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# The Evaluation of Blood Alcohol Concentration of Drivers Involved in Traffic Accidents or Suspected for Alcohol in The Roadside Controls in Four Big Cities of Turkey

Türkiye'nin Dört Büyük İlinde Trafik Kazalarına Karışan veya Alkol Şüphesi Bulunan Sürücülerin Yol Kenarı Kontrollerinde Kandaki Alkol Konsantrasyonlarının Değerlendirilmesi

① Hale Nur Can<sup>1</sup>, ② Mahmut Aşirdizer<sup>2</sup>, ③ Sevdegül Bilvanisi<sup>1</sup>, ④ Recep Dursun<sup>3</sup>, ⑤ Latif Duran<sup>4</sup>, ⑥ Gökmen Karabağ<sup>5</sup>, ⑦ Enes Arıca<sup>3</sup>, ⑧ Adnan Bilge<sup>6</sup>, ⑨ Faruk Aydın<sup>5</sup>, ⑩ Gizem Demet Sever Tilki<sup>7</sup>

<sup>1</sup>Van Yüzüncü Yıl University Faculty of Medicine, Department of Emergency Medicine, Van, Turkey

<sup>2</sup>Bahçeşehir University Faculty of Medicine, Department of Forensic Medicine, İstanbul, Turkey

<sup>3</sup>Dicle University Faculty of Medicine, Department of Emergency Medicine, Diyarbakır, Turkey

<sup>4</sup>Ondokuz Mayıs University Faculty of Medicine, Department of Forensic Medicine, Samsun, Turkey

<sup>5</sup>Manisa Celal Bayar University Faculty of Medicine, Department of Forensic Medicine, Manisa, Turkey

<sup>6</sup>Manisa Celal Bayar University Faculty of Medicine, Department of Emergency Medicine, Manisa, Turkey

<sup>7</sup>Van Yüzüncü Yıl University Faculty of Medicine, Department of Forensic Medicine, Van, Turkey

## ABSTRACT

**Objective:** Previous studies have revealed a relationship between the driving under the influence of alcohol (DUIA) and/or driving under the influence drugs (DUID) and the increased risk of death and injury in traffic accidents. The aim of this study was to investigate of blood alcohol concentration (BAC) of drivers after involved in a traffic accident or for suspected for drunkenness in the roadside traffic control in the Turkey's four major cities.

**Methods:** In this study, we retrospectively reviewed the laboratory registrations in university hospitals in four big cities of Turkey (Van, Manisa, Diyarbakır and Samsun) for BAC for five years (from 1 January 2015 to 31 December 2019) of the drivers.

**Results:** In 342 cases (7.1%), BACs were above the cut-off value (0.01 g/100 mL). Of the cases sent for alcohol determination, 11.3% were women and 88.7% were men, and their mean age was 35.3±13.1. In 342 alcohol positive cases, BACs were above 0.101% in 58.8% of cases. BAC positivity of the cases was 9.4% in Manisa, 6.3% in Van, 5.3% in Samsun, and 5% in Diyarbakır. BAC was found to be positive in 4.4% (n=24) of females and 7.4% (n=318) of males (p<0.05).

**Conclusion:** This study is one of the limited number of multicentre studies in this field; it was concluded in the study that zero tolerance should be for drunk driving in traffic, the deterrence of fines should be increased, and roadside screening tests should be used more widely.

**Keywords:** Traffic accidents, alcohol, roadside tests, Turkish traffic regulations



**Address for Correspondence/Yazışma Adresi:** Hale Nur Can, Van Yüzüncü Yıl University Faculty of Medicine, Department of Emergency Medicine, Van, Turkey  
**E-mail:** halenurcan@gmail.com **ORCID ID:** <https://orcid.org/0000-0002-8107-3986>

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## ÖZ

**Amaç:** Önceki çalışmalar, alkollü araç kullanma ve/veya uyuşturucu etkisi altında araç kullanma (AUAK) ile trafik kazalarında artan ölüm ve yaralanma riski arasında bir ilişki olduğunu ortaya koymuştur. Bu çalışmanın amacı, Türkiye'nin dört büyük şehrinde trafik kazası geçirdikten sonra veya yol kenarı trafik kontrolünde alkollü olduğu şüphesi bulunan sürücülerin kanlarındaki alkol konsantrasyonlarının (BAC) araştırılmasıdır.

**Yöntem:** Bu çalışmada, Türkiye'nin dört büyük ilindeki (Van, Manisa, Diyarbakır ve Samsun) üniversite hastanelerinde sürücülerin beş yıllık (1 Ocak 2015 - 31 Aralık 2019 tarihleri arasında) BAC için laboratuvar kayıtlarını geriye dönük olarak inceledik.

**Bulgular:** Üç yüz kırk iki olguda (%7,1) BAC'ler eşik değerin (0,01 g/100 mL) üzerindeydi. Alkol tayini için gönderilen olguların %11,3'ü kadın, %88,7'si erkek olup, yaş ortalaması  $35,3 \pm 13,1$ 'dir. Üç yüz kırk iki alkol pozitif olguda, olguların %58,8'inde BAC'ler %0,101'in üzerindeydi. Olguların BAC pozitifliği Manisa'da %9,4, Van'da %6,3, Samsun'da %5,3 ve Diyarbakır'da %5 idi. Kadınların %4,4'ünde (n=24) ve erkeklerin %7,4'ünde (n=318) BAC pozitif bulundu ( $p < 0,05$ ).

**Sonuç:** Bu çalışma, bu alandaki sınırlı sayıda çok merkezli çalışmalardan biridir; çalışmada trafikte alkollü araç kullanmaya sıfır tolerans gösterilmesi, cezaların caydırıcılığının artırılması ve yol kenarı tarama testlerinin daha yaygın olarak kullanılması gerektiği sonucuna varılmıştır.

**Anahtar Kelimeler:** Trafik kazaları, alkol, yol kenarı testleri, Türk trafik düzenlemeleri

## INTRODUCTION

According to the World Health Organization (WHO) data for 2020, approximately 1.35 million people die each year due to road traffic accidents, 20 to 50 million people suffer non-fatal injuries, and many people experience disabilities as a result of their injuries. Road traffic accidents are the leading cause of death for children and young adults aged 5-29. Accidents also cause significant economic losses for individuals, their families and their nations as a whole. Treatment costs and other losses such as productivity losses of the injured or dependent family members corresponds to 3% of the gross domestic product of most countries (1).

Previous studies have revealed a relationship between the driving under the influence of alcohol (DUIA) and/or driving under the influence drugs (DUID) and the increased risk of death and injury in traffic accidents (2,3).

According to an article published in South Korea in 2016, 41.8% of the drivers convicted of DUIA between 2010 and 2014 committed the same crime again after their first crime. 18.5% were convicted of DUIA three or more times. It has been stated that DUIA is a recurrent crime due to habits and/or addictions, causing significant dangers on the roads (4).

Previous studies have shown that every 0.02 g/100 mL increase in blood alcohol concentration (BAC) doubles the risk of death in traffic accidents compared to the blood values of non-alkoholic drivers. In cases where BAC reaches values between 0.05 g/100 mL and 0.07 g/100 mL it has been stated that this risk increases between 4 and 10 times (5,6).

In 87% of 1118 drivers died in the traffic accidents in Finland, Norway, Portugal and Sweden between 2006 and 2009, BAC were 0.05 g/100 mL or over (7). In 90.5% among the drivers who had positive BAC and involved to the serious traffic accident in Belgium, Denmark, Finland, Italy, Lithuania, and the Netherlands, between 2007 and 2010, BAC were 0.05 g/100 mL or over, too (8).

In Turkey, according to the 48<sup>th</sup> sentence of the Turkish Road Traffic Law, which came into force in 1983, driving on the road under the influence of narcotics or euphoric substances or losing safe driving skills due to influence of alcohol, were clearly made illegal. The regulations added to this law in 2013 emphasized that imprisonment and heavy fines will be applied for drivers under the influence of narcotics, and that their driving licence will be revoked for an indefinite period. However, these imprisonments and heavy fines and revocations of driving licence for definite or indefinite periods were described in detail only for drivers who also exceeded the limits of alcohol use. To compensate for this, the 179<sup>th</sup> sentence of Turkish Penal Code came into force in 2005, adding heavy imprisonments for drivers who lost their safe riding skills due to effects of alcohol or narcotics. In Turkey, the BAC limit for professional drivers is defined to be 0.021% and 0.05% for other drivers. If the alcohol level is in between 0.031% and 0.1% according to breath or blood measurements, it is accepted that the driver must be medically examined to decide about the presence or absence of safe driving skills; if the alcohol level surpasses 0.101%, it is accepted that the driver has lost safe driving skills in the applications of forensic medicine and of the legal authorities (2,3).

In Turkey, 6,096,074 road accidents occurred between 1995 and 1999. In 15% of these accidents, deaths and/or injuries occurred, and 34,405 people died and 1,498,921 people were injured in these accidents (9). In the period between January 1, 2016 and July 1, 2019, the driving licenses of 452,354 drivers due to DUIA and 3,746 drivers due to DUID were revoked for definitive or indefinite periods.

In this study, it is aimed to investigate of BAC of drivers sent to emergency laboratories of the university hospitals after involved in a traffic accident or for suspected for drunkenness in the roadside traffic control in the Turkey's four major cities.

## MATERIALS and METHODS

In this study, we retrospectively reviewed the laboratory registrations in university hospitals in four big cities of Turkey (Van, Manisa, Diyarbakır and Samsun) for BAC for five years (from 1 January 01 to 31 December 2019) of the drivers. These drivers were involved in traffic accidents or suspected for alcohol in the roadside controls. All toxicological BAC analysis were performed at the request of the judicial authorities and/or police departments. Locations, population, the number of licensed drivers and the number of traffic accidents belong these four big cities are shown in Table 1.

### Alcohol Analysis:

BAC (g alcohol/100 mL blood) analyses were performed in each province with the devices described below.

**Van:** In laboratory of Van Yuzuncu Yil University Hospital, alcohol analysis was carried out by Architrct C8000 autoanalyzer (Abbott Laboratories From USA) using commercially available kits based on the principle of alcohol dehydrogenase enzymatic method. Cut-off value of this method was 0.01%.

**Manisa:** In laboratory of Manisa Celal Bayar University Hospital, alcohol analysis was carried out by an enzymatic rate method (Beckman Coulter AU600 and Beckman Coulter AU5821 Analysers). Cut-off value of this method was 0.01%.

**Diyarbakır:** In laboratory of Forensic Medicine Department of Diyarbakır Dicle University Hospital, blood alcohol analyses are carried out with a Shimatsu Brand HS-20 Model HeadSpace unit to Shimatsu Brand GC-2010 Model Gas Chromatography device with FID (flame ionization detector) Flame Ionization Detector. In gas chromatography device, Restek Brand BAC Plus Model 1.30

Table 1. Locations, population, the number of licensed drivers and the number of traffic accidents belong four big cities of Turkey (Van, Manisa, Diyarbakır and Samsun)

Cities	Population*	The number of licensed driver *	The number of traffic accidents**
<b>Van</b> Settled in Eastern Anatolia Region	1,112,804	203,910	22,125
<b>Manisa</b> Settled in Western Anatolia (Aegean) Region	1,212,121	457,837	82,687
<b>Diyarbakır</b> Settled in Southern Eastern Anatolia Region	1,703,193	369,847	50,772
<b>Samsun</b> Settled in Northern Anatolia (Black Sea) Region	1,314,612	440,364	92,171
<b>Total of four cities</b>	5,342,730	1,471,958	247,755



(\*) After evaluation of statistical data belong to 2015-2019 years, which obtained from web pages of Turkey Statistical Institute and the General Directorate of Security, annual values were calculated.

(\*\*) These data is belong to the total data of the years 2015-2019

Table 2. Number of analyses, number and percentage of positive BAC cases in

Cities	Number of analyses	Positivity of BAC cases		Positivity rate per 100.000 licensed drivers
		n	%	
Van	1328	83	6.3	40.7
Manisa	1870	175	9.4	38.2
Samsun	910	48	5.3	10.9
Diyarbakır	720	36	5.0	9.7
<b>Total</b>	<b>4828</b>	<b>342</b>	<b>7.1</b>	<b>23.2</b>

BAC: Blood alcohol concentration

Table 3. The distribution of the BAC positive cases by gender, age groups and cities

Age Groups	Gender	Van	Manisa	Samsun	Diyarbakır	Total	%	BAC positivity rate
≤18	M	0	0	0	1	1	0.3	2.3% (1/43)
	F	0	0	0	0	0		
	T	0	0	0	1	1		
19-30	M	39	69	24	20	152	48.0	7.8% (164/2095)
	F	3	5	2	2	12		
	T	42	74	26	22	164		
31-45	M	26	62	9	10	107	34.2	6.9% (117/1687)
	F	0	5	4	1	10		
	T	26	67	13	11	117		
46-60	M	13	29	7	2	51	15.5	7.0% (53/755)
	F	1	1	0	0	2		
	T	14	30	7	2	53		
61≤	M	1	4	2	0	7	2.0	2.8% (7/248)
	F	0	0	0	0	0		
	T	1	4	2	0	7		
<b>Total</b>	M	<b>79</b>	<b>164</b>	<b>42</b>	<b>33</b>	<b>318</b>	<b>100.0</b>	<b>7.1%</b> <b>(342/4828)</b>
	F	<b>4</b>	<b>11</b>	<b>6</b>	<b>3</b>	<b>24</b>		
	T	<b>83</b>	<b>175</b>	<b>48</b>	<b>36</b>	<b>342</b>		
	F/T Rate	<b>4.8%</b>	<b>6.3%</b>	<b>12.5%</b>	<b>8.3%</b>	<b>7.1%</b>		

BAC: Blood alcohol concentration

Table 4. Distribution of cases according to BACs (g/100 mL) and cities

BACs (g/100 mL)	Van		Manisa		Samsun		Diyarbakır		Total	
	n	%	n	%	n	%	n	%	n	%
0.011%-0.030%	24	28.9	18	10.3	6	12.5	3	8.4	51	14.9
0.031%-0.050%	5	6.0	11	6.3	4	8.3	4	11.1	24	7.0
0.051%-0.100%	20	24.1	29	16.6	9	18.8	8	22.2	66	19.3
0.101≤	34	41.0	117	66.8	29	60.4	21	58.3	201	58.8
<b>Total</b>	<b>83</b>	<b>100.0</b>	<b>175</b>	<b>100.0</b>	<b>48</b>	<b>100.0</b>	<b>36</b>	<b>100.0</b>	<b>342</b>	<b>100.0</b>
<b>BAC positivity rates</b>	6.3% (83/1328)		9.4% (175/1870)		5.3% (48/910)		5.0% (36/720)		7.1% (342/4828)	

BAC: Blood alcohol concentration

m \* 0.32 mm \* 1.80 µm analytical column (Inj. Temp: 200°C, Det. Temp: 240°C, Split Flow: 100 mL/min, linear velocity: 38 cm/sec (Hydrogen)) is used. Cut-off value of this method was 0.005%.

**Samsun:** In laboratory of Samsun Ondokuz Mayıs University Hospital, alcohol analysis was performed with an enzymatic method using alcohol dehydrogenase in Roche Diagnostic Cobas 6000 c501 autoanalyzer. Cut-off value of this method was 0.01%.

A BAC value was considered negative if it was 0.01% or below, and positive if it was 0.011% or above.

Drug analysis was requested in only 23 cases, and the results of these analyses were not included in the study.

### Statistical Analysis

Results were statistically evaluated by the chi-square test. Level of significance was  $p \leq 0.05$ .

### Ethical Approval

The study was conducted with the approval (dated: 11.12.2020 and number: 2020/10-13) of the Van Yuzuncu Yil University Non-Invasive Clinical Research Ethics Committee.

### Limitation of Study

In this study, it was noted as a limitation that the law enforcement officers conducting traffic control sent people who objected in their control with alcoholometry or who did not blow on the alcoholometry device for blood control. In the hospital laboratory registry systems, information about whether the person who came in 93.4% of the cases came as a result of an accident or traffic control could not be reached. Likewise, information about the accident/traffic control time could not be accessed in 97.3% of the cases. For this reason, it was not possible to classify the cases as accident or traffic control and to make back calculations for the accident/control time.

## RESULTS

In the five-year study period from January 01, 2015 to December 31, 2019, there were 4,828 alcohol analysis for drivers involved in traffic accidents or suspected for alcohol in the roadside controls in four big cities of Turkey (Van, Manisa, Diyarbakır and Samsun). In 342 cases (7.1%), BACs were above the cut-off value. While the highest positivity rate of BAC per was in Manisa (9.4%), the lowest rate in Diyarbakır (5.0%) (Table 2).

Of the 4,828 cases for whom BAC was requested, 545 were female (11.3%) and 4,283 were male (88.7%) ( $p < 0.05$ ). BAC was found to be positive in 4.4% ( $n=24$ ) of females and 7.4% ( $n=318$ ) of males ( $p < 0.05$ ).

The mean ages and their standard deviations of the cases sent for BAC analysis were  $35.3 \pm 13.3$  [minimum (min): 16, maximum (max): 76] in males,  $34.9 \pm 11.7$  (min: 11, max: 97) in

females and finally was  $35.3 \pm 13.1$  (min: 11, max: 97) in total ( $p > 0.05$ ). Nineteen of the twenty-six drivers under the age of 18 were motorcycle drivers, and seven did not have a driving license. The distribution of the BAC positive cases by age groups and cities was submitted in Table 3. Most of the BAC positive cases (48%) ( $p < 0.05$ ), and the maximum BAC positivity (7.8%) were detected in the 19-30 age group.

In 342 alcohol positive cases, BACs were above 0.101% in 58.8% of cases. They were between 0.051%-0.1% in 19.3%, between 0.031%-0.05% in 7.0% and between 0.011%-0.03% in 14.9% (Table 4).

## DISCUSSION

As it has been noted that there has been a rapid increase in the number of DUIA, which has played an important role in traffic accidents in the world in recent years, roadside alcohol screening tests come to the fore for the detection of these people (2). In the United States of America, deaths due to drunk driving take an important place among deaths in traffic accidents; In 2015, 31% of traffic deaths were caused by DUIA (10). Considering the traffic accidents that occur in Turkey due to drunk driving and the damage caused by the deaths, injuries and material damages caused by these accidents to the economy of our country, it is stated that driving under alcohol should be absolutely prohibited (11).

In the present study, the rate of positive BAC detection among cases sent to university hospitals in four major cities of Turkey for alcohol analysis was found to be 7.1% on average. The highest BAC positivity was in Manisa with 9.4%, and it followed by Van (6.3%), Samsun (5.3%) and Diyarbakır (5%) ( $p < 0.05$ ). In the previous studies, the incidence of confirmed DUIA has been described as between 0.3% and 4% for all drivers (12-15), between 36% and 69% for drivers suspected of DUIA (15,16), between 32% and 90.5% for drivers involved and/or injured in traffic accidents (8,15), and between 9% and 87% for drivers who died in traffic accidents (7,12,15). The lower rate of positivity in Turkey among suspected DUIA cases can be explained by the fact that there is less alcohol consumption. While pure alcohol consumption among persons (age 15+) in litres per capita per year according to 2020 projection of WHO, is 1.9 in Turkey, it is 10.1 in the United States and 7.8-15.1 in European countries (17).

In a study conducted in Turkey, it was stated that 70% of those who drive while under the influence of alcohol are college graduates (18). In the study conducted by Kabalcı and Metin (19), the education levels of Turkey by provinces were determined, considering the population over the age of 15, it was found that the education level was 5.3 in Van, 5.8 in Diyarbakır, 6.9 in Samsun and Manisa (for other provinces, the minimum: 4.8 maximum: 8.7). In the present study, among the DUIA cases, the province with the highest BAC was Manisa (9.4%). On the

other hand, Diyarbakır was the province with the lowest BAC (5%) (Table 2). The education levels of BAC positive cases were not determined in our study.

In the previous studies it was reported that, 26% and 30.5% of the total drunk drivers (12,13), 26% of the drunk drivers involved in the accident (13), 7.3% and 32.4% of the drunk drivers injured in the accident (8,19-21), 17% and 21.1% of the drunk deceased drivers (7,12), were female drivers. In the present study, 11.3% of the drivers who requested BAC determination and 4.4% of the drivers who was BAC positive were females. Among the BAC positive cases, the rates of female drivers were 12.5% in Samsun, 8.3% in Diyarbakır, 6.8% in Manisa and 4.3% in Van (Table 3). According to the data of the General Directorate of Security for 2011, the rates of female drivers were 17% in Samsun, 14.3% in Manisa, 11.8% in Diyarbakır and 11.7% in Van (20). In these cities, no significant relationship was found between the rates of female drivers and BAC positivity of female drivers in proportional comparison ( $p>0.05$ ).

The mean age of suspected DUIA cases in our study was  $35.3\pm 13.1$  years, and mean age of the males ( $35.3\pm 13.3$  years) was similar to that of the females ( $34.9\pm 11.7$  years) ( $p>0.05$ ). In several studies involving European countries, it was defined that drivers positive for alcohol were mainly (from 41.9% to 70.6%) younger than 35 years (7,8,13), their mean age was between 34 and 38.6 (13,21). In another study conducted in Portugal, it was reported that ethanol detection was mainly from individuals aged between 21 and 30 years-old (26.6% of cases) (22). Similarly, the cases in the present study were concentrated in the 19-30 age group (48% of BAC positive cases) ( $p<0.05$ ) (Table 3).

Karjalainen et al. (21) found BAC values above 0.12% in 86.8% of the cases in their series, between 0.05% and 0.12% in 6.6% and below 0.05% in 6.6%. In the study of Costa et al. (22), BAC values were higher than 0.12% in 54.1% -59.3% of the cases, between 0.08-0.12% in 11.1% -13%, between 0.05-0.08% in 7.3%. It was less than 0.05% in 20.3% -27.5% of cases. Acar et al. (3), it was stated that, BACs was higher than 0.101% in 47.5%, between 0.051-0.100 in 22.5%, between 0.031-0.050 in 2.5%, and 0.001-0.030 between in 27.5% of cases (3). In the current study, similar to previous studies, BACs were above 0.101% in 58.8%, between 0.051%-0.1% in 19.3%, between 0.031%-0.05% in 7.0% and between 0.011%-0.03% in 14.9% of cases ( $p<0.05$ ) (Table 4). This distribution was differing according to cities it is possible to explain this difference with thesis about the selectivity of police officers taking part in roadside screening tests reported by Senna et al. (23).

## CONCLUSION

In this study, the incidence of BAC-positive cases was 7.1% in DUIA cases involved in traffic accidents or suspected on roadside scans. While the criminal relationship between traffic

accidents and DUIA cases is well defined in road traffic accident statistics, the number of multicentre studies focusing on this issue and revealing the similarities and differences between provinces is limited in Turkey.

We conclude that, zero tolerance for drunk driving in traffic, increasing the deterrence of fines and tightening roadside controls will prevent these deaths and injuries to a great extent.

## Ethics

**Ethics Committee Approval:** The study was conducted with the approval (dated: 11.12.2020 and number: 2020/10-13) of the Van Yuzuncu Yil University Non-Invasive Clinical Research Ethics Committee.

**Peer-review:** Internally peer-reviewed.

## Authorship Contributions

Data Collection or Processing: H.N.C., M.A., S.B., R.D., L.D., G.K., E.A., A.B., F.A., G.D.S.T., Analysis or Interpretation: M.A., E.A., Literature Search: M.A., Writing: H.N.C.

**Conflict of Interest:** No conflict of interest was declared by the authors.

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