a documented evaluation of the corresponding region.

Statistical Analysis

Normality of distribution was assessed using the Shapiro-Wilk (n≤50) or Kolmogorov-Smirnov (n>50) tests. Non-normally distributed continuous variables were presented as median (minimum-maximum) and categorical variables as number (n) and percentage (%). For two-group comparisons, the Mann-Whitney U test was used for continuous variables and the chi-square test with Yates' continuity correction was used for categorical variables; Fisher's exact test was used instead for 2x2 tables in which any expected cell count was below 5. Odds ratios (ORs) with 95% confidence intervals (CIs) are reported for binary outcomes. Spearman's correlation analysis was used to assess associations between blood ethyl alcohol level (analyzed as a continuous variable) and other continuous variables; 95% CIs were obtained with the Fisher z transformation, and partial Spearman's correlations adjusted for the number of injured regions were calculated for ALT and AST. The potential ordered relationship between the three-category blood alcohol level and the number of injured regions was evaluated using the Jonckheere-Terpstra trend test, followed by pairwise Mann-Whitney U tests. The association between alcohol status (>50 vs. ≤50 mg/dL) and extremity involvement was examined with multivariable logistic regression adjusted for age and sex, the only pre-injury covariates available in the dataset; injury-related variables (other injured regions, surgery, length of stay, laboratory values) were not included because they are consequences of the injury rather than confounders. Multicollinearity, linearity of the logit for age, and model fit were assessed with variance inflation factors (threshold >5), the Box-Tidwell test, and the Hosmer-Lemeshow test and Nagelkerke R^2, respectively. With 100 events and three parameters, there were approximately 33 events per variable. Exploratory sensitivity analyses modeled age with a cubic B-spline and alcohol either in three categories or as a continuous variable, and restricted the analysis to patients with a documented extremity evaluation. Because no protocol was registered, all analyses were considered exploratory. To account for multiple testing, Benjamini-Hochberg false-discovery-rate q values were calculated across all 19 inferential tests, with Holm-adjusted p values used as a more conservative sensitivity analysis (Supplementary Table S1). Missing laboratory data (16.9-18.0%) were not imputed, and analyses involving laboratory variables used all available observations. Analyses were performed using SPSS 27.0 (IBM Corp., Armonk, NY, USA) and R version 4.3.3 (R Foundation for Statistical Computing, Vienna, Austria). A two-sided p value <0.05 was considered statistically significant.

Results

Of the 464 patients who presented to the emergency department following traffic accidents during the study period, 13 were excluded, and 451 were included in the final analysis (Figure 1). The descriptive characteristics of the final analysis cohort are summarized in Table 1. Of the 451 patients, 364 (80.7%) were male and 87 (19.3%) were female; the median age was 27 years (range, 20-40). Regarding blood ethyl alcohol level, 320 patients (71.0%) had no measurable blood ethyl alcohol; 52 patients (11.5%) had a level below the legal limit (>0-50 mg/dL); and 79 patients (17.5%) had a level above the legal limit (>50 mg/dL). Accordingly, measurable blood ethyl alcohol was detected in 131 patients (29.0%). Among the 131 alcohol-positive patients, the median blood ethyl alcohol level was 106.7 mg/dL (range, 0.01-327.2); in the above-legal-limit group, the median blood ethyl alcohol level was 164.9 mg/dL (range, 54.6-327.2). Overall, 9 patients (2.0%) died, 104 (23.1%) were admitted to the hospital, and 52 (11.5%) underwent surgical intervention. The median length of hospital stay was 0 days (range, 0-62), reflecting that most patients were discharged on the same day (Table 1). Among the 52 patients who underwent surgical intervention, orthopedic surgery was performed most frequently (n=41, 78.8%), followed by neurosurgery (n=5, 9.6%); the remaining patients underwent plastic surgery (n=3), general surgery (n=1), or a combined general surgery-orthopedics procedure (n=1), and the surgical specialty was not recorded for one patient.

Comparisons between patients with a blood ethyl alcohol level above the legal limit and those at or below the limit are presented in Table 2. The proportion of males was higher in the above-legal-limit group (93.7% vs. 78.0%; OR 4.18, 95% CI 1.64-10.69; p=0.002), whereas median age did not differ between groups [28 (20-40) vs. 27 (20-40) years; p=0.758]. The number of injured regions was higher in the above-legal-limit group (median 1, range 0-4) than in the comparison group (median

Table 1. Descriptive characteristics of the final analysis cohort (n=451)	
Variable	**Value**
Total number of patients	451
Sex, male/female, n (%)	364 (80.7%)/87 (19.3%)
Age, years, median (min-max)	27 (20-40)
Blood ethyl alcohol level, n (%)	
No measurable alcohol (0 mg/dL)	320 (71.0%)
Below legal limit (>0-50 mg/dL)	52 (11.5%)
Above legal limit (>50 mg/dL)	79 (17.5%)
Blood ethyl alcohol level among alcohol-positive patients (n=131), mg/dL, median (min-max)	106.7 (0.01-327.2)
Number of injured regions, median (min-max)	1 (0-4)
Hospital admission, n (%)	104 (23.1%)
Surgical intervention, n (%)	52 (11.5%)
Mortality, n (%)	9 (2.0%)
Length of hospital stay, days, median (min-max)	0 (0-62)
Hemoglobin, g/dL, median (min-max) (n=375)	15.4 (7.3-19.5)
ALT, U/L, median (min-max) (n=370)	23.5 (2-861)
AST, U/L, median (min-max) (n=370)	25 (11-642)
Urea, mg/dL, median (min-max) (n=372)	27 (8-68)
Creatinine, mg/dL, median (min-max) (n=372)	0.85 (0.40-6.00)

Percentages were calculated based on the total cohort (n=451); laboratory variables are based on available data (n shown). Blood ethyl alcohol level categories are mutually exclusive (totals sum to 100.0%).
ALT: Alanine aminotransferase, AST: Aspartate aminotransferase, min-max: Minimum-maximum

Table 2. Comparisons according to the legal blood ethyl alcohol limit (>50 vs. ≤50 mg/dL)					
Variable	**Above legal limit (n=79)**	**≤50 mg/dL[a] (n=372)**	**OR (95% CI)**	**p**	**q**
Male sex, n (%)	74 (93.7%)	290 (78.0%)	4.18 (1.64-10.69)	0.002	-
Age, years, median (min-max)	28 (20-40)	27 (20-40)	-	0.758	-
Number of injured regions, median (min-max)	1 (0-4)	0 (0-4)	-	0.002	0.004
Hospital admission, n (%)	24 (30.4%)	80 (21.5%)	1.59 (0.93-2.73)	0.120	0.190
Length of stay among admitted patients, days, median (min-max)[b]	4 (1-62)	5 (1-28)	-	0.591	0.721
Mortality, n (%)	1 (1.3%)	8 (2.2%)	0.58 (0.07-4.73)	1.000[c]	1.000
Surgical intervention, n (%)	11 (13.9%)	41 (11.0%)	1.31 (0.64-2.67)	0.589	0.721

The chi-square test with Yates' continuity correction was used for categorical variables and the Mann-Whitney U test for continuous variables. q: Benjamini-Hochberg false-discovery-rate adjusted p value across 19 tests; -: not part of the adjusted test family. [a]The ≤50 mg/dL group includes patients with no measurable alcohol (0 mg/dL, n=320) and those with a level below the legal limit (>0-50 mg/dL, n=52). [b]Only patients who were admitted (above legal limit n=24; ≤50 mg/dL n=80); the upper bound of 62 days corresponds to a single case requiring multiple trauma management and orthopedic surgery. [c]Fisher's exact test.
OR: Odds ratio, CI: Confidence interval

0, range 0-4) (p=0.002; q=0.004). No statistically significant association was observed between a blood ethyl alcohol level above the legal limit and hospital admission (30.4% vs. 21.5%; OR 1.59, 95% CI 0.93-2.73; p=0.120), mortality (1.3% vs. 2.2%; OR 0.58, 95% CI 0.07-4.73; Fisher's exact test, p=1.000), or need for surgical intervention (13.9% vs. 11.0%; OR 1.31, 95% CI 0.64-2.67; p=0.589). Among admitted patients, no statistically significant difference in length of stay was observed between the two groups (median 4 vs. 5 days; p=0.591), and the upper bound of 62 days in the above-legal-limit group corresponded to a single case requiring management of multiple trauma and orthopedic surgery.

The Spearman's correlation analyses of blood ethyl alcohol level (evaluated as a continuous variable) with other continuous variables are summarized in Table 3 and Supplementary Figure S1. Blood ethyl alcohol level showed a weak positive correlation

with the number of injured regions (n=451; rho=0.204, 95% CI 0.114-0.291; q<0.001), and weak-to-moderate positive correlations with ALT (n=370; rho=0.297, 95% CI 0.201-0.387; q<0.001) and AST (n=370; rho=0.341, 95% CI 0.248-0.428; q<0.001). After adjustment for the number of injured regions, the partial correlation coefficients were 0.259 for ALT and 0.289 for AST (both p<0.001). Blood ethyl alcohol level also correlated with hemoglobin (rho=0.195; q<0.001), urea (rho=-0.167; q=0.004), and length of hospital stay (rho=0.126; q=0.017), but not with creatinine (rho=0.081; p=0.117) or age (rho=0.046; p=0.330) (Table 3).

In terms of injured regions, the most frequently affected in the overall cohort were the extremities (n=100, 22.2%) and the head/brain (n=94, 20.8%), followed by the thorax (n=47, 10.4%), abdomen (n=21, 4.7%), pelvis (n=16, 3.5%), and cervical region (n=10, 2.2%). Region-specific comparisons between the above-legal-limit group and the comparison group are presented in Table 4. Head or brain involvement was more frequent in the above-legal-limit group (30.4% vs. 18.8%; OR 1.88, 95% CI 1.09-3.25; p=0.032), but this difference was not statistically significant after false discovery rate correction (q=0.067). Extremity involvement was 30.4% vs. 20.4% (OR 1.70, 95% CI 0.99-2.92; p=0.074; q=0.141). No statistically significant differences were observed for the cervical, thoracic, abdominal or pelvic regions (all p≥0.499). Documented evaluation of the head/brain region was more frequent in the above-legal-limit group (39.2% vs. 28.2%; p=0.059), whereas evaluation rates for the other regions were similar between groups (Supplementary Table S2). Among patients with a documented head/brain evaluation, involvement did not differ between groups (77.4% vs. 66.7%; p=0.359).

In multivariable logistic regression of the full cohort (n=451; 100 events), a blood ethyl alcohol level above the legal limit was not significantly associated with extremity involvement after adjustment for sex and age (adjusted OR 1.71, 95% CI 0.99-2.97; p=0.056) (Table 5). There was no evidence of multicollinearity (variance inflation factors; 1.00-1.03). Model calibration was adequate (Hosmer-Lemeshow p=0.742), but explained variance was low (Nagelkerke R^2=0.020). The Box-Tidwell test indicated non-linearity of the logit for age (p=0.008). When age was modeled as a cubic B-spline, the estimate was similar (adjusted OR 1.65, 95% CI 0.94-2.88). In exploratory sensitivity analyses (Supplementary Table S3), the association was statistically significant under three conditions: when the analysis was restricted to the 213 patients with a documented extremity evaluation (adjusted OR 2.86, 95%

Table 3. Spearman's correlations between blood ethyl alcohol level and continuous variables

Variable	n	rho (95% CI)	p	q
Number of injured regions	451	0.204 (0.114 to 0.291)	<0.001	<0.001
ALT	370	0.297 (0.201 to 0.387)	<0.001	<0.001
AST	370	0.341 (0.248 to 0.428)	<0.001	<0.001
Hemoglobin	375	0.195 (0.096 to 0.291)	<0.001	<0.001
Urea	372	-0.167 (-0.264 to -0.066)	0.001	0.004
Creatinine	372	0.081 (-0.020 to 0.182)	0.117	0.190
Length of hospital stay	451	0.126 (0.034 to 0.216)	0.007	0.017
Age	451	0.046 (-0.047 to 0.138)	0.330	-

All correlations were calculated using Spearman's rho; 95% CIs were obtained with the Fisher z transformation. Pairwise complete observations were used. q: Benjamini-Hochberg false-discovery-rate adjusted p value across 19 tests. Partial correlations adjusted for the number of injured regions: ALT rho=0.259, AST rho=0.289 (both p<0.001). The full correlation matrix is shown in Supplementary Figure S1.
CI: Confidence interval, ALT: Alanine aminotransferase, AST: Aspartate aminotransferase

Table 4. Involvement of anatomical regions according to the legal blood ethyl alcohol limit (n=451)

Region	Above legal limit (n=79), n (%)	≤50 mg/dL (n=372), n (%)	OR (95% CI)	p	q
Head/brain	24 (30.4%)	70 (18.8%)	1.88 (1.09-3.25)	0.032	0.067
Extremities	24 (30.4%)	76 (20.4%)	1.70 (0.99-2.92)	0.074	0.141
Thorax	10 (12.7%)	37 (9.9%)	1.31 (0.62-2.76)	0.607	0.721
Pelvis	4 (5.1%)	12 (3.2%)	1.60 (0.50-5.10)	0.499[a]	0.721
Abdomen	4 (5.1%)	17 (4.6%)	1.11 (0.36-3.40)	0.773[a]	0.864
Cervical	1 (1.3%)	9 (2.4%)	0.52 (0.06-4.14)	1.000[a]	1.000

All 451 patients are included; regions without a documented clinical or radiological evaluation were coded as not involved. The chi-square test with Yates' continuity correction was used when expected cell counts were sufficient; [a]Fisher's exact test was used when any expected cell count was below 5. q: Benjamini-Hochberg false-discovery-rate adjusted p value across 19 tests.
CI: Confidence interval, OR: Odds ratio

CI 1.31-6.24); when alcohol was modeled in three categories (>0-50 mg/dL: adjusted OR 2.50, 95% CI 1.31-4.77; >50 mg/dL: adjusted OR 2.00, 95% CI 1.14-3.53; reference 0 mg/dL); and when blood ethyl alcohol level was modeled as a continuous variable (adjusted OR 1.04 per 10 mg/dL, 95% CI 1.01-1.07). When blood alcohol levels were categorized into three groups (none/below legal limit/above legal limit), an ordered increase in the number of injured regions was observed (Jonckheere-Terpstra trend test, z=3.81; p<0.001; Figure 2). Pairwise comparisons showed differences between the no-alcohol group and both the >0-50 mg/dL group (p=0.004) and the >50 mg/dL group (p<0.001), but not between the >0-50 mg/dL and >50 mg/dL groups (p=0.994).

Discussion

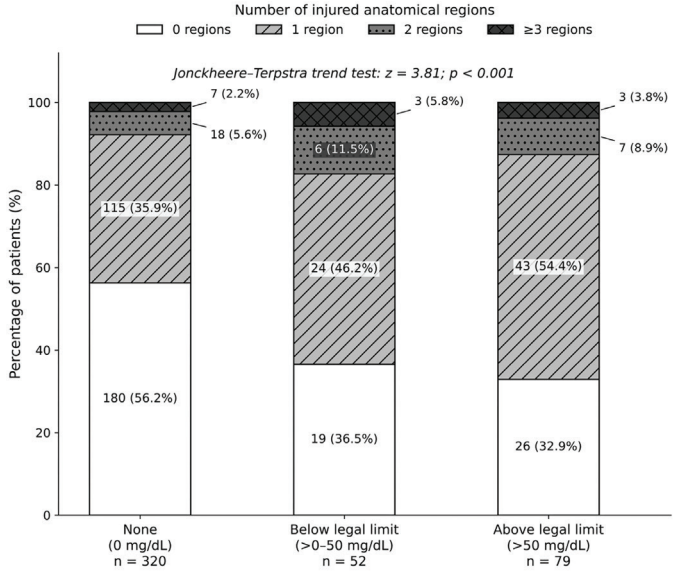


Figure 2. Distribution of the number of injured anatomical regions by blood ethyl alcohol category. Bars show the number (percentage) of patients with 0, 1, 2, or ≥3 injured anatomical regions within each blood ethyl alcohol category. The Jonckheere-Terpstra trend test, a rank-based nonparametric test, was used given the non-normal, discrete distribution of this variable. The distribution shift occurs mainly between the absence and presence of measurable alcohol, with no statistically significant difference between the >0-50 and >50 mg/dL groups

In this study of 451 patients aged 20-40 years presenting to the emergency department after traffic accidents, measurable blood ethyl alcohol was detected in 29.0% of patients, and a level above the legal limit (50 mg/dL) was detected in 17.5%. Blood ethyl alcohol level was weakly associated with the number of injured anatomical regions and with ALT and AST levels; whereas no statistically significant association was observed with mortality, hospital admission, surgical intervention, or involvement of any specific body region after correction for multiple testing. The alcohol-positive rates fall within the wide range of 8% to 47.1% reported in international trauma centers (13,14); this variability may stem from differences in screening policies, patient populations, and cultural/legal factors. A study conducted in Turkey reported this rate as 22.1% (15).

The higher proportion of males in the above-legal-limit group (93.7% vs. 78.0%) is consistent with behavioral studies showing that driving under the influence of alcohol is markedly more common among young male drivers; one study reported that 18.5% of young male drivers and 11.8% of young female drivers had driven after drinking alcohol (16). In contrast, the absence of an age difference between the two groups (p=0.758), when considered alongside epidemiological data showing that the risk of late-night accidents rises markedly among individuals aged 18-24 (17), suggests that restricting our sample from the outset to a narrow age range (20-40 years) may have reduced age-related variance.

The absence of a statistically significant association between blood ethyl alcohol level and mortality should be interpreted with caution because only nine deaths occurred, and the confidence interval was wide (OR 0.58, 95% CI 0.07-4.73), which is compatible with both a substantial reduction and a more than fourfold increase in the odds of death. Previous studies have reported heterogeneous findings. Jurkovich et al. (13) reported that alcohol intoxication altered the initial clinical assessment of 2237 trauma patients but did not directly predict outcome. Hsieh et al. (18) showed that alcohol intoxication did not increase in-hospital mortality and was associated with a lower ISS in some subgroups. Similarly, an analysis of 88,794 patients from the National Trauma Data Bank found no significant difference in

Table 5. Logistic regression analysis for extremity involvement (n=451; 100 events)

Variable	Crude OR (95% CI)	p	Adjusted OR (95% CI)	p
Blood ethyl alcohol >50 mg/dL (ref. ≤50 mg/dL)	1.70 (0.99-2.92)	0.055	1.71 (0.99-2.97)	0.056
Age, per year	0.97 (0.93-1.01)	0.132	0.97 (0.93-1.01)	0.126
Male sex (ref. female)	1.11 (0.63-1.98)	0.711	1.00 (0.56-1.80)	0.993

Binary logistic regression. Regions without a documented evaluation were coded as not involved. Model diagnostics: variance inflation factors 1.00-1.03; events per variable ≈33; Hosmer-Lemeshow χ^2=5.14, df=8, p=0.742; Nagelkerke R^2=0.020; area under the ROC curve 0.57. The Box-Tidwell test indicated non-linearity of the logit for age (p=0.008); with age modeled as a cubic B-spline (3 df), the adjusted OR for blood ethyl alcohol >50 mg/dL was 1.65 (95% CI 0.94-2.88; p=0.078).
OR: Odds ratio, CI: Confidence interval (wald)

in-hospital mortality according to alcohol positivity (19), and an analysis of 6,268 patients from the TraumaRegister DGU® likewise found no difference in overall mortality between groups (20). Other studies, including a recent analysis of the Japan Trauma Data Bank, have reported lower mortality among intoxicated or drinking patients (12,21), a finding generally attributed to lower injury severity in these patients or to residual confounding, and a recent single-center registry study reported inconsistent associations between blood alcohol and mortality (11). Because injury severity was not measured in our study, we could not assess whether these mechanisms applied to our cohort.

No statistically significant difference was observed between groups in the need for surgical intervention (OR 1.31, 95% CI 0.64-2.67), consistent with the mixed picture in the literature: some studies have shown alcohol positivity to be associated with increased resource use (ICU admission, consultation, procedural intervention) (22,23), while others have found no significant difference (14,24). Similarly, no statistically significant difference was observed in hospital admission (30.4% vs. 21.5%; OR 1.59, 95% CI 0.93-2.73) or in length of stay among patients who were admitted (p=0.591), consistent with Beydoun et al.'s (14) finding that alcohol positivity did not directly predict length of hospital stay and with another study that found no significant association between AUDIT/BAC and hospital/ICU length of stay (25). The confidence intervals for these outcomes do not exclude modest associations.

In our study, blood ethyl alcohol level showed a weak positive correlation with the number of injured anatomical regions (rho=0.204). In the full cohort, extremity involvement was not significantly associated with blood ethyl alcohol levels above the legal limit after adjustment for sex and age (adjusted OR 1.71, 95% CI 0.99-2.97). Larger estimates were obtained in the analysis restricted to patients with a documented extremity evaluation and in the categorical analysis, but these sensitivity analyses were exploratory, and the restricted analysis was susceptible to ascertainment bias. Beydoun et al. (14), using a propensity-score approach, reported that higher blood alcohol level was positively associated with head injury but inversely associated with extremity injuries; this could not be examined further because accident mechanism was not recorded in our dataset. Accident mechanism, road-user role, use of protective devices, and timing of blood sampling were not available, so residual confounding cannot be excluded in either direction.

Blood ethyl alcohol level showed weak-to-moderate positive correlations with ALT (rho=0.297, 95% CI 0.201-0.387) and AST (rho=0.341, 95% CI 0.248-0.428); these correlations persisted after adjustment for the number of injured regions. Kelley et al. (26) reported that blood alcohol concentration was associated with differences in hematologic and serum chemistry parameters in trauma patients. However, AST is also released from injured skeletal muscle; the number of injured regions does not measure soft-tissue damage; and the timing of blood sampling, chronic alcohol use, and pre-existing liver disease were not recorded. These correlations therefore cannot be attributed to a direct hepatic effect of acute alcohol exposure. The positive correlation with hemoglobin and the negative correlation with urea were not hypothesized, and should be regarded as exploratory.

The Jonckheere-Terpstra test indicated an ordered shift in the number of injured regions across the three alcohol categories (z=3.81; p<0.001). However, the distributions of the >0-50 and >50 mg/dL groups did not differ (p=0.994), and the principal difference lay between patients with and without measurable alcohol levels (Figure 2). This exploratory pattern should not be interpreted as evidence of a dose-response or threshold relationship.

Head/brain involvement was more frequent in the above-legal-limit group of the full cohort (30.4% vs. 18.8%); however, the difference was not statistically significant after correction for multiple testing and was absent among patients with a documented head/brain evaluation (77.4% vs. 66.7%; p=0.359). Because a head or brain evaluation was documented more often in patients above the legal limit (39.2% vs. 28.2%), this difference likely reflects differential evaluation rather than differences in injury occurrence; impaired consciousness in intoxicated patients may lower the threshold for head imaging. Rundhaug et al. (24) showed that blood alcohol level lowered the Glasgow Coma Scale score in patients with moderate-to-severe traumatic brain injury but was not associated with computed tomography findings, and Leijdesdorff et al. (27) reported less frequent cerebral injury and lower injury severity among intoxicated patients with traumatic brain injury. In a study of 347 severely injured trauma patients, Riuttanen et al. (28) reported that alcohol positivity did not significantly affect ISS or ICU length of stay. Finally, studies showing that very high blood alcohol levels (>200-300 mg/dL) are associated with increased resource use (23,29) could not be examined in our cohort, because only 19 patients had levels above 200 mg/dL.

Study Limitations

The main limitations of our study are as follows: (1) the single-center, retrospective design, which may have led to data loss and selection bias; and the use of a convenience sample without an a priori sample size calculation. (2) The low number of mortality events (n=9) provides very limited power for this outcome; therefore, the absence of a statistically significant association should not be interpreted as evidence of no association. (3)

the absence of laboratory data in a subset of patients (16.9-18.0%), with ALT/AST missing more often in the comparison group (19.1%) than in the above-legal-limit group (12.7%); (4) The lack of a validated ISS (such as ISS or NISS): the number of injured regions is a descriptive count that does not capture injury severity and limits direct comparison with ISS/NISS-based studies such as those by Beydoun et al. (14) and Riuttanen et al. (28). (5) Regional involvement was ascertained from clinically indicated evaluations; regions without a documented evaluation were coded as not involved, which may have led to misclassification of some injuries; head/brain evaluation was documented more often in patients above the legal limit, introducing possible ascertainment bias; (6) accident mechanism, road-user role (vehicle occupant/pedestrian/motorcyclist), protective-device use, and time from injury to blood sampling were not recorded; therefore, the regression model was adjusted only for sex and age, and residual confounding is likely (7). Blood ethyl alcohol testing in the emergency department is applied selectively in clinical practice; it is not routinely ordered for pedestrian trauma but is more frequently requested for patients who were driving a vehicle, which suggests that our sample may carry a selection bias favoring driver-related cases that could not be quantified. (8) the inability to distinguish whether the alcohol-liver enzyme association reflects acute or chronic use, and the possibility that AST partly reflects skeletal muscle injury; (9) the restriction of the sample to the 20-40-year age range, which limits generalizability to broader age groups; and (10) The absence of a registered protocol meant that all analyses were exploratory; although multiplicity was addressed with false-discovery-rate correction, the findings should be regarded as hypothesis-generating.

Conclusion

In young adults presenting to the emergency department after traffic accidents, no statistically significant association was observed between blood ethyl alcohol level and mortality, hospital admission, surgical intervention, or involvement of any specific body region, although the study had limited power to detect differences in mortality. Measurable blood ethyl alcohol was weakly associated with a greater number of injured anatomical regions and higher liver enzyme levels. These exploratory findings require confirmation in prospective, multicenter studies using validated ISS and complete data on accident mechanisms.

Ethics

Ethics Committee Approval: This study was approved by the Niğde Ömer Halisdemir University Non-interventional Clinical Research Ethics Committee (decision date: 28.12.2023, protocol no: 2023/113).

Informed Consent: As this study was a retrospective chart review, informed consent was not obtained from patients.

Authorship Contributions

Concept: A.V., T.D., Design: A.V., M.O.C., Data Collection or Processing: A.V., M.O.C., S.S., S.R.Y., Analysis or Interpretation: A.V., T.D., A.B.V., Literature Search: S.S., S.R.Y., A.B.V., Writing: A.V., T.D., M.O.C., S.R.Y.

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