

Alcohol and Driver Fatalities in Israel: An Examination of the Current Problem

Dena H. Jaffe PhD¹, Bella Savitsky MPH¹, Konstantin Zaistev MD², Jehuda Hiss MD² and Kobi Peleg MPH PhD^{1,3}

¹Israel National Center for Trauma and Emergency Medicine, Gertner Institute for Epidemiology and Public Health Policy, Tel Hashomer, Israel

²National Center for Forensic Medicine, Tel Aviv, Israel

³Department of Disaster Management, School of Public Health, Tel Aviv University, Ramat Aviv, Israel

ABSTRACT: **Background:** The role of alcohol in driver fatalities in Israel is unknown, and monitoring blood alcohol concentration among drivers is not routine. Moreover, over the past decade, self-reported access to and consumption of alcohol in Israel has been on the rise.

Objectives: To use available data to characterize alcohol-related driver fatalities.

Methods: The prevalence of alcohol-related driver fatalities were estimated for 443 drivers, aged 17+ years, using data from Israel's National Center for Forensic Medicine for 2000–2004.

Results: Between 8% and 17% of driver fatalities had a BAC \geq 0.05 g/dl. Most drivers with alcohol exceeding this level were males aged 21–30 years who died on weekends. Recreational and/or medicinal drugs were found in 6%–11% of driver fatalities. Mean BAC among driver fatalities with BAC \geq 0.05 g/dl was threefold higher than the legal driving limit and appears to be increasing with time.

Conclusions: In light of the evidence suggesting an increasing mean BAC over time as well as reported increasing trends in access to alcohol and consumption, this study should serve as a basis for future research to comprehensively characterize the extent of this problem.

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KEY WORDS: alcohol, driver, fatality, motor vehicles, blood alcohol concentration, road traffic crashes

Road traffic crashes are one of the major causes of injury and hospitalization in Israel, especially among adults aged 15–29 years [1,2]. Over time, the numbers of RTC and resultant injuries have decreased [1]. For example, from 1996 to 2007 the total number of road crashes involving casualties fell from 25,405 to 16,016 [1]. Fatalities from RTC during this period also decreased from 517 in 1996 to 398 in 2007 [1]. Similar

reductions observed in other industrialized countries have been attributed to behavioral and structural changes such as increased seatbelt use and road improvements [3]. One major obstacle to RTC reductions remains drinking and driving [4].

The relationship between elevated blood alcohol concentrations and RTC fatalities has been documented in many industrialized countries [4,5]. Numerous studies have shown that individuals who are younger and male are most likely to be involved in motor vehicle fatalities associated with alcohol [6,7]. In Israel, little is known about the extent of alcohol involvement in RTC injuries and fatalities [8–10]. In a recent report on drivers who were hospitalized following a RTC, the prevalence of blood alcohol (BAC > 0.05 g/dl) was estimated at 15% [9]. In another older study in Israel [10], where the prevalence of alcohol among driver fatalities was calculated for the years 1976–1980, a total of 257 driver fatalities were tested for blood alcohol and 14% (n=36) had a BAC > 0.05 g/dl. Subsequent characterizations of drinking and driving in Israel primarily used self-reported studies of alcohol consumption [11–13]. For example, one study from 1996 showed that in a sample of Israeli college students who drank alcohol, 30% reported driving after drinking [11]. In a study conducted in Scotland for the period 2001–2003, 54% to 67% of pub patrons reported drinking before driving [13]. Self-reported data from behavioral studies in the United States have shown that alcohol-impaired driving is more likely to occur among binge or heavy drinkers than light to moderate drinkers and that the prevalence of these events is increasing over time [14].

In 1982, the legal driving limit in Israel was established as BAC < 0.05 g/dl. For over two decades, monitoring alcohol among drivers in Israel has been minimal, likely the result of a lack of public interest and weak law enforcement [13]. In recent years, as public advocacy for road safety grew, the performance of random sobriety checks increased and enforcement of alcohol-related driving offenses improved as well. The latter was primarily due to changes in the law and law enforcement since January 2006, such that police officers were provided greater latitude in checking drivers suspected of drunk driving. Indeed, over the past decade the number of

BAC = blood alcohol concentration
RTC = road traffic crashes

sobriety tests performed on drivers increased tenfold, from 3000 to 30,000 annually [15].

Relevant and current information on the extent and scope of drunk driving in Israel is unknown. This study uses available data to characterize the current state of alcohol-related driver fatalities in Israel.

SUBJECTS AND METHODS

Data on RTC fatalities were obtained from Israel's National Center for Forensic Medicine at Abu Kabir (hereafter forensic institute) for the years 2000–2004. This dataset was created in an attempt to assess the involvement of alcohol in RTC. It is the only forensic institute in Israel and is centrally located in Tel Aviv. Deaths from unnatural cause are sent to the forensic institute to determine cause of death. In practice, for deaths that occur in more distant areas (e.g., northern and southern Israel) or for families not wanting to delay burial, the cause of death may be determined at the local hospital instead of the forensic institute. During the study period the Israel Central Bureau of Statistics reported 704 drivers killed in motor vehicle accidents [1]. Over this same time, the forensic institute recorded 445 drivers involved in RTC. While our data represent a relatively high percent of driver fatalities (63%) managed at the institute, the potential for selection bias exists and the generalizability of the results may be limited. For example, ethnic and religious variations in drinking in Israel may also be a factor affecting the institute's practice [10,16]. Richter et al. [10] discussed these limitations in a similarly designed study and posited that the resultant bias most likely reflects an underestimation.

All personal identifiers were removed from the dataset. The dataset included limited demographic information and accident descriptors. Autopsies were performed upon request of the family or police, or for other unspecified reasons. Toxicological assessments were performed during almost all autopsies, and inconsistently for those without autopsies. Guidelines for performing alcohol and drug tests were unclear, and as a result, individuals with missing data for alcohol or drug levels were assigned a value of zero, biasing the results toward the null. Drivers were limited to four-wheel vehicles since motorcycle operators constitute a separate risk group [17]. Type of four-wheel vehicle, such as passenger car, van or truck was unknown. Excluded were two individuals under 17 years old. The final study cohort included 443 drivers, aged 17+ years.

MEASURES

Age was assessed categorically in 10 year intervals, with the exception of 17–20 year olds. The day of death was dichotomized into weekday (Sunday through Wednesday) versus weekend (Thursday through Saturday), since the typical work week in Israel extends from Sunday through Thursday. Fatalities transferred from hospitals to the forensic insti-

tute were identified. The presence of alcohol in blood was defined as a blood alcohol concentration ≥ 0.05 g/dl, which represents Israel's legal driving limit. Alcohol was assessed as a dichotomous variable ($<$ or ≥ 0.05 g/dl). Medicinal and recreational drug levels in blood were identified as detectable concentrations of benzodiazepine, opium, amphetamine, hashish, morphine or carbamazepine.

STATISTICAL ANALYSES

Descriptive analyses were performed using the *t*-test, chi-square test and Fisher's exact test. Logistic regression analyses were performed and odds ratios and 95% confidence intervals were estimated. Age was assessed as a continuous variable in linear and quadratic models. Analyses excluding fatalities transferred from hospitals were run in order to assess the effect of weekend versus weekday and the results were similar. SPSS statistical software (version 16) was used for data analysis.

RESULTS

Demographic and crash-related descriptors for the entire study period and according to toxicological testing are presented in Table 1. The majority of drivers involved in RTC and taken to the forensic institute were males and almost one-third were between 21 and 30 years old. Toxicological testing was performed differentially by age, year of death, and for those with an autopsy. In particular, over time, the likelihood of toxicological testing increased from 41% (43/104) in 2000 to 64% (48/75) in 2004 (chi-square_(1df) = 15.2, $P < 0.001$). Alcohol (BAC ≥ 0.05 g/dl) was found in approximately 8% of the sample, and medicinal and recreational drugs, such as benzodiazepine and hashish, were found in about 6% of fatalities. Of those who underwent toxicological testing, blood levels of alcohol ≥ 0.05 g/dl or drugs were observed in 17% and 11% of the sample, respectively.

Differences in driver characteristics by BAC (< 0.05 versus ≥ 0.050 g/dl) are shown in Table 2. Statistically significant variations were observed by weekend versus weekday and occurrence of an autopsy. For example, drivers with BAC ≥ 0.05 g/dl were three times more likely to die on a weekend than a weekday and four times more likely to have had an autopsy.

Among the 37 drivers with BAC ≥ 0.05 g/dl, the mean BAC was 0.184 ± 0.078 g/dl and the median BAC 0.172 g/dl. The 25th and 75th percentiles for this group were 0.124 g/dl and 0.237 g/dl, respectively. Among drivers with BAC ≥ 0.05 g/dl, mean alcohol concentrations according to demographic and death-related characteristics are illustrated in Figure 1. Although there was only one woman driver fatality, the mean BAC for men was higher (0.158 g/dl vs. 0.186 ± 0.079 g/dl, respectively). Drivers who died on weekends had higher mean BAC compared to those who died on weekdays (0.189 ± 0.804 vs. 0.176 ± 0.077 g/dl, respectively), and those who

Table 1. Characteristics of RTA fatalities among Israeli drivers aged 17+ years, 2000–2004*

	Total		Toxicological testing				Chi-square ² P value
	No.	%	No		Yes		
Total	443	(100)	220	(100)	223	(100)	
Age (yrs)							< 0.001
17–20	42	(9.5)	31	(14.1)	11	(4.9)	
21–30	143	(32.3)	76	(34.5)	67	(30.0)	
31–40	75	(16.9)	25	(11.4)	50	(22.4)	
41–50	73	(16.5)	35	(15.9)	38	(17.0)	
51–60	56	(12.6)	22	(10.0)	34	(15.2)	
61–70	30	(6.8)	17	(7.7)	13	(5.8)	
71+	24	(5.4)	14	(6.4)	10	(4.5)	
Gender							0.089
Male	393	(88.9)	190	(86.4)	203	(91.4)	
Female	49	(11.1)	30	(13.6)	19	(8.6)	
Day the death occurred							0.650
Week day	255	(57.6)	129	(58.6)	126	(56.5)	
Weekend	188	(42.4)	91	(41.4)	97	(43.5)	
Year of death							0.002
2000	104	(23.5)	61	(27.7)	43	(19.3)	
2001	91	(20.5)	36	(25.0)	55	(16.1)	
2002	84	(19.0)	42	(19.1)	42	(18.8)	
2003	89	(20.1)	54	(15.9)	35	(24.2)	
2004	75	(16.9)	48	(12.3)	27	(21.5)	
Autopsy performed							< 0.001
No	302	(68.2)	208	(94.5)	94	(42.2)	
Yes	141	(31.8)	12	(5.5)	129	(57.8)	
Alcohol level							
BAC < 0.05 g/dl	406	(91.6)	–	–	186	(83.4)	
BAC ≥ 0.05 g/dl	37	(8.4)	–	–	37	(16.6)	
Medicinal/recreational drugs							
No	418	(94.4)	–	–	198	(88.8)	
Yes	25	(5.6)	–	–	25	(11.2)	

*In Israel, driving permits may be obtained at age 17 years. Gender was missing for one person who underwent toxicological testing. Weekend included deaths occurring on Thursday, Friday and Saturday. The presence of alcohol and medicinal/recreational drugs included benzodiazepine, opium, amphetamine, or hashish detected in blood at the time of autopsy.

did not have an autopsy had higher BAC compared to those who did (0.189 ± 0.073 vs. 0.175 ± 0.093 g/dl, respectively). Mean BAC among those with BAC ≥ 0.05 g/dl increased from 0.137 ± 0.061 g/dl in 2000 to 0.211 ± 0.110 g/dl in 2004, although there was no statistically significant trend. Maximum BAC increased over time from 0.197 g/dl in 2000 to 0.395 g/dl in 2004.

Table 2. Characteristics of RTA fatalities among Israeli drivers aged 17+ years who underwent toxicological testing according to blood alcohol concentration, 2000–2004*

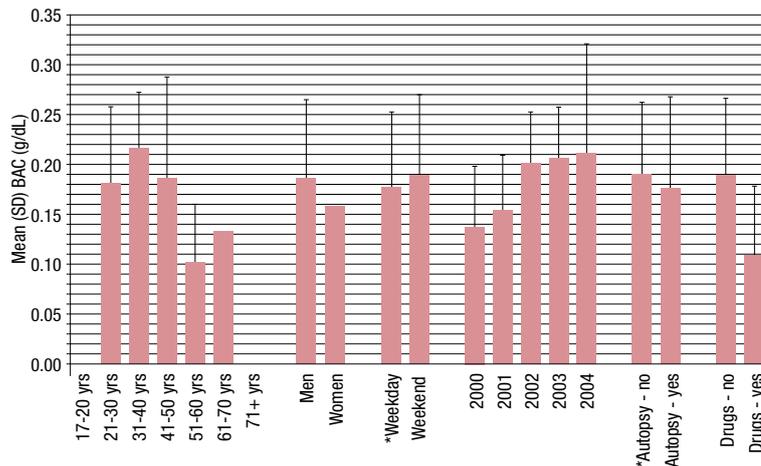
	BAC < 0.05 g/dl		BAC ≥ 0.05 g/dl		P value
	No.	(%)	No.	(%)	
Total	186	(100)	37	(100)	
Age (yrs)					0.071
17–20	11	(5.9)	0	(0.0)	
21–30	50	(26.9)	17	(45.9)	
31–40	41	(22.0)	9	(24.3)	
41–50	30	(16.1)	8	(21.6)	
51–60	32	(17.2)	2	(5.4)	
61–70	12	(6.5)	1	(2.7)	
70+	10	(5.4)	0	(0.0)	
Gender					0.212
Male	167	(89.8)	36	(97.3)	
Female	18	(9.7)	1	(2.7)	
Year of death					0.253
2000	37	(19.9)	6	(16.2)	
2001	28	(15.1)	8	(21.6)	
2002	39	(21.0)	3	(8.1)	
2003	45	(24.2)	9	(24.3)	
2004	37	(19.9)	11	(29.7)	
Day the death occurred					0.002
Weekday	114	(61.3)	12	(32.4)	
Weekend	72	(38.7)	25	(67.6)	
Autopsy performed					< 0.001
No	68	(36.6)	26	(70.3)	
Yes	118	(63.4)	11	(29.7)	
Medicinal/recreational drugs					0.389
No	163	(87.6)	35	(94.6)	
Yes	23	(12.4)	2	(5.4)	

*P values are taken from the chi-square of Fisher's exact test for distributional differences between groups. In Israel, driving permits may be obtained at age 17 years. Gender was missing for one person who underwent toxicological testing and had a BAC < 0.05 g/dl. Weekend included deaths occurring on Thursday, Friday and Saturday. The presence of alcohol was defined as BAC ≥ 0.05 g/dl at the time of autopsy. The presence of medicinal and recreational drugs includes benzodiazepine, opium, amphetamine, or hashish detected in blood at the time of autopsy.

In a logistic regression model using the cohort of drivers who underwent toxicological screening, age was a significant linear predictor of a positive BAC (≥ 0.05 g/dl). Namely, with each increased year of age the likelihood of BAC ≥ 0.05 g/dl decreased by 3% (OR 0.97, 95% CI 0.95–1.00). No association was observed for year of death.

OE = odds ratio
CI = confidence interval

Figure 1. Mean blood alcohol concentration (g/dl) among RTA driver fatalities with BAC ≥ 0.05 g/dl (n=37), 2000–2004. Note: The legal driving limit in Israel is BAC < 0.05 g/dl. Error bars represent +1 standard deviation from the mean.



* $P < 0.05$

DISCUSSION

Little is known about the extent of alcohol-related driver fatalities in Israel. The present study attempts to assess this prevalence, but the data available are inadequate. These limitations highlight the need for routine surveillance and testing. Our results show that between 8% and 17% of driver fatalities from 2000 to 2004 had a BAC above the legal driving limit (≥ 0.05 g/dl). Notably, our estimates may be subject to selection bias, where not all deaths from unnatural causes were systematically sent to the forensic institute. Using the total number of driver deaths for this time period from national data [1], the most conservative calculation for alcohol-related driver fatalities was estimated at 5%.

Despite these limitations, the observed mean and median BAC levels among driver fatalities with BAC ≥ 0.05 g/dl exceeded the legal driving limit threefold. We found that most alcohol-related driver fatalities had a relatively high BAC, were males aged 21–30 years, and the motor vehicle fatality occurred on a weekend, concurring with findings from trauma hospitalization data [9]. Lower levels of alcohol were detected in drivers on whom autopsies were not performed.

Compared to a similar study using data from the 1970s showing that 14% of driver fatalities tested positive for alcohol (BAC ≥ 0.05 g/dl) [10], we found 17% alcohol-related driver fatalities among those who underwent toxicological testing. Compared to other western countries such as the USA, France and Hong Kong, where the prevalence of a positive BAC among driver fatalities is estimated at 25–32%, the observed rate in Israel is relatively low [7,18,19]. This

modest rate of alcohol-related fatalities is consistent with the relatively low adult (15+ years) per capita consumption of all alcoholic products, which has remained under 2.5 L pure alcohol over the past few decades [20].

The distribution of driver fatalities in Israel by age and gender are similar to findings from other countries [4,17,19,20]. In most industrialized countries, men in their twenties are most likely to have an alcohol-related driver fatality. In our study, men comprised the majority (~90%) of all driver-related fatalities regardless of alcohol involvement, and about one-third of driver fatalities were aged 21–30 years. In the subgroup of those with positive BAC, 46% were from this age group. We found a significant association between age and the presence of alcohol. Our findings require further research regarding the true nature of this association due to the relatively small numbers of cases in each age group, especially those aged 17–20.

Alcohol was three times as likely to be involved in fatal crashes on weekends compared to weekdays, and BAC levels were almost three times higher among those killed in the former than the latter. Similar but smaller risks were observed in the U.S. among driver fatalities with BAC ≥ 0.08 g/dl [6] for weekend versus week day driving. Although relatively few fatalities occurred among 18–21 year olds, this age group is overrepresented on the weekends since in Israel most individuals aged 18–21 years serve in the military and are allowed to drive civilian vehicles only on weekends.

We did not observe an increase in alcohol-related driver fatalities over time, although we did see suggestive evidence of an increase in mean BAC from 2000 to 2004. In Israel over the past few decades, changes in alcohol use have been reported and several studies have shown that access to and consumption of alcohol in Israel has been on the rise since the 1980s [12,13]. For example, Shinar [12] reported that during the 1990s the number of pubs in Israel increased from 200 to over 2500. From 1993 to 2003, the BAC doubled among Israeli pub attendees intending to drive (0.026 g/dl to 0.053 g/dl, respectively) [13]. Compared to other countries, our findings of no change in alcohol-related driver fatalities over time are contrary to the decreases observed in the USA [7]. It is theorized that the reduction in alcohol-related car crashes in the U.S. over the past decade is due to effective interventions including sobriety checkpoints, stronger state-level law enforcement, and mass media campaigns [21,22].

Although drug use was not the focus of this study, it is important to note that among driver fatalities the estimated drug-related incidents ranged from 6% to 11%, and in the most conservative scenario (i.e., divided by the total number of driver deaths for the time period) was 4%. The combined use of drugs and alcohol among driver fatalities was substantially low (2 of 37 drivers with BAC ≥ 0.05 g/dl). This finding may be an important indicator of risk – namely, at-risk driv-

ers may be those who consumed alcohol only and not those participating in recreational drug use.

Despite the importance and relevance of these findings, our study is not without limitations. Autopsy data are useful in the initial characterization of deaths in unusual circumstances [8,23]; however, the data were not complete and descriptive and predictive variables were lacking. Second, the sample was relatively small, which limited our ability to detect differences. Next, BAC sampling was performed on only half the sample. In an attempt to adjust for this bias, we conservatively assumed that those with missing BAC values or BAC < 0.05 g/dl had null blood alcohol levels. In addition, as noted above, all driver fatalities were not included in the study, thus posing a selection bias and limiting the generalizability of the study. We note that more toxicological testing was performed on drivers aged 31–40. Finally, increased testing in the later study years and variations in distribution of alcohol-related driver fatalities during the study period may have been influenced by external causes, such as the heightened violent period in Israel at the time. Indeed, during the years 2001–2002, when the number of terrorist suicide attacks increased substantially, public and social gatherings decreased and the opportunity for alcohol-related RTC was reduced [24].

CONCLUSIONS

In Israel there is no systematic collection of BAC from driver fatalities and thus no reliable method to assess prevalence. Nonetheless, we estimated that current alcohol-related driver fatalities range from 8% to 17% but may be as low as 5%. At-risk groups included men aged 20–30 years who consumed excessive amounts of alcohol (and not other drugs) and drove on weekends. In light of the evidence suggesting an increase in mean BAC, as well as reported trends in access to alcohol and its increased consumption, this study should serve as a basis for future research to obtain a more comprehensive characterization of the extent of this problem. We recommend surveillance, routine toxicological testing and the creation of sobriety checkpoints, especially on weekends.

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Correspondence:

Dr. D.H. Jaffe

National Center for Trauma and Emergency Medicine Research, Gertner Institute for Epidemiology and Health Policy Research, Tel Hashomer 52621, Israel

Phone: (972-3) 535-4252

Fax: (972-3) 535-3393

email: denaj@gertner.health.gov.il

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