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Fatal road accidents in Spain: psychoactive substances in killed drivers in 2014

Arroyo A[*1], Marrón MT[1], Leal MJ[2] and Vidal C[1]

[1]Legal Medicine Institute of Catalonia. Laboratory Department, Barcelona, Spain
[2]EAPE Joves. La Roca Catalonia Healthy Institute. Primary Attention, La Roca. Barcelona, Spain

[*]**Corresponding author:** Arroyo A, Legal Medicine Institute of Catalonia. Laboratory Department, Barcelona, Spain, Fax: +34 93656115, Tel: +34 646846276, E-mail: 8034aaf@comb.cat

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Abstract

Objectives: Road traffic accidents (RTAs) are often related to impairment by alcohol or drugs. The objectives of this study is to present toxicological data on drivers killed in traffic accidents in Spain in 2014 from a sample of 614 drivers and 240 (out of 614) with positive results for alcohol, illicit drugs and psychoactive medicinal drugs.

Methods: The authors consulted the results previously published in the report by the Instituto Nacional de Toxicología y Ciencias Forenses (National Institute of Toxicology and Forensic Sciences, INTCF) for Spain in 2014 Blood samples from drivers killed in RTAs in four areas of the country were analysed by the INTCF.

Results: Among killed drivers the results show a prevalence of 26.2%, for alcohol, 13.3% for illicit drugs and 10.7% for psychoactive medicinal drugs. The figure for alcohol is high (77.6% with a level over 1.2 g/L) and the presence of illicit drugs, especially cannabis (46.3%), cocaine (50%), opiates (15.8%) and amphetamines (4.8%), remains also very high. Benzodiazepines were the most commonly found medicinal drugs. The data were compared with previous years and other countries.

Conclusion: Alcohol is still the most frequently identified psychoactive substance in the blood of drivers killed in traffic accident. The prevalence of illicit drugs and psychoactive medicinal drugs is high. A moderate decrease in the number of deaths and tests carried out was observed in the period 2010-2014. In Spain, the implementation of prevention campaigns by the Directorate-General for Traffic, the impact of local authority information policies, restrictions and changes in road traffic laws have had a favourable but moderate impact on driver behaviour, with a drop in total fatal accidents, although no analysis was made of the factors that could have led to the decrease: economic crisis, fewer cars on the road or more enforcement policies. A global need arises in order to increase more preventive measures by analyzing all risk factors for traffic road accidents. Drinking, drugs and driving has long been recognized and at present it continues to be a public health problem.

Keywords: DUID; Toxicology; Illicit drugs; Legal medicine; Traffic accidents

Introduction

Throughout the world, road traffic accidents (RTAs) and their consequences are studied to help develop new prevention and enforcement policies. Impaired driving among drunk or intoxicated drivers is a social and public health problem recognised worldwide and the presence of alcohol and drugs in drivers has been found to be frequent and the cause of fatal outcomes. According to US National Highway Traffic Administration (NHTSA), in 2008, 18% of drivers killed in traffic accidents tested positive for drugs, an increase from 13% in 2005 (NHTSA 2010). Between 1993-2010, the Fatal Analysis Reporting System (FARS) database showed that 11.4% were tested for drugs [1]. Alcohol was present in 52.4% of all drugged drivers and prescription drugs accounted for a high fraction 46.5%. Nevertheless there is a general problem with US data because few states analyse drugs in blood samples from fatally injured drivers, so the total number included in the FARS database is low.

Several studies on relative risks (RR), meta-analyses and case-control studies in the context of traffic accidents in the presence of psychoactive substances have been reported. Some of them assessed RR in accidents and the presence of alcohol and drugs. Romano, *et al.* studied this association and concluded that alcohol had a greater influence in accidents than drugs [2]. Using FARS data, Voas, *et al.* also studied the RR of alcohol as a cause of death in accidents in a sample of drivers in 2007, compared to sober drivers in the same period [3].

Other published sources, such as meta-analyses, compare and associate the presence of drugs and psychoactive medicines in RTAs. Statistical association between drug use and traffic accidents were found in 25 out of 28 studies for benzodiazepines and hypnotics,

for cannabis in 23 out of 36 studies as well as for opiates, amphetamines, cocaine and antidepressants [4]. A meta-analysis of 66 studies highlights the presence and risk of accidents with the use of illegal drugs and prescribed drugs and a trend towards fatal outcomes, although it is important to distinguish between assessments in studies with and without controls [5]. In India, a review of 23 studies found alcohol was present in all. Drugs were included only in two studies. However, methodological rigour was considered insufficient to estimate the risk of accidents among drunk drivers and further research was considered necessary [6].

There are also numerous articles reporting case-control studies. In New Zealand, Poulsen, *et al*. analyzed the motor vehicle crash and the association for the presence of alcohol, illicit drugs and psychoactive medicinal drugs (PMD) compared to non-consuming drivers and the odds ratios (OR) was established [7]. Using a case-control design, Li, *et al*. also researched this association in a sample of 737 drivers and 7,710 controls [8]. The odds ratio (or) was 23.24 for drivers testing positive for alcohol and drugs vs. negative controls.

In Spain, the Direccion General de Tráfico (Directorate –General for Traffic, DGT) provides statistics on traffic accident mortality [9]. In 2014 there were 91,570 traffic accidents; 981 were fatal accidents (1%), finding a total of 1,688 deaths (1,131 occurred in traffic crashes on interurban roads and 355 on urban roads within 24 hours and 1,247 on interurban roads and 441 on urban roads when extending the observation time to 30 days), 8 more than in 2013 vs. 2,060 deaths in 2011 meaning 4.6 deaths/day. Spain is ranked fifth in European for death rates in traffic accidents. The mean mortality rate in fatally injured drivers in 2014 was 36/ million inhabitants' (53 in 2010) lower than the Europe rate which was 52 [10]. In 2014 this indicator was 29 for United Kingdom, 42 for Germany and 53 for France vs. 30, 45 and 62 for these countries respectively in 2010, according to data from Eurostat and the European Commission database CARE (Community Database on Road Accidents).

Spain has legal limits only for alcohol in blood and breath; there are no legal limits for other drugs. The legal alcohol blood limit for drivers is 0.5 g/L [11]. New legislation in Spain has defined alcohol levels over 1.2 g/L as a crime [12]. With regard to illicit drugs or PMD it is forbidden to drive under the influence of drugs or medicines that may alter physical or mental state and therefore may affect the ability to drive safely [13].

Spain has been concerned about drugs and driving and participated in the DRUID integrated project, financed by the European Union. Fierro, *et al*. carried out a cross sectional road-side survey and drugs detection was performed in oral fluid samples, as well as Gómez-Talegon, *et al*. study where alcohol, illicit drugs and medicines were examined, both of them in living drivers [14,15]. The DRUID Work Package Classification WP2 was carried out by researchers at the University of Santiago de Compostela [16]. Samples of oral fluid and blood were collected from random drivers and analysed for alcohol and drugs. The results were published in 2011 and the prevalence of alcohol, drugs and medicines was reported. Prevalence of alcohol, illicit drugs and medicines in drivers was 6.6%, 10.9% and 1.9% respectively. The University of Valladolid and Spanish Directorate- General for Traffic also collaborated in DRUID project (DRUID Work Package Classification WP4) were also attitude for driving was outlined [17]. Studies of drivers' oral fluid have also been assessed in Catalonia where police are using devices to assess the presence of illicit drugs in oral fluid, with positive results confirmed by gas chromatography/mass spectrometry; 82% of positive results were confirmed; 62.3% were positive for one illicit drug, 29.8% for two and 7.8% for three or more illicit drugs [18].

Objective

The objectives of this study were to evaluate the prevalence of alcohol and drugs among killed victims in traffic accidents in Spain in 2014, compare the data with other countries and assess the changes and the impact of local authority information policies and restrictions.

Methods

The authors consulted the results previously published in the report by the Instituto Nacional de Toxicología y Ciencias Forenses (National Institute of Toxicology and Forensic Sciences, INTCF) for Spain in 2014 [19]. The INTCF is a national Department that provides analytical services and legal information to the Justice Ministry in Spain. This institute covers four departments of the autonomous communities, Barcelona, Madrid Seville and the Canary Islands. These annual reports present results from analytical toxicology testing carried out by INTCF. In 2014 the sample included 865 (76.4%) cases analysed in this centre of reference out of a total of 1,131 deaths in the country 614 drivers (70.9%), 173 pedestrians (20%) and 78 passengers (9%).The rest of cases were not analysed by INTCF (the Institutes of Legal Medicine may also receive samples from fatal crashes to be analysed) and data were not available. The results of toxicological analysis on drivers (614) are discussed. Data on pedestrians or passengers were not included. Alcohol, illicit drugs (cannabis, cocaine, opiates derivate from morphine, amphetamines, ketamine) and psychoactive medicinal drugs (PMD) (benzodiazepines, antidepressants and other prescribed medicines) were investigated. The cut-off concentration for alcohol in blood test was 0.3 g/ L. Levels under this were considered negative. Positive cases were considered when alcohol, illicit drugs or PMD were found in the analysis of the samples. Data for cut-off and analytical techniques for illicit drugs and PMD were not available.

Results

There was a significant majority of men among the sample of dead drivers (90.5%), while women represented 8.3% and no information was given 1.1%. Among the cases with positive results, the most frequent age groups were 31-40 (50 cases) and 41-50 (60cases). Seven drivers were under 20 years of age and three over 60. Men represented 94.1% of positives and women 5.8%. A total of 35.1% (216) deaths occurred on holidays/weekends and 64.8% (398) on working days. The vehicle involved in the fatal traffic accidents were: car 333 (63.2%), motorcycle 164 (7%), bicycle 33(5.3%), lorry 28 (4.5%) van 18 (2.9%) tractor 16 (2.6%), no data available 22 (3.5%).

Among drivers 39% (240) tested positive for illicit drugs, PMD or alcohol in blood and 60.9% (374) tested negative. In the total sample (614 killed drivers), 26.2% alcohol, 13.3% illicit drugs and 10, 7% PMD was detected. Other findings in the sample of cases testing positive (N = 240 out of 614) are shown in Table 1.

	Total killed drivers N = 614	Positive cases N = 240
Alcohol	26.2%	67.0% (161)
Illicit drugs	13.3%	34.1% (82)
PMD	10.7%	27.5% (66)

In 67.08% (161) of positive cases, alcohol was detected alone or associated with drugs and/or psychoactive substances
In 34.17% (82) of positive cases, drugs were detected alone or associated with alcohol and/or psychoactive substances
In 27.5% (66) of positive cases, psychoactive substances were detected alone or associated with alcohol and/or drugs
Table 1: Psychoactive substances in total killed drivers and positive cases

A total of 77.6% (125) cases showed an alcohol level over 1.2 g/L; 29 cases had levels between 1.5 and 2 g/L, 46 cases had levels from 2.01 to 2.5 g/L and 27 cases were over 2.5 g/L. The distribution of substances in the positive sample (N = 240) is shown in Table 2. Distribution of illicit drug detected is shown in Table 3. Cocaine and cannabis were the most frequently detected drugs. Among the cases with positive results for PMD (40), the most widely represented were: benzodiazepines 57.5% (23), benzodiazepines and antidepressants 0.07% (3); benzodiazepines and others 0.05% (2); benzodiazepines antidepressants and others 0.05% (2); antidepressants 0.2% (8); antidepressants and others 1; antiepileptic and hypnotics 1. The group "others" included anti-inflammatory, analgesics and antihistamines, whose detection may have been due to hospital emergency treatment

Alcohol	107(44.5%)
Alcohol + illicit drugs	38 (15.8%)
Alcohol + illicit drugs + PMD	5 (2.08%)
Alcohol + PMD[1]	11 (4.5%)
Illicit drugs	29 (12.08%)
Illicit drugs + PMD	10 (4.1%)
PMD	40 (16.6%)

[1]alcohol and benzodiazepines: 6 (0.02%); alcohol benzodiazepines and antidepressants: 4 (0.01%); alcohol benzodiazepines and others: 1
Table 2: Distribution of substances and associations in positive cases (N = 240)

Cocaine	50
Cannabis	46.3
Opiates derivate from morphine	15.8
Amphetamine and related substances	4.8
Ketamine	1.2

These percentages are related to the substances alone or associated to other illicit drugs, alcohol and/ or PMD
Table 3: Positive results for alcohol and illicit drugs, by drug detected (%)

Discussion

The predominance of male drivers matches most of the articles in the specialist literature, as does the high number of accidents at weekends. The high proportion of young drivers corresponds to the findings in other studies, such as Jones, *et al*. Brady, *et al*. and Davey, *et al*. who found mean age between 30-39 in a sample of living drivers [20-22]. Mean age of victims in road traffic in Sweden was 48 years [23].

In the context of driving, there are numerous published studies on alcohol and drugs in blood samples from drivers killed in RTCs. We will compare our findings with some of those studies. The objective of our study is not to produce a review article; however some of them, reported around the world, are discussed.

The amount of data available increases with greater industrialisation and socio-economic level of countries. Among fatally injured drivers In Finland, that was positive for psychoactive substances 43% tested positive for PMD, 51% for alcohol and the rest for other illicit drugs [24]. This author also assessed the relationship between fatal accidents, substance abuse and other variables such as mental health problems and socioeconomic levels, emphasising the importance of integrating physical, mental and social health policies. In Sweden a 2-year survey was conducted on fatally injured drivers, alcohol was present in 38%, pharmaceuticals in 7% and illicit drugs in 9% [25].

In a joint study of 4 countries (Finland, Norway, Portugal and Sweden) Legrand, *et al*. found very high values for alcohol, which was the most prevalent substance 32% > 0.1g/L and 87% > 0.5g/L (n = 1,187 cases) [26]. With regard to drugs, the countries differed with respect to benzodiazepines, between 1.8 and 13.3%, and amphetamines, between 0.7% and 4%. In less developed countries such as India, in 100 cases of drivers and pedestrians killed in accidents, 23% had previously consumed alcohol [27].

Based on data from autopsies and toxicology results, a Greek study found that among motor vehicles fatalities who tested positive for alcohol or illicit drugs in blood (32.9%), there was a 50% increased risk for a severe cervical spine and 85% for a severe upper extremity injury, compared to those who tested negative for alcohol or drugs 67.1% [28].

There was greater variability and differences between countries with respect to drug detection in dead drivers. In Portugal between 1990 and 2007, opiates and cannabis were the most frequent drugs, with 55% of results positive for alcohol, although the data indicate a low proportion of requests for drug tests [29].

In Poland, according to data from 2009, cannabis and amphetamines were the most widely detected drugs in forensic samples from drivers [30]. Cannabis is also frequent in Australia, alone or associated with alcohol. The role of cannabis and alcohol was examined, in 1,074 crash participants and 135 coroners' reports [31]. Romano, *et al*. describes 25% of killed drivers testing positive for drugs, where cannabis and stimulants were the most widely used [32]. In USA comparing 2009-2010 to 1999-2000, the prevalence of drug usage increased 49% [33]. The study by Brady and Li examined the prevalence of alcohol and/or other drugs in a large sample of fatally injured drivers from 2005-2009, including 19.9% positive for two or more substances [34]. Amphetamines are a major recreational drug of abuse in Sweden and were present in 3.9%, in 106 killed drivers. Its presence in traffic accidents was evaluated in a study between 2001 - 2010 [35].

In Spain several papers have investigated drugs and driving. Bermejo, *et al*. studied blood alcohol concentration (BAC) in living and fatally injured drivers and comparison was established along eight years between 1984-1982 [36]. From all accidents studied only 26 had negative BAC levels (23%), while a high frequency of BACs higher than 2.5 g/L (22%) was found. Del Rio and Alvarez, also reported data from 285 fatally injured drivers in Northern Spain [37]. Alcohol alone was detected in 44.2% and one or more other substances were found together with alcohol in 6.3% (18 drivers), with PMD in 22.2% (4 out of 18), alcohol with illicit drugs in 66.6% of the cases (12 out of 18) and alcohol with PMD and illegal drugs in 11.1% (2 out of 18). Cocaine was the most commonly detected drug. Based on the same material Del Rio and Alvarez, reported a prevalence of illicit drugs of 10.2%. Illicit drugs alone were detected in 2.5% and together with other substances in 7.7% [38]. Cocaine was also the most common drug detected. Other investigators, such as Lopez Rivadulla, *et al*. reported a study of the drugs involved in fatal road traffic accidents between 1996-1998 carried out in the Forensic Toxicology Service of the University of Santiago de Compostela, in a sample of 338 drivers [40]. Cannabis was most frequently found. In the case of PMD benzodiazepines were most prevalent (19%). Substance use and driving has is also discussed in Spain by Alvarez, *et al.* [41].

The data evaluated in this article are compared to results from databases in other countries and other Spanish studies in Table 4. The comparison of the results shows some differences among the trends in alcohol and drugs among the countries but referring to Spain is interesting to stand out that alcohol presence had decreased along the time. Nevertheless studies from around the world and comparison between different countries regarding trends in the use of alcohol and drugs in drivers is difficult because it is connected to different study designs, biological matrices, drugs or PMD included in the analysis or cut-off limits established in the laboratories for evaluation. These limitations are particularly striking in the article by Christophersen, *et al*. where trends in alcohol and drugs among drivers is reviewed in Australia, Brazil, Norway, Spain and United States [42]. They agree that fatal traffic accidents related to non-alcohol drugs have increased.

In general, alcohol is still the most frequently identified psychoactive substance in the blood of drivers killed in traffic accidents in most countries. Due to the scale of the problem, the scientific literature and official bodies in different countries continually publish data from in vivo or death studies. However there are still countries where post-mortem examinations and toxicological tests are not routinely performed and we have not a reference to the proportion of killed drivers that are subject to legal autopsy in Europe [43].

The legal limits for alcohol in different countries vary from zero to 1.5g/L. In Spain as well as most European countries, the general legal limit is 0.5g/L. England and Wales's 0,8g/L. Few countries have implemented similar legal limits for drugs. At present, the Netherlands are in the process of implementing legal limits for drugs.

For illicit drugs or psychoactive medicinal drugs there are generally no such limits as for alcohol but driving under the influence of illegal drugs or PMD is forbidden. In Denmark, psychoactive substances, including alcohol alone or in combination with

other drugs exceeding the legal limit 0.53 g/L (0.5g/kg) in drivers are provided [44]. In this country, until July 2007, the driving under the influence of drugs (DUID) legislation was based on impairment, evaluated on the basis of a clinical investigation and toxicological analyses but in 2007 fixed concentration limits were introduced into the traffic legislation. Psychoactive substances including alcohol limits were also established by Danish legal limits and were used to evaluate the frequency of drivers violating the legislation while limit of quantification was used for monitoring positive drivers [45]. Other countries as Norway introduced legislative limits for driving under the influence of drugs in 2012, to harmonize with the legislation on driving under the influence of alcohol [46]. Per se limits corresponding to blood alcohol concentrations (BACs) of 0.02% were established for 20 drugs and concentration limits for graded sanctions corresponding to BACs of 0.05% and 0.12% were established for 13 of these drugs as well. In this country Jones describes the background and implementation in Sweden of zero-concentration limits for controlled drugs in drivers' blood [20].

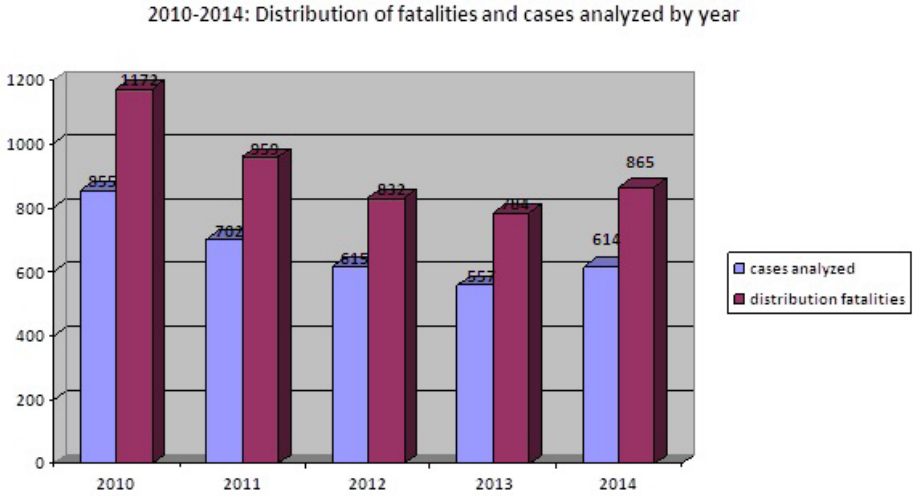
Years	Author	Alcohol %	Illicit Drugs %	PMD%	Country
2014	INTCF (2014)	26.2	13.3	10.7	Spain
1993-2010	Wilson, 2014[1] [1]	52.4	32.6-45.8	46.5	USA
2000-2006; 2007-2013	Drummer, 2016 [48]	24.8	34.4	21.2	Australia (Vic.)
2008-2011	Ahlner, 2014 [23]	21	7	7.6	Sweden
1999-2010	Brady, 2014 [21]	39.7	24.8		USA
2005-2009	Brady, 2013 [34]	40.2	10.5 cannabis 9 stimulants 5.7 narcotics 4 depressants		USA
2006-2008	Gjerde, 2011 [49]	25	10.2	13.8	Norway
2000-2004	Jaffe, 2009 [52]	8-17	Illicit drugs and /or PMD 6-11		Israel
2001-2010	Christophersen, 2015[2] [50]	27.1	19.6		Norway
2001-2010	Christophersen, 2014[3] [51]	25.3- 49.1	14.1-19.2	14.4-17.7	Norway
2001-2002	Morland, 2011[4] [53]	40	12		Nordics countries
2001-2002	Schwilke, 2006 [55]	41	12.7 cannabis 9.7 coc-amphet	39	USA
2011-2012	Pelição, 2016 [54]	36.1	12 cocaine 4.3 cannabis 4.1 amphetamines		Brazil
1991-2000	Del Rio, 2002 [39]	43.8	8.8	4.7	Spain
1994-1996	Del Rio, 1999 [37]	44.2			Spain
1994-1996	Del Rio, 2000 [38]	50.5	10.2	9.1	Spain
1996-1998	Lopez Rivadulla, 2000 [40]		4 cannabis	19	Spain

[1] Results in cases positive for drugs
[2] Differences between motorcycles riders or car drivers were established
[3] Difference between all investigated drivers or drivers killed in single vehicle accidents were established
[4] In 60% of positive drivers in single vehicles accidents

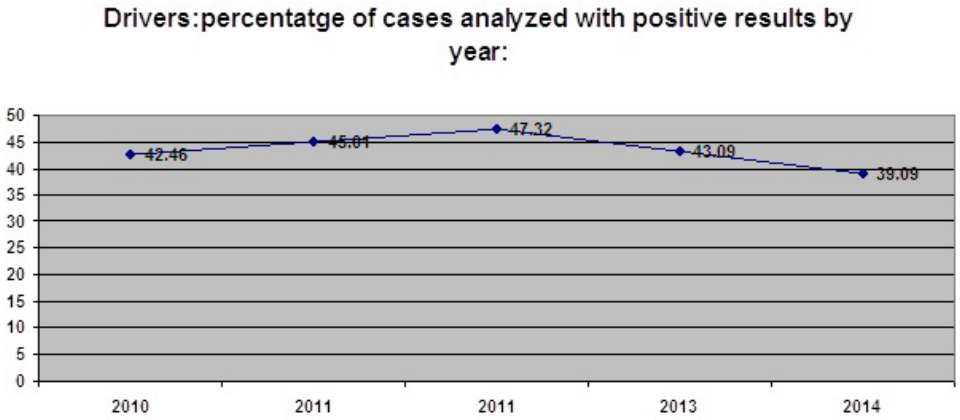
Table 4: Alcohol, Illicit Drugs and Psychoactive Medicinal Drugs (PMD). Data from killed drivers in different countries

According to Spanish legislation, drivers who test positive for a psychoactive substance are administratively punished, with a €500 fine, while losing points on their driver's licence. The driving licence is lost when 12 points are reached. If drivers are involved in a car collision, they are criminally punished by losing their driving licence, receiving a sentence that can be substituted by community service and the corresponding fine. In 2014 new Spanish legislation has been published related to traffic regulation including driving under the influence of alcohol and drugs [47]. The fine has been elevated to 1000 € and six demerit points if driving when the presence of illegal drugs is detected in the subject.

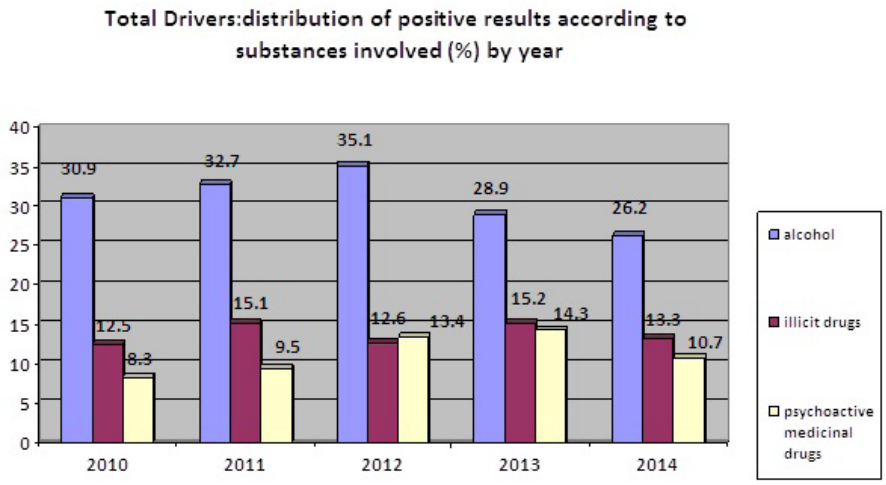
The comparative data from the INTCF for five-year period, 2010-2014 show the distribution of fatalities by year as well as a reduction in the number of cases tested, from 855 to 614 (Graph 1). The number of positive cases dropped from 42.4% to 39.09% (Graph 2). Cases analysed overall as positive for alcohol, illicit drugs and PMD are shown in Graph 3. A reduction in alcohol presence in killed drivers was observed, with a rise in illegal drugs and PMD.



Graph 1: 2010-2014: Distribution of fatalities and cases analysed by year



Graph 2: Drivers: Percentage of cases analyzed with positive results by year



Graph 3: Total Drivers: Distribution of positive results according to substance involved (%) by year

Conclusion

Our data show that although the prevalence of alcohol has been dropping, it is still very high in Spain, with significant amounts of illicit drugs and PMD compared to other countries. Nevertheless comparison of the data included in this paper in 2014 with that obtained by the Spanish studies in 1994-1996 by del Rio indicates an important decrease in alcohol prevalence (26.2 vs. 50.5), and with data provided by INTCF in 1992-1995 (26.2 vs. 51.3) [38]. The data on illicit drugs indicate high levels of consumption, especially cocaine and cannabis, which has remained constant in recent years.

In Spain, the implementation of prevention campaigns by the Directorate-General for Traffic, the impact of local authority information policies, restrictions and changes in road traffic laws have had a favourable but moderate impact on driver behaviour, with a drop in total fatal accidents, although no analysis was made of the factors that could have led to the decrease: economic crisis, fewer cars on the road or more enforcement policies.

A global need arises in order to increase more preventive measures by analyzing all risk factors for traffic road accidents. Drinking, drugs and driving has long been recognized and at present it continues to be a public health problem.

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