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Ethanol Level of Vitreous Fluid in Road Accident fatalities referred to Tehran Legal Medicine Center in 2018

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Abstract: **Background:** High risk behaviors such as substance use are among the human factors that can play an important role in fatal road accidents and deaths. **Objective:** To determine the status of alcohol consumption based on vitreous fluid exam in cadavers sent to Tehran Legal Medicine Organization. **Materials and Methods:** In this descriptive analytical cross-sectional study, all fatalities sent to the Tehran Legal Medicine Organization during 2018 were studied. A vitreous sample was used to measure the amount of alcohol. **Results:** Out of 676 cadavers (85% male; mean age 40.6±6.45), the toxicology results for alcohol was positive in 6.51% (91% male; mean age 37.10±15.7). There was a significant difference between the two sexes (P < 0.00) and the educational level (P1< 0.00). Most fatal accidents occurred in positive toxicology cases between 10-12 pm and on Fridays followed by Thursdays. **Conclusion:** The policy of non-consumption of alcohol based on Islamic teachings in Iran has played an important role in significantly reducing fatal accidents caused by alcohol.

Keywords: Alcohol; Fatal Accident; Islamic teachings; Legal toxicology; Mortality; Vitreous fluid

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1. Introduction

About 16,000 people around the world die every day from various injuries. Injuries and trauma account for 12% of the total disease burden, the third most common cause of death, and the leading cause of death between the ages of 1 and 40 years. These injuries occur mainly in road accidents (1). In line with the process of industrialization, the number of deaths due to traffic accidents is on the rise in Iran. In various studies, high statistics (30-39 cases per 100,000 population) are mentioned for road accidents (2, 3), that are higher than the global (22.6 cases per 100,000 people) and the Eastern Mediterranean (13.9 cases per 100,000 people) average (4, 5). Mortality due to road accidents, accounting for 10.3% of the total mortality, is the third most important cause of death in Iran and almost five times higher than the global average. Studies show that about 0.8 million people (1.1% of the country's population) are hospitalized due to road accidents and impose a significant burden on the country's health care system (5).

Several studies have aimed to determine and categorize the factors that contribute to road accidents (1, 6). Human factors are one of the most important causes of accidents and injuries in all types of transportation, both land and air (7, 8). In the analysis of road accidents in Iran, the human factor is the most important factor, and is present in 90% of traffic accidents alone or in combination with other factors (2).

These human factors can be divided into two main groups: 1) factors related to the process of human neurobiological development that is outside the control and management of the person driving (such as driving at a young age and cognitive and skill decline in older ages), 2) Complex factors that become a source of serious risk in interaction and close relationship with personality traits and psychological conditions of the individual. These factors, commonly referred to as "high risk driving behaviors," include any behavior that increases the risk of an accident or injury. In this group, we can mention substance and alcohol consumption, high speed, disregard for traffic signals, etc. The main basis of such behaviors depends on the personality pattern and general attitudes of the individual, although situational factors also play a role in mitigating or exacerbating them (9).

There are several studies on the role of drugs and alcohol as

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two important underlying factors in the incidence and severity of trauma (10, 11). Alcohol increases the short-term risk of accidents by removing brain inhibition, impairing judgment, and slowing the response to stimuli. Young people, women and people with little experience in alcohol consumption are less tolerant of alcohol and more prone to alcohol-related accidents (12, 13). Numerous drugs also affect driving behavior by disrupting the data processing and prolonging response time (14). Alcohol consumption is generally prohibited under Iranian law, and according to the law, consuming alcohol in any form is banned according to Islam's rules and is subjected to punishment (15).

During these years, although we are witnessing an improvement in the process of controlling road accidents with the joint operation of the police, the Ministry of Health, and the Forensic Medicine Department, there is still a long way to go to reach international standards. On the other hand, such accidents have not been considered by researchers in the country until recently and there is not enough information about the underlying factors, main causes, and other predictors of road accidents to help prevent them effectively; and data is often incomplete and not of high research quality. 10-60% of accidents are somehow related to illegal substance use; however, there are different consumption patterns in different countries (16). For example, cannabis and cocaine in European and American countries, and narcotics in the Middle East, are the main substances detected in laboratory tests in people with posttraumatic stress disorder (17, 18). There are many limitations in providing accurate statistics on people who are alive because of the concealment of individuals, drug metabolism, and the impossibility of extensive screening. In this regard, and considering the sample of vitreous humor as a stable substance with slight changes after death (19), we aimed to determine the status of alcohol consumption in vitreous humor of cadavers referred to Tehran Forensic Medicine Center.

2. Materials and Methods

In this descriptive analytical cross-sectional study, all cadavers referred due to road accidents (including driver, passenger and pedestrian) to the Tehran Legal Medicine Organization, in 2018, were examined. First, the whole vitreous fluid in both eyes of the cadaver was emptied separately with a syringe (About 2 cc) and then transferred to the toxicology laboratory by maintaining the cold chain (4°c) and assessed for existence of alcohol using the Head Space Gas Chromatography method and with the Agilent device according to the existing protocols. Vitreous alcohol is measured to avoid error in laboratory results because of corruption in cadavers, which reduces the sensitivity and value of measuring alcohol in blood and urine samples (which are routinely used in living people) (19, 20).

The inclusion criterion was age of fifteen years or more and we excluded cadavers that were unidentified, had deteriorated, and were decomposed (especially both eyes). Data were collected using a form for each deceased person that included age, sex, date and time of the accident, the person's position in the accident (being a pedestrian or driver), level of education, type of vehicle, specific underlying disease, history of drug use, and toxicological results. The status of the accident and the location of the person, as well as having a history of drug and substance use were determined according to the contents of forensic and police files and hospital and relatives' reports. SPSS software, version 22 was used to analyze data. Frequency, mean, standard deviation, Chi-square test, and mean comparisons were used as appropriated.

Prior to collecting data, necessary permissions were obtained from the Ethics Committee of Tehran Forensic Medicine Center and written informed consent was obtained from the families. The names and identities of the individuals remained confidential and the statistical results were published in groups.

3. Results

Among the 676 cadavers referred the Tehran Legal Medicine Organization during 2018, vitreous alcohol was positive in 44 (6.51%) (M/F=11, P< 0.00) cases.

The mean±SD age of the cadavers was 40.64±6.45 years (M: 38.36±5.59, F: 55.74±9.22), with an age range of 15-96 years (men: 14-96 years, women: 20-83 years). The most frequent age group was 38-42 years. The mean±SD age of men with a positive alcohol result was 43.33±13.01 years (range: 17-54 years, table 2).

In terms of education level, there was a statistically significant difference between different levels. In positive toxicology samples, university graduates (57.82%) and in negative toxicology, diplomas (87.33%) had the highest statistics (table 3).

In examining the position of the injured person, a statistically significant difference was seen between different positions. In positive toxicology samples, the driver (45.45%) and subsequently the passenger of the car (31.82%) had the highest statistics; while more than half of the dead with negative toxicology test were pedestrians (60.44%) and then drivers (43.25%) (P< 0.00, table 4).

The time and day of the accident were also investigated. The highest rate of accidents occurred between 6-8 am and 10-12 pm (21 cases, 12%), followed by 1 pm to 6 am (18 cases, 11%), with more than half (70%) of fatal accidents in men who died with a positive toxicological result, it occurred between 10 and 12 pm. Two cases (20%) occurred at 4 in the morning

and one case (10%) occurred between 6-8 pm, and there was also a statistically significant difference between the days. Incidence of accidents was seen (P< 0.05) in positive toxicology samples, Fridays had more accidents (27.27%), although there was no significant difference between the days of the week (P> 0.05, table 5).

Moreover, in our study there were no cases of mental illness, seizures, Parkinson's, balance disorders or any kind No other disease was found that could directly contribute to the accident. No history or symptoms of cirrhosis or hepatitis (chronic alcohol use) were found.

4. Discussion

In the present study, only 7% of cases reported a positive toxicological result, which is much lower than similar global statistics which is estimated at 27.7% (22-25). This could be due to cultural and religious differences. Due to the lack of similar studies in other Islamic countries, it is not possible to make a more accurate comparison in this regard. Very heavy punishment for alcohol consumption in Iran can be a factor in reducing the rate of statistics (16). On the other hand, the difference between the statistics obtained in this study and other studies conducted in Iran could be due to the differences in the statistical population of this study. The present study was performed for the first time on cadavers of people with fatal road accidents. However, previous studies have been performed on living people, which could show higher rates of alcohol consumption. In these cases, many people who survived road accidents had consumed alcohol and had a positive test result, but it was not to the extent that it disturbed their senses and balance.

Also, according to the comparison of solar date and lunar months, it is worth mentioning that 21 days have passed since the study was conducted during the month of "Safar", which is a forbidden month according to Islamic beliefs, and so alcohol is consumed less compared to other months.

In the present study, out of 44 deaths that were positive for toxicology, 40 (91%) were men and 4 (9%) were women. In terms of gender, there was a significant difference between the men and women (P< 0.00). The World Health Organization states that of the 1194,115 people killed in traffic accidents worldwide in 2001, 848,234 were men and 345,881 were women (2.34:1) (21). Also, according to other reports (22), the number of male deaths in Iran in 2007 was 5,360 compared to 1,031 female deaths (5:1).

According to road accident statistics in Iran in 2006, 99% of drivers were men and women accounted for only 1% of these cases (22). In all cases of fatalities (such as firearms, homicides, suicides, drowning and falling from heights, etc.), the high proportion of men dying is a global phenomenon. In traffic accidents, men are more likely to die than women in all age groups, which can be due to behavioral and physical factors as well as job, education, awareness and attitude, economic status, daily activities and entertainment, and social and cultural situation. Also, high risk behaviors are more common in men than women. In several studies (23-26), the number of fatal accidents was higher in men and also the prevalence of alcohol consumption among male deceased in road accidents was higher in men than in women.

In the present study, the mean ages of the samples tested negative and positive in toxicology were 43.39±20.02 and 37.10±15.7 years, respectively. However, the mean age of positive toxicology test samples was lower, but it was not statistically significant (P> 0.05). In one study in Mashhad, 25% of road accidents that led to trauma were due to alcohol consumption, and the highest frequency of injuries was seen in 18-year-olds (27). The mean age of drivers who died in road accidents due to drug use and psychotropic substances was reported to be 32.4 years in one study (28), and 21-30 years in another (25). In another study (24) on drivers with fatal accidents, it was shown that the prevalence of alcohol consumption was higher in young drivers than older drivers. Moreover, the age of drivers who died in road accidents due to drug use was 35 years in another study (23). In fatal crashes, the age of drivers consuming alcohol and cocaine varied between 16 and 45 years (17).

In terms of education level, there was a statistically significant difference between different levels. In positive toxicology samples, university graduates (57.82%) and in negative toxicology, diplomas (87.33%) had the highest statistics. Education level is an influential factor in driver perception when driving in traffic flows. It seems that people with a higher education, environmental conditions and risk factors are better understood. As the level of education, life expectancy, and driving comprehension increase, a person drives safer and in safer conditions. Therefore, increasing the level of education can be considered as an effective step in improving the driving situation and promoting traffic culture. In a study aimed at investigating the role of human factors in the incidence and severity of road accidents in Iran, it was found that 12.5% of drivers who experienced road accidents were illiterate, 32.1% had undergraduate degree, 18.8% had a diploma, 2.4% had a college degree, 3.1% had a bachelor's degree, and 1% had a master's degree (22). Also, according to the results of this study, alcohol consumption may be present in any category of education from illiterate to doctoral.

In this study, about half (45.45%) of the dead with positive toxicology were car drivers and 31.82% were passengers. On the other hand, more than half (60.44%) of the dead with negative toxicology test were pedestrians followed by car drivers (43.25%). According to global research, most deaths due to traffic accidents have targeted vulnerable people (pedestri-

ans) (29). In one study, 86.82% of the dead were pedestrians (22). In our study, motorcyclists accounted for a high percentage of deaths. Motorcyclists are one of the most vulnerable groups in road accidents (30). Motorcycle deaths are on the rise around the world. Motorcycle accidents lead to serious injury or death in 90% of cases (29). Risky behavior is one of the main causes of these accidents. Numerous behaviors such as overtaking, improper speed, nonobservance of the right of way when overtaking, nonobservance of traffic rules and also not wearing a helmet have been identified as risk factors of this type of injury (29). Huang and colleagues (25) showed that 40% of fatal accidents in motorcycle riders were related to alcohol consumption. The results of this study showed that high-speed car accidents and accidents involving drunken motorcyclists were more deadly than other types of road accidents.

In the present study, among those who died with a negative toxicology test, the highest number of accidents was between 68 am (18 cases) and 16 am (15 cases). It seems that in people with no history of alcohol consumption, drowsiness in the early hours of the morning can lead to a fatal accident. Another study showed that in 3.9% of all traffic accidents, drowsiness played a significant role (31).

Contrary to what was mentioned above, this study showed that in more than half of the cases (7 cases) in people with positive toxicology, fatal accidents occurred between the late hours of the night (10-12 am). Drinking alcohol early at night and driving recklessly afterwards were the cause of the accident, which is consistent with another similar study (23).

In this study, no cases of diseases that could directly contribute to the accident, such as neurological diseases, seizures, Parkinson's disease, balance disorders, etc. were found. There was no history of taking sleeping pills. No history of cirrhosis or hepatitis or any disease that suggests chronic alcohol use was found.

5. Conclusion

Although the general pattern of fatal accidents in positive alcohol toxicology cases is similar to global studies, in which alcohol consumption has a significant impact on fatalities and fatal accidents because of its effect on brain function and social abuse, but unlike global studies, it seems that Islamic culture in Iran has had a significant impact on reducing the role of alcohol consumption in fatal accidents compared to global statistics.

6. Appendix

6.1. Acknowledgements

None.

6.2. Author contribution

All authors have the same Contribution.

6.3. Funding/Support

None.

6.4. Conflict of interest

The authors declare that there is no conflict of interests regarding the publication of this paper.

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Table 1: Frequency distribution of Toxicology according to Sex.

Sex/Toxicology	Male	Female	Total	P Value
	40	4	44	
Positive	90.90%	9.10%	6.51%	
	5.90%	0.59%		
	536	96		
Negative	84.81%	15.19%	632	< 0.00
	79.28%	14.20%	93.49%	
Total	576	100	676	
	85.20%	14.79%	100%	

Table 2: Frequency distribution of Age according to Sex and Toxicology.

Toxicology	Sex	Male	Female	Total
Positive	Range	17-54	18-43	17-54
	mean	13.01±43.33	6.09±31.34	37.10±5.07
Negative	Range	15-96	16-92	15-96
	mean	9.23±33.41	8.56±26.63	43.39±9.02
Total	Range	15-96	20-83	15-96
	mean	5.69±38.36	9.22±55.74	6.45±40.64

Table 3: Frequency distribution of Education level according to Sex and Toxicology.

Toxicology	Positive		P Value	Negative		Total	P Value
Education	Female	male		Female	male		
Under diploma and illiterate	1	6		6	61	74	
	2.27%	13.63%		13.63%	9.65%	10.95%	
	0.14%	0.89%		0.89%	9.02%		
	1	11		23	225	260	
Diploma	2.27%	25.00%	< 0.00	52.27%	35.60%	38.46%	< 0.00
	0.14%	1.62%		3.40%	33.28%		
	2	23		11	192	228	
College education	4.55%	52.27%		25.00%	30.38%	33.73%	
	0.30%	3.40%		1.62%	28.40%		
Total	4	40		40	536	676	
	0.60%	5.90%		6%	0.35%	100%	

Table 4: Frequency distribution of victims' position according to sex and toxicology.

Position/Toxicology	Positive		P Value	Negative		Total	P Value
F	M		F	M			
Motorcycle rider	1	5		4	36	42	
	2.27%	11.36%		9.09%	5.70%	24.85%	
	0.14%	0.74%		0.59%	5.33%		
	1	19		12	101	18	
Car driver	12.27%	43.18%		27.27%	15.98%	0.65%	
	0.14%	2.81%		17.91%	14.94%		
	2	12		36	61	24	
car's passenger	4.55%	27.27%	< 0.00	5.70%	9.65%	14.20%	< 0.00
	0.30%	17.91%		5.33%	9.02%		
pedestrian	0	4		44	338	74	
	0	9.09%		6.96%	53.48%	43.78%	
	0	0.59%		6.51%	50%		
Total	4	40		96	536	676	
	0.59%	5.90%		14.20%	79.28%	100%	

Table 5: Frequency distribution of accident day according to toxicology.

Day/Toxicology	Positive	P Value	Negative	Total	P Value
Saturday	8 18.18% 1.18%	< 0.00 14.72%	93 14.94% 13.76%	101	>0.05
Sunday	5 11.36% 0.74%	108	113 17.09% 15.97%	16.72%	
Monday	3 6.82% 0.44%		81 13% 11.98%	84 12.42%	
Tuesday	4 9.09% 0.59%	97	101 15.35% 14.35%	14.94%	
Wednesday	2 4.55% 0.30%		73 11.55% 10.80%	75 1109%	
Thursday	10 22.73% 1.48%		93 14.72% 13.76%	103 15.24%	
Friday	12 27.27% 1.78%	87	99 13.77% 12.87%	14.64%	
Total	44 6.50	632	676 93.50%	100%	