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## Review

# The prevalence of alcohol and psychotropic drugs in fatalities of road-traffic accidents in Jordan during 2008–2014



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## ABSTRACT

**Objective:** Several studies confirmed alcohol and psychotropic drug consumption as important risk factors underlying fatal accidents. This paper presents updated toxicological findings in the fatalities of road traffic accidents of Amman district, in order to have an overall picture of the occurrence of these substances in these victims in Jordan.

**Method:** Over a seven-year period (2008–2014), 2743, autopsies were conducted at Jordan University Hospital in which the sum of  $n = 311$  (11.38%) were victims of road traffic accidents. Blood samples from these victims were collected. Toxicology screening for psychotropic drugs and alcohol was conducted on these samples, and the results were analyzed according to age, sex and victim's status.

**Results:** This study revealed that Alcohol and psychotropic drugs were positive in 36.5% ( $n = 58$ ) of the cases, and for alcohol alone ( $n = 13$ , 37.1%). The majority of the victims were pedestrians ( $n = 155$ , 49.8%). Additionally, 29.6% ( $n = 92$ ) of the cases were of ages 19–29. Detected psychotropic drugs were benzodiazepines, barbiturates. None of the collected specimens were positive for illicit cocaine, amphetamines or cannabis.

**Conclusions:** The results from this study proved the existence of alcohol and psychotropic drugs in the victims of road traffic accidents; Indicating an association between the uses of these substances in accident involvement. Though having some limitations, other conclusions require further data collection, cooperation with related parties in Jordan, and utilizing simple extended toxicological screens.

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## 1. Introduction

Jordan road traffic accidents (RTA) reveal publicly a major health and an alarming problem. It was considered as the second-leading cause of death and the responsible for killing of 1552 Jordanian, during the years 2014 and 2013.<sup>1</sup> The attributes of RTA and safety impact of policy measures undertaken in Jordan were earlier reported.<sup>2</sup> The role of alcohol and illicit drugs in driver's impairment as well as to road safety has been a cause of concern and a prominent problem worldwide for a long time ago, knowing that druged driving not only puts the driver at risk but also passengers and

others who share the road. There has been a link between druged driving and the increased accident risks owing to their effects on the central nervous system, impairments vary between Alcohol and different types of illicit drugs. Alcohol, for instance, decreases significantly the driving skills and capabilities due to the influence on concentration, alertness and the reflexes of individuals, including drivers, pedestrians and vehicle passengers.<sup>3,4</sup>

Robust evidence of prevalence studies from different countries showed that higher rates of RTA primarily linked to Alcohol and illicit drugs or medications. In South Africa and Slovenia, Alcohol was the determining factor for 58% and 42.4% pedestrian's fatalities during the period of 2001–2004 and 1999–2006, respectively.<sup>5,6</sup> In the United States of America, alcohol-related motor vehicle crashes killed approximately 17,000 annually.<sup>7</sup> The prevalence of alcohol and drugs in fatally injured drivers was described in Ontario/Canada for the period of 2001–2005; the study showed that 90.9% of the drivers had alcohol above the legal limit for drinking and

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driving ( $\geq 80$  mg/dl in blood), while, 80.9% of the drivers had drugs of abuse in their systems like ( $\Delta 9$ -tetrahydrocannabinol, benzoyllecgonine/cocaine, morphine).<sup>8</sup> Recent roadside studies in 13 European countries revealed that alcohol was the most prevalent (3.48%) among drivers, followed by illicit drugs (1.9%, with cannabis most frequently detected), and medicinal drugs (1.36%).<sup>9</sup>

In Sweden, samples of 895 victims involved in fatal accidents were analyzed for alcohol and drugs. In 21% of fatalities, blood-alcohol concentration (BAC) was above the statutory limit of driving (0.2 g/L), but the median BAC was appreciably higher (1.72 g/L). Approximately 7% of the victims had illicit drugs (mainly amphetamine and cannabis), either alone (2.5%), together with alcohol (1.8%) or with a prescription drug (2%) in their blood. However, in 7.6% of crash victim's psychotropic prescription drugs identified, were mainly benzodiazepines, Z-hypnotics and tramadol.<sup>10</sup> The literature showed that there are few reports addressing poisoning with alcohol and drugs in medico-legal and postmortem cases in Jordan.<sup>11–15</sup> In spite of, the seriousness of RTA impact on individual's health and economy, there were no documented reports relating the role of alcohol or drug involvement in RTA in Jordan.

This prospective study is an attempt to evaluate the status of alcohol and psychotropic drugs in fatalities involved in RTA over a seven-year period (2008–2014) from the northern district of Amman. Therefore, comprehensive screening was conducted to blood, urine and vitreous specimens that were obtained at autopsy from RTA victims during that period.

## 2. Methods

### 2.1. Study population

A sum of 2743 Medico-legally-related deaths, including RTA deaths ( $n = 311$ ) from the period 2008–2014, within the north of Amman which is customary referred to Jordan University Hospital (JUH) included within this study. Biological samples of these victims collected, and toxicological analysis was conducted for them at the toxicology laboratory at JUH for this study. Data containing the toxicological results were compiled according to age, sex and the type of RTA involvement victims.

### 2.2. Alcohol and toxicology screen

Blood samples were obtained from a femoral vein into tubes containing sodium fluoride as preservative (1–2%, v/v) for alcohol level determination. Urine was utilized for initial drug screen and vitreous humor for verification of alcohol level. Alcohol determination was performed by a gas chromatography/flame ionization detector.<sup>14</sup> Toxicology screen for psychoactive drugs was performed by gas chromatography/mass spectrometry.<sup>15</sup>

## 3. Results

Twenty-four hours from car crashes RTA victims were brought to JUH. Victims included motor vehicle drivers, pedestrians and vehicle passengers. As requested from the prosecutor's office, forensic practitioner conducted the autopsies. Accordingly, collected a sum of samples from the 311 autopsies and submitted them for analysis at JUH laboratory.

As reflected from the distributions of RTA fatalities in Table 1, the majority of the victims were pedestrians ( $n = 155$ , 49.8%), others were drivers and passengers ( $n = 68$ , 21.9%), ( $n = 80$ , 25.7%), respectively. However, depending on the available data within the mortuary, the status of other RTA fatalities ( $n = 8$ , 2.6%) was not evident. Moreover, the young-active age group (19–29) accounted

**Table 1**  
RTA category depending on victim's status.

RTA category	N (%)
Drivers	68 (21.9)
Pedestrian	155 (49.8)
Passengers	80 (25.7)
Unknown	8 (2.6)

**Table 2**  
Age distribution of victims.

Age group (year)	N (%)
$\leq 18$	70 (22.5%)
19–29	92 (29.6%)
30–39	41 (13.2%)
40–49	35 (11.3%)
50–59	22 (7.1%)
$\geq 60$	51 (16.4%)

for the majority of fatalities ( $n = 92$ , 29.6%), then the age group ( $\leq 18$ ) ( $n = 70$ , 22.5%), the elderly ( $\geq 60$ ) ( $n = 51$ , 16.4) and at last the age group (30–39) ( $n = 41$ , 13.2%) as shown in Table 2.

In Table 3. The proportion of men exceeded that of women, 257 (82.6%) of the victims were males and 54 (17.4%) were females.

According to the subsequent toxicological analysis of biological samples obtained from the victims, 36.5% ( $n = 58$ ) confirmed presence of drug and/or alcohol, and was relatively the highest among Pedestrians ( $n = 25$ , 43.1%). Positive results were alcohol alone, psychotropic drugs, and combined drugs and alcohol to give an overall idea for the prevalence of these substances within specimens obtained from RTA victims, Table 4. Alcohol existed in 37.1% in both drivers and Pedestrians. The detected psychotropic drugs as presented in Fig. 1, including barbiturates, benzodiazepine, Paracetamol and all other drugs which contain Non-sedative-hypnotics, mainly antipsychotic, anticonvulsants, caffeine, antihistamines. However, none of the samples contained illicit amphetamines, cocaine or cannabis.

A total of 32.8% of RTA driver victims had positive alcohol and for psychotropic drugs. 43.1% of Pedestrians showed positive for alcohol and psychotropic drugs. 22.4% of pedestrians RTA victims were positive for psychotropic drug (with and without alcohol). Alcohol only was the most common finding in all RTA victim categories. For all RTA victims the psychotropic drugs detected were barbiturates (Phenobarbital), and benzodiazepines (diazepam, nordiazepam, chlordiazepoxide and carbamazepine with concentration found 1.3  $\mu\text{g}/\text{mg}$  blood). Other drugs (mainly, Phenytoin an anticonvulsant) alone (average concentration found range from 0.5 mcg/ml – 13 mcg/ml) or combined with benzodiazepines or atracurium (0.77 mcg/ml) were the main psychotropic drugs positive in RTA driver victims, followed by barbiturates.

## 4. Discussion

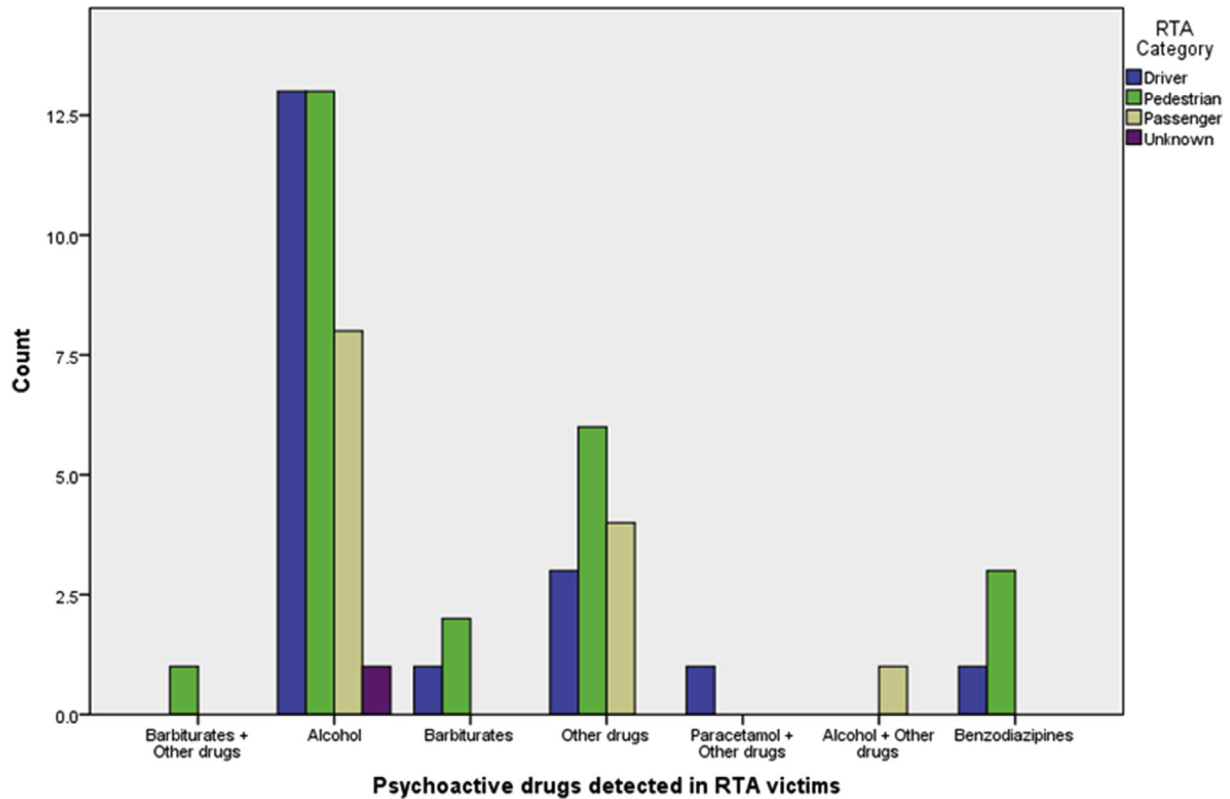
Traffic accidents in Jordan decreased from 768 in 2013 to 688 in 2014, and accordingly the resulting casualties showed a reduction in the severity rates from 0.37 to 0.13 (casualty/accident) during the same period.<sup>1</sup>

**Table 3**  
Gender of victims killed in traffic crashes.

Gender	N (%)
Male	257 (82.6%)
Female	54 (17.4%)

**Table 4**  
Alcohol and Psychotropic drugs detected versus victim's status.

RTA category drug	Driver	Pedestrian	Passenger	Unknown	Total
Barbiturates	1 (33.3)	2 (66.7)	0 (0.0)	0 (0.0)	3
Alcohol	13 (37.1)	13 (37.1)	8 (22.9)	1 (2.9)	35
BAC average levels	83 mg/100 ml	73.3 mg/100 ml	69 mg/100 ml		
Barbiturates + Other drugs	0 (0.0)	1 (100)	0 (0.0)	0 (0.0)	1
Alcohol + Other drugs	0 (0.0)	0 (0.0)	1 (100.0)	0 (0.0)	1
Other drugs	3 (23.1)	6 (46.2)	4 (30.8)	0 (0.0)	13
Paracetamol + Other drugs	1 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	1
Benzodiazepines	1 (25.0)	3 (75.0)	0 (0.0)	0 (0.0)	4
Total	19 (32.8)	25 (43.1)	13 (22.4)	1 (1.7)	58 (100)



**Fig. 1.** Psychotropic drugs and alcohol in RTA victims.

However, Jordan faces a serious and an alarming traffic accident's problem compared with the developed and with a number of the developing countries. The country experienced excessive human and economic losses as well as social and emotional impacts as a result of this problem.<sup>2</sup> Traffic accidents are a complex phenomenon. They are caused by a multitude of factors, including roadway and its environment, road users, behavior and vehicle aspect.<sup>1,16–18</sup> While the first single cause of accidents in Jordan is carelessness, aggressive driving is believed to be the major contributory factor in traffic accidents.<sup>16</sup>

Drugged driving and RTA are looming public health concern, and there is a growing concern over their involvement in RTA and fatalities, due to the increasing number of Jordanians using illicit drugs, where alcohol and psychotropic drugs can alter perception and behaviors for those who consume them.<sup>19</sup>

Autopsies are conducted on the majority of RTA victims as a routine practice to establish the cause of death and biological samples collected depending on the suspicion of the forensic pathologist for further investigation, which might reflect sampling bias.<sup>16</sup> For that purpose, the samples are regularly submitted to the

Forensic Laboratory of the Public Security Directorate. The main strength this study had was the comprehensive screening for a relatively small number of autopsies which accounted for (11.38%) of those autopsies that were performed at JUH over this study period.

It is conventional when conducting an autopsy to face some difficulties in interpreting postmortem and antemortem BAC or drug's levels as well as to the state of inebriation and the degree of behavioral impairment at the time of death. Some factors play a major role in interpreting alcohol results like body condition, the time between death and autopsy, environmental conditions and the nature of the specimen collected for analysis. However, in this study none of the bodies showed signs of putrefaction or decomposition.<sup>20</sup>

One of the repetitive important questions in forensic science and toxicology is determining if a positive blood ethanol resulted from postmortem synthesis or antemortem ingestions.

None the less; the production of ethanol between the time of death and autopsy can be resolved by using samples from femoral blood, which is the least susceptible to postmortem changes.

Concentrations of ethanol in this sample with added potassium or sodium fluoride (1–2% w/v) provides foremost the best measures for the deceased BAC.

Moreover, comparing ethanol concentration in different body fluids like urine and vitreous humor is effectively needed to ensure obtaining the correct diagnosis, whether a person was under the influence of alcohol at the time of death.<sup>20</sup> To some extent, at autopsy the BAC approximately will always be lower than the maximum BAC reached during a drinking binge. Due to the continuous ethanol metabolism up to the time of death, accordingly the BAC might decrease substantially depending on alcohol elimination speed from the blood which might exceed 20 or 30 mg/100 ml per hour in heavy drinkers.<sup>20</sup>

As for Impairment and according to some studies, driving performance can be affected by alcohol even in low dosage (as low as <0.02 g/100 ml), Currently there is no evidence of a threshold blood alcohol below which impairment doesn't occur and there is no defined classification of drivers who will not be impaired by alcohol.<sup>21</sup>

And for drugs, the clinical concept of therapeutic and toxic doesn't necessarily correspond with impairment. Even though, some individuals are impaired with levels of a drug normally considered as curative (sedatives), there is no critical level of most drugs above which impairment is present or below which no impairment can be established.<sup>21</sup>

The results of this study documented the presence of alcohol and psychotropic drugs in RTA victims, which builds up an association between the uses of these substances in RTA involvement. Therefore, Alcohol (average of 75 mg/100 ml) and drugs were responsible for 58 deaths (2.11%) of all postmortems (n = 2743) that were performed at JUH during seven years (2008–2014).

Psychotropic drugs impair intellectual functions, judgment, normal reflexes, so people under their influence might be reflected in several medico legal problems, including RTA.<sup>8–11</sup> These facts could be also observed the results of this study. This study showed that positive results for drug and/or alcohol were 36.5%, (n = 58), Toxicology results of RTA victims were positive for benzodiazepines 6.9% and 5.1% were positive for barbiturates. The presence of a local or general anesthetic in blood almost surely means that the deceased underwent some form of emergency life-saving treatment. We identified 13 of such cases, and these were classified as being other drugs, some of the drugs found in blood, such as paracetamol is not considered a danger for traffic safety.

This study showed that young drivers of ages 19–29 years and less than 18 years were more commonly vulnerable to RTA involvement. Majority of victims were Pedestrians (n = 155), showing the highest percentage of positive findings (49.8%). Males were mostly involved in fatal road traffic accidents and counted for 257 (82.6%).

However, the results should be interpreted in the contest of some limitations. Including the small number of cases and the constrained demographic distribution of cases as it merely covered the capital Amman, which might have resulted in underestimation of the actual representation for the overall population, and the insufficiency of accident circumstance related data.

Previous Jordanian study showed that positive results for drug and/or alcohol were 72.3%, (n = 68), and the relatively highest among them were driver victims (n = 19, 20.2%).

For all RTA victims, the psychotropic drugs detected were opioids, barbiturates, benzodiazepines, and anti-depressants. Opioids were the main drug class detected in RTA driver victims (3.2%, n = 3), followed by benzodiazepines and anti-depressants, while barbiturates were of high frequency in car passengers (3.2%, n = 3), Multiple drug use was prominent in 3.2% (n = 3).

Commonly young drivers of ages less than 29 years and elderly of over 60 years were more vulnerable to RTA involvement. The majority of victims were drivers (n = 29), having the highest percentage of positive findings (20.2%). Young males in the age group 19–29 were mostly involved in fatal road traffic accidents (35.7%).<sup>22</sup>

## 5. Conclusion

The results from this study documented the presence of alcohol and psychotropic drugs in RTA victims, which might have some association between the uses of these substances in RTA involvement. However, due to some limitations, other detailed conclusions require further recommendations such as extending the study to include larger populations at the national level, include additional details of the accidents, police investigations and apply an inexpensive and easier method of toxicological analysis and screening such as immunoassays in the site of accidents.

Physicians must advice drivers and other patients to avoid using psychotropic drugs or alcohol during driving or any risky activity, and conduct awareness campaigns among the public about the potential dangerous effects of such substances on driving. It is not only a real challenge, but also a significant investment towards improving public health in Jordan.

## Conflict of interest

None to declare.

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