Blood alcohol level and toxicologic test in drivers killed in road traffic accidents in the coal region of Santa Catarina State, Brazil

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Abstract

Objective: _To investigate the epidemiological profile and the toxicological analysis among drivers fatally injured in road traffic accidents (RTAs). **Methods:** Retrospective observational study with 185 fatalities_

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occurred in the coal region of Santa Catarina State during the period 2011-2017. **Results:** *Mean age was 37,34 ± 15,08 years and male gender was the most frequent (92,4%). The most prevalent city was Criciúma (25,4%). The majority presented negative blood alcohol level (49,7%) and negative toxicologic test (61,6%). Among positive toxicologic tests (18,9%), the most frequent drugs were benzodiazepines and cocaine (both with 5,4%).* **Conclusion:** *It is important to emphasize the dangers of driving under the influence of alcohol and/or other substances. We also suggest the implementation of toxicologic tests in police blitz and the improvement in these exams to diminish undetermined results.*

Introduction

Every year, 1.25 million people die due to road traffic accident (RTAs). Higher rates are found in low-income countries[1]. According to the Forensic General Institute (Instituto Geral de Perícias – IGP), the number of fatal RTAs in Santa Catarina in 2017 was 1.411, almost the double compared to firearms victims (744) [2].

Using legal drugs, as alcohol, medications, as anxiolytics and antidepressants, and illicit drugs as *cannabis,* cocaine and amphetamines (e. g., ecstasy) contributes significantly to increased mortality of RTAs[3].

Alcohol consumption is attributed to 70% of fatal (RTAs)[4]. Besides, "World Health Organization (WHO) calculates that the harmful use of alcohol resulted in 3,3 million deaths in 2012, which means 5,9% of deaths worldwide are caused by alcohol" [5]. By being a depressant on the Central Nervous System (CNS), alcohol abuse combined to driving vehicles may cause drowsiness and syncope[6].

On the other hand, *cannabis* use impairs driving-related skills. It affects memory, level of attentiveness, reaction time, motor coordination, depth perception, peripheral view and time perception[7].

Cocaine can induce behavioral changes, such as anxiety, irritability, aggressiveness, paranoia and hallucination. Its consumption is associated with speeding, loss of control of the vehicle, aggressive driving and lack of attention[8].

Amphetamines are synthetic stimulants of CNS. They initially produce euphoria and a sense of well-being. However, it can also cause anger, insomnia, anxiety, ravings and even seizures. After that, depressive symptoms are usual, such as fatigue and drowsiness[9]. Hence, these manifestations can also lead to motor vehicle accidents[10].

Considering the risk of fatalities while driving under the influence of alcohol and/or other substances, this study aims to describe the epidemiological and toxicological profile of drivers who have died in RDAs in the coal region of Santa Catarina State from January 2011 to December 2017.

Methods

We performed a retrospective observational study with secondary data collection and quantitative approach. This research was carried out with data from the Institute of Forensic Medicine

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(Instituto Médico Legal - IML) of Criciúma in Santa Catarina State. We obtained annual books of death records from January 2011 to December 2017. These registers included fatalities occurred in all cities from the Association of Cities of the Coal Region in Santa Catarina (Associação dos Municípios da Região Carbonífera - AMREC). Then, we elected the first 25-30 cases from each book that met the inclusion criteria: being a fatal victim and the driver in an RTA and having all the information researched. Our sample included 185 cases.

Independent variables were: sex (male or female), age (years), city (AMREC cities) and place of death (hospital, emergency service, place of the occurrence). Dependent variables were: blood alcohol level (positive or negative); if positive, the blood alcohol concentration (g/L), drug test (positive or negative); if positive, which drug (benzodiazepine, cocaine, marijuana, opioids or other).

All analysis was performed with IBM SPSS Statistics version 21.0. Descriptive analysis of variables was carried out. Qualitative variables (sex, city, place of death, blood alcohol level, drug test and positive drug test) were expressed as frequency and percentage. Quantitative variables (age and blood alcohol concentration) were described as mean and standard deviation, once they had presented normal distribution. Inferential evaluation was accomplished with a $p<0,05$ level of significance and a 95% confidence interval. The normality of the distribution of each quantitative variable was assessed by means of the Kolmogorov-Smirnov test. Comparison of average age with blood alcohol level and drug test was determined by means of Kruskal-Wallis H test. Evaluation of association between sex and blood alcohol level and drug test was obtained by means of likelihood ratio test.

This project was approved by the Research Ethics Committee of the Universidade do Extremo Sul Catarinense (CAAE 98696018.4.0000.0119). We also had the consent of IML for data collection.

Results

Table 1 shows the epidemiological profile and toxicological findings among 185 drivers killed in RTAs. Among AMREC cities, Criciúma had most of the occurrences (47), followed by Içara (34) and Urussanga (18). There was a wide range of age, from 17 to 79 years old. The average age was 37,34 years. Besides, of 185 cases studied, 71 were over 40 or more and, among these, 20 were over 60. We also noticed a discrepancy between sex within the cases: 171 were male, and only 14 were female. Positive blood alcohol level was found in 62 events. Blood alcohol concentration (BAC) ranged from 2,43 to 46,45 g/L. The average was 19,68 g/L, which reveals high BACs among drivers. However, the majority of drivers (49,7%) tested negative for blood alcohol level.

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Table 1. Epidemiological profile and toxicological findings among drivers killed in RTAs in AMREC cities from January 2011 to December 2017.

	Mean ± SD, n (%) N = 185
Age (years)	37,34 ± 15,08
Sex	
Male	171 (92,4)
Female	14 (7,6)
City	
Criciúma	47 (25,4)
Içara	34 (18,4)
Urussanga	18 (9,7)
Nova Veneza	14 (7,6)
Morro da Fumaça	13 (7,0)
Forquilhinha	11 (5,9)
Orleans	11 (5,9)
Siderópolis	11 (5,9)
Lauro Muller	7 (3,8)
Treviso	5 (2,7)
Cocal do Sul	5 (2,7)
Balneário Rincão	4 (2,2)
Undetermined	5 (2,7)
Place of death	
Place of occurrence	108 (58,4)
Hospital	75 (40,5)
Emergency service	2 (1,1)
Blood alcohol level	
Negative	92 (49,7)
Positive	62 (33,5)
Undetermined	31 (16,8)
Blood alcohol concentration	19,68 ± 9,41
Toxicology test	

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Negative	114 (61,6)
Positive	35 (18,9)
Undetermined	34 (18,4)
Substances detected in toxicology test	
Benzodiazepines	10 (5,4)
Cocaine	10 (5,4)
Marijuana	7 (3,8)
Opioids	5 (2,7)
Other	4 (2,2)
None	149 (80,5)

Source: research data, 2019.

Analysis of drug test showed 32 positive results, and the most prevalent drugs were benzodiazepines and cocaine, with 10 cases each. They were followed by marijuana (7), opioids (5), and other (4). Within "other drugs", it was found tricyclics, phenobarbital, lidocaine, venlafaxine and acetaminophen.

Nevertheless, we observed a great number of undetermined tests in both blood alcohol level and drug test, which represented a limiting factor for the survey. These include situations tests were not performed, or there was inability in the method of collecting, or cases IML could not access the results (when death had occurred in hospital). In general, we also noticed the number of undetermined tests had been diminishing over the years, demonstrating an improvement in the methods of collection and an increased importance of performing the examination.

Table 2. Correlation between age, sex and blood alcohol level among drivers killed in RTAs in AMREC cities from January 2011 to December 2017.

	Blood alcohol level, Mean ± SD, N=185			P-value
	Positive	Negative	Undetermined	
	n=62	n=92	n=31	
Age (years)	38,65 ± 15,232	37,36 ± 16,009	34,65 ± 11,609	0,586¥
Sex				
Male	59 (95,2)	82 (89,1)	30 (96,8)	0,215¥¥
Female	3 (4,8)	10 (10,9)	1 (3,2)	

¥ Value obtained after applying Kruskal-Wallis H-test.

¥¥ Value obtained after applying likelihood ratio test.

Source: research data, 2019.

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Table 3. Correlation between age, sex and toxicology test among drivers killed in RTAs in AMREC cities from January 2011 to December 2017.

	Toxicology test, Mean ± DP, n (%)			P-value
	Positive	Negative	Undetermined	
	N=35	N=114	N=34	
Age (years)	39,63 ± 15,962	37,69 ± 15,846	34,03 ± 11,194	0,148[¥]
Sex				
Male	31 (88,6)	105 (92,1)	33 (97,1)	0,368[¥¥]
Female	4 (11,4)	9 (7,9)	1 (2,9)	

[¥] Value obtained after applying Kruskal-Wallis H-test.

[¥¥] Value obtained after applying likelihood ratio test.

Source: research data, 2019.

Tables 2 and 3 provides the correlation between age, sex and blood alcohol level and toxicological findings, respectively. In both cases, our results have not demonstrated statistical significance, since the average age of positive, negative and undetermined tests were very similar. In relation to sex, there was the limiting factor a very discrepant sample, with 171 men and only 14 women. Consequently, it was not possible to infer which sex was the most prevalent among drivers who had used alcohol and drugs.

Discussion

Among drivers fatally injured in AMREC cities, we observed a wide range of age. The most prevalent was those aged 30-50 years old. It was a little above the expectations, since in this age group RTAs are the thirty-leading cause of death[1]. In addition, in Brazil, the highest incidence of road traffic-related mortality is seen in 15-39 years old individuals[11]. A possible explanation for this statistic may be the archives we analyzed could had also included passengers, pedestrians and cyclists.

On the other hand, another hypothesis is the risk those aged 30-50 years could present while driving a vehicle. A study from Ontario, Canada, presented data of individuals older than 18 years who had received physician's warning because of their higher risk of causing RTAs, from 2006 to 2009. The typical patient was a 60 years old man who lived in an urban area and had been diagnosed with at least one of 20 most common conditions analyzed, such as alcoholism, epilepsy and dementia[12].

We also noted significant higher proportion of male than female cases. This finding supports other research results, as the one carried out in Recife, Pernambuco, which evaluated RTAs assisted by Emergency Mobile Care Services in 2015. Among victims, there was a ratio of 3.6 men for each woman[13]. Furthermore, in 2011, male corresponded to 82,3% of total fatalities in motor vehicle crashes[14].

Regarding AMREC cities, higher mortality rates were found in Criciúma (25,4%), followed by Içara (18,4%). Compared to other cities from the region, these two presented a significantly greater number

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of deaths. Similar statistics were seen in previous years. According to IML data, in 2013, 21,7% of fatalities in RTAs occurred in Criciúma. In 2014, this rate was 23,9% [2].

Most people died at the place of the accident, which possibly indicates the aggressive kinematics of the crashes. The majority of cases tested negative for blood alcohol level. However, we observed a great number of undetermined alcohol tests, which impaired our analysis. It is important to note that alcohol consumption is linked to 70% of fatal RTAs[4]. In 2014, worldwide percentage of adults who used any amount of alcohol and drived was 5,9%[15]. Driving under the influence of alcohol is an important risk factor for RTAs. The higher the BAC, the greater the risk of accidents. A survey in the United Kingdom estimated the probability of fatal injuries increases by 1.74 for every 0,02% increment in BAC[16].

Our study was unable to infer which sex was the most prevalent in drinking and driving, since the number of men was significantly higher than women. Previous researches concluded that the rate of men who drink and drive was 10,7%, while the rate of women was only 1,7%[15]. Furthermore, the risk of death in road traffic crashes is 3-4 times larger in men[17].

Also, we could not stablish which group of age was the most frequent among drivers killed in RTAs who used alcohol. This is due to the similar mean ages observed in positive, negative and undetermined blood alcohol levels.

In 2013, the literature shows most of those who consume alcohol were 25-29 years old (28,5%) and 18-24 years old (27,1%)[18]. In addition, among adolescents this is the most used substance. This consumption has been occurring increasingly earlier, more frequently and in greater amounts[19]. Children start being exposed to the "positivity" of using alcohol between 9-13 years old with constant advertising of the product and the incentive to consume it[20].

In positive blood alcohol tests, we discovered high BACs. This information demonstrates current social permissiveness of alcohol abuse and trivialization of risks of drunk driving. Since the introduction of motor vehicles in the late 1800s, driving under the influence of alcohol has been disapproved. It came to be chiefly problematic after Prohibition was abolished in 1933; researchers started to describe alcoholism as an illness, and publicity progressively associated drinking with the "good life". Though no one defended drunk driving, U.S. culture stimulated it[21]. In UK, it was estimated that at least 6.070 RTAs had involved drivers with BACs above the legal limits. According to the British Road Safety Act, the legal limit is de 0,08 g/dL. This does not apply to Scotland, where the BAC limit was diminished to 0,05 g/dL in December 2014[16].

Most toxicologic tests reported negative results. Among positive tests, benzodiazepines were the most used drug. This finding meets previous surveys, which determined benzodiazepines as the most frequent licit drug found in drivers. Besides, these medications are among the most consumed worldwide[22]. In Brazil, they stand as the third most prescribed drugs, and 5,6% of the population has used it at least once in life[23]. A research discovered that 2.3 million people are dependents on these medications in Germany[24]. Studies carried out with simulators and driving tests proved the impairing effects of benzodiazepines on driving performance. There were cognitive alterations, visual impairment, reduction of motor coordination, increase of reaction time and difficulty of keeping on the road[22].

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Cocaine use was similar to benzodiazepines rates. This finding is in accordance with results of 2010 from all Brazilian capitals. Researchers interviewed 3.398 drivers; 4,6% presented positive toxicologic test. The frequency of the substances was: cocaine (2,1%), cannabis (1,5%), amphetamines (1,2%) and benzodiazepines (1%)[10].

We also could not link the toxicologic test to sex, since our sample included mostly men. Nonetheless, World Drug Report indicates men are three times more likely to use marijuana, cocaine and amphetamines; women, prescribed opioids and tranquilizers[25]. Surveys from diverse countries showed the consumption of narcotics is superior among men, although this gender ratio has been reducing through the years. Furthermore, men would be more inclined to earlier use of illicit drugs, for a longer time, in larger quantities and more often than women. Female demonstrated predominance of medications, such as benzodiazepines, stimulating substances and anorexic agents[26]. The estimated global prevalence of benzodiazepines abuse is 0,8%, and the prevalence of dependence is 1,4% in men and 1,3% in women[24].

Comparing mean age with toxicologic tests, we could not obtain an expressive result, since mean ages were similar in positive, negative and undetermined tests. It is estimated that about 5% of the world's population between 15 and 64 years old consumed an illegal drug in 2013[25].

Conclusion

This study showed that most drivers killed in RTAs were men over 30 years. Our findings present the importance of carrying out actions to educate this population. It includes emphasizing the dangers of driving under the influence of alcohol and/or other substances. We reinforce that people still trivializes the risks of drunk driving, mainly within the most prevalent group found in this research.

We also suggest the implementation of toxicologic tests in police blitz. Moreover, we recommend an improvement in the collection methods of drug tests and in its efficacy, in order to reduce undetermined results.

Acknowledgments

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