GOBIERNO DE ESPAÑA
MINISTERIO DE JUSTICIA

TOXICOLOGICAL FINDINGS IN ROAD TRAFFIC FATALITIES

Report 2021

Recommended citation: Toxicological Findings in Road Traffic Fatalities (2021). National Institute of Toxicology and Forensic Sciences. Ministry of Justice

National Institute of Toxicology and Forensic Sciences
José Echegaray, 4. 28232 Las Rozas. Madrid.

Website:
https://www.mjusticia.gob.es/es/ministerio/organismos-entidades/instituto-nacional

Collaborate:

Toxicological Findings in Road Traffic Fatalities

Report 2021

GOBIERNO DE ESPAÑA | MINISTERIO DE JUSTICIA

Madrid, 2021

Catalog of publications of the General Administration of the State: https://cpage.mpr.gob.es

Report presented by Antonio Alonso Alonso
The Director of the National Institute of Toxicology and Forensic Sciences

NIPO (pdf): 051-20-012-0
ISSN: 2792-484X

Published by:
Ministry of Justice
General Technical Secretariat

Layout:
Safekat, S. L.

Table of contents

Introductory note and acknowledgements

The National Institute of Toxicology and Forensic Sciences (INTCF), the Institute of Legal Medicine and Forensic Sciences of Catalonia (IMLCFC), the Basque Institute of Legal Medicine (IVML), the Institute of Legal Medicine and Forensic Sciences of Aragon (IMLCFA), the Institute of Legal Medicine and Forensic Sciences of Murcia (IMLCFM), the Institute of Legal Medicine and Forensic Sciences of Valencia (IMLCFV), the Institute of Legal Medicine and Forensic Sciences of the Balearic Islands (IMLCFIB) and the Luis Concheiro Institute of Forensic Sciences (INCIFOR), with the collaboration of the National Road Safety Observatory (ONSV) of the Directorate General for Traffic (DGT), present the annual report on deaths occurring in road traffic accidents during 2021, which have been investigated from a toxicological and forensic viewpoint in the entire national territory.

This edition continues the initiative we took last year to include in this report not only toxicological analyses conducted by the INTCF, but also those conducted by the IMLCFs equipped with a chemical and toxicological analysis laboratory, with the incorporation of toxicological data provided by a total of seven Institutes of Legal Medicine and Forensic Sciences. This is aimed at providing the most comprehensive information possible from toxicological analyses on road traffic fatalities.

In addition, this year, the statistical data contained in this report are made available to the various administrations and citizens in a dynamic manner through a publicly accessible website developed by the Directorate General for Digital Transformation (DGTD) of the Ministry of Justice (https://datos.justicia.es/analisis-toxicologicos-accidentes-trafico). This will allow the different autonomous communities (ACs) to easily explore toxicological results on road traffic fatalities within the territory of their own AC.

The information presented in this report related to the toxicological findings comes from the requests made by the different judicial bodies and refers to the toxicological analyses performed by the INTCF (toxicology centre of reference) and by the IMLCFs equipped with a chemical-toxicological analysis laboratory (IMLCFM, IMLCFV, IMLCFA and IMLCFM) from post-mortem samples of 812 drivers and 180 pedestrians deceased in road traffic accidents during the year 2021. Its objective is to show the toxicological analyses results related to the presence of alcohol, drugs of abuse and psychopharmaceuticals drugs. Therefore, it shows the incidence of consumption of each of these three types of toxic substances, either alone or in combination. The study also relates these toxicological findings to several epidemiological variables, such as gender, age, type of vehicle, or day of the week when the fatal accident occurred. These data, as well as those presented in previous reports, provide information that is highly relevant for those working on road traffic accident prevention. Finally, a comparative study with post-mortem toxicological data obtained in previous years is presented, with the aim of showing the change over time in some of the evaluated parameters.

The INTCF wishes to express its sincere thanks to all the medical examiners, physicians, specialists, and laboratory assistants of the INTCF and the IMLCF that took part in the chemical-toxicological analyses related to these cases. We would particularly highlight the coordination work carried out by the heads of the Chemistry and Drugs Services of the different INTCF offices (María Antonia Martínez González, Begoña Bravo Serrano, Teresa Soriano Ramón, Nuria Sanvicens Diez and Luis Manuel Menéndez Quintanal).

We are also grateful for the contribution of the following IMLCFs in collecting and sending post-mortem samples to the INTCF for analysis, without whose contribution this report would not have been possible:

- Institute of Legal Medicine and Forensic Sciences of Andalusia
- Institute of Legal Medicine and Forensic Sciences of Castilla y León
- Institute of Legal Medicine and Forensic Sciences of Castilla-La Mancha
- Institute of Legal Medicine of Galicia (IMELGA)
- Institute of Legal Medicine and Forensic Sciences of Madrid
- Institute of Legal Medicine and Forensic Sciences of the Canary Islands
- Institute of Legal Medicine of Extremadura
- Institute of Legal Medicine and Forensic Sciences of Navarra
- Institute of Legal Medicine and Forensic Sciences of Asturias
- Institute of Legal Medicine and Forensic Sciences of Cantabria
- Institute of Legal Medicine of La Rioja
- Institute of Legal Medicine and Forensic Sciences of Ceuta and Melilla

Our gratitude to the National Road Safety Observatory of the Directorate General for Traffic for the work done in the detailed review of each of the cases presented according to the criteria established by the Directorate General for Traffic.

Moreover, as the INTCF director, I would like to express my special thanks to all the staff of the IT section of the Madrid, Seville, and Barcelona Departments, that set up and performed the statistical searches in the INTCF LIMS system, and to David Barroso Domínguez for the effort made in compiling and processing all the data.

Director of the National Institute of
Toxicology and Forensic Sciences
Dr. Antonio Alonso Alonso

General information

FIGURE 1: NUMBER OF FATALITIES (n = 1094)
ANALYSED BY THE DIFFERENT INSTITUTIONS

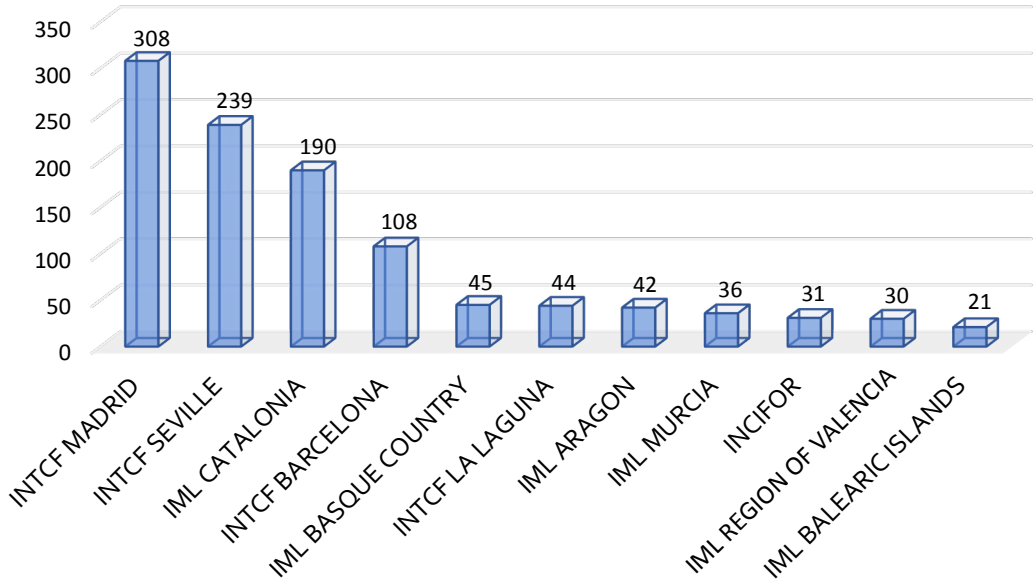


FIGURE 2: SCOPE OF ACTIVITY OF THE INTCF

FIGURE 3: DISTRIBUTION BY AUTONOMOUS COMMUNITIES

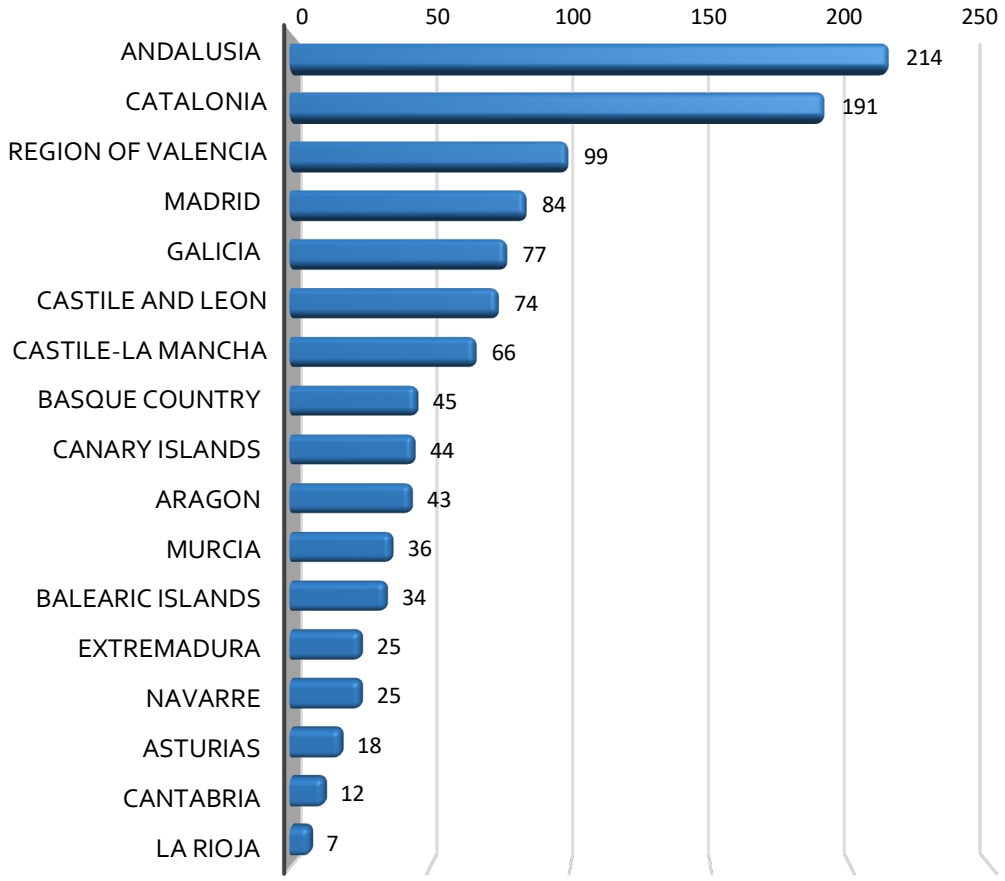
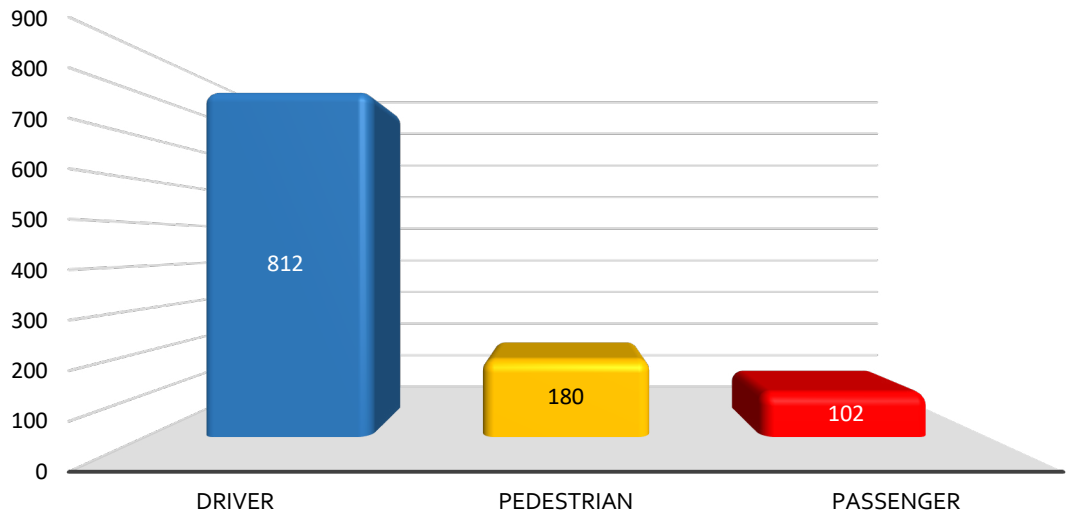


FIGURE 4: NUMBER OF FATAL VICTIMS CLASSIFIED (n = 1094) BY THEIR ROLE IN THE ACCIDENT



Drivers (n = 812)

FIGURES 5 AND 6: PERCENTAGE DISTRIBUTION BY GENDER AND AGE RANGE (812 DRIVERS)

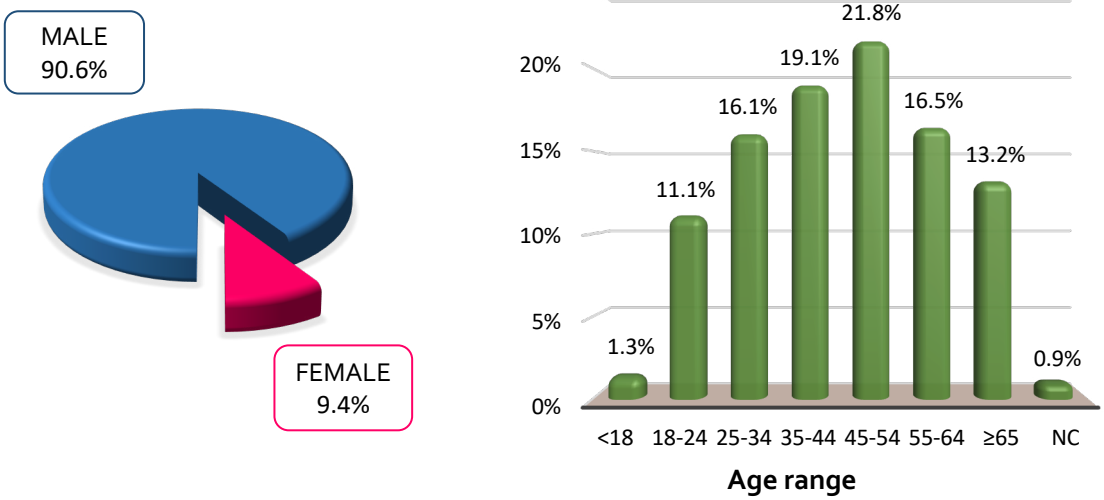
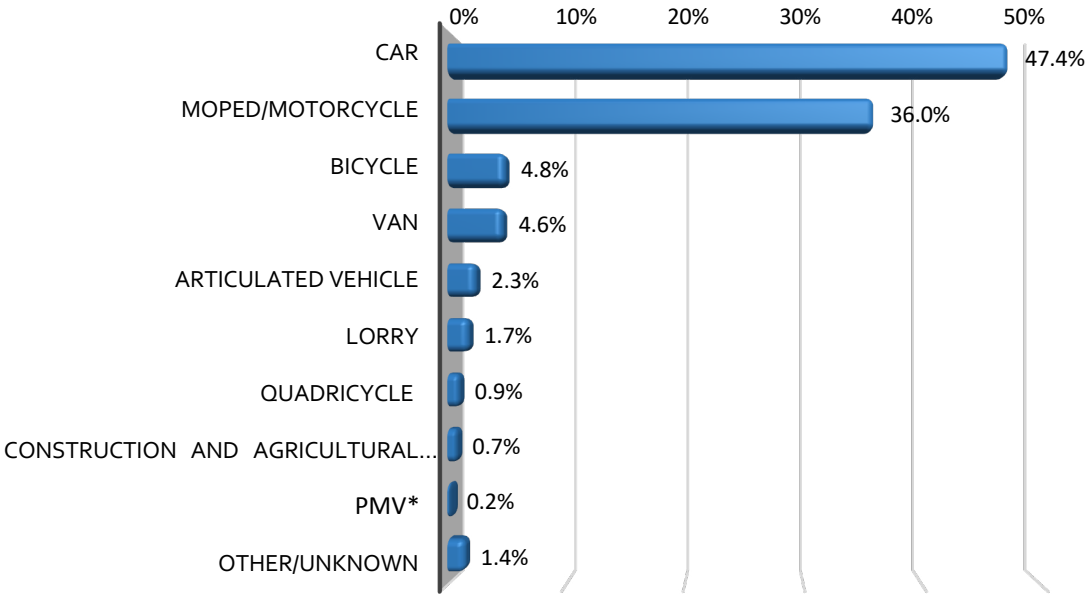
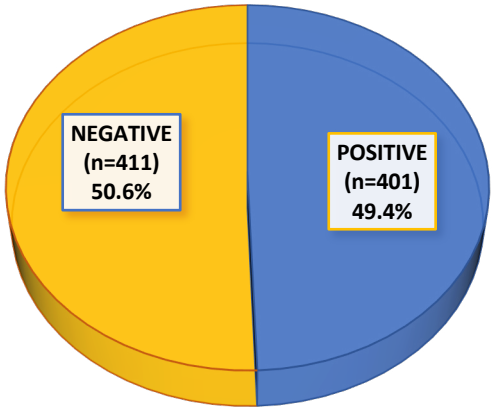


FIGURE 7: PERCENTAGE DISTRIBUTION BY TYPES OF VEHICLE (812 DRIVERS)



* PMV: Personal Mobility Vehicle.

FIGURE 8: PERCENTAGE DISTRIBUTION ACCORDING TO TOXICOLOGICAL RESULTS (812 DRIVERS)



In this report, a "positive" result is considered as the result of a confirmatory test demonstrating the presence of any drug of abuse or psychotropic drug, regardless of the quantity, or blood alcohol concentration greater than 0.3 g/l [1].

It is important to highlight in this figure that out of 812 drivers deceased in road traffic accidents and subjected to an autopsy, 401 (**49.4%**) showed positive toxicological results for alcohol, drugs of abuse, and psychopharmaceuticals drugs, alone or in combination.

FIGURE 8B: PERCENTAGE DISTRIBUTION OF RESULTS BY MONTH (812 DRIVERS)

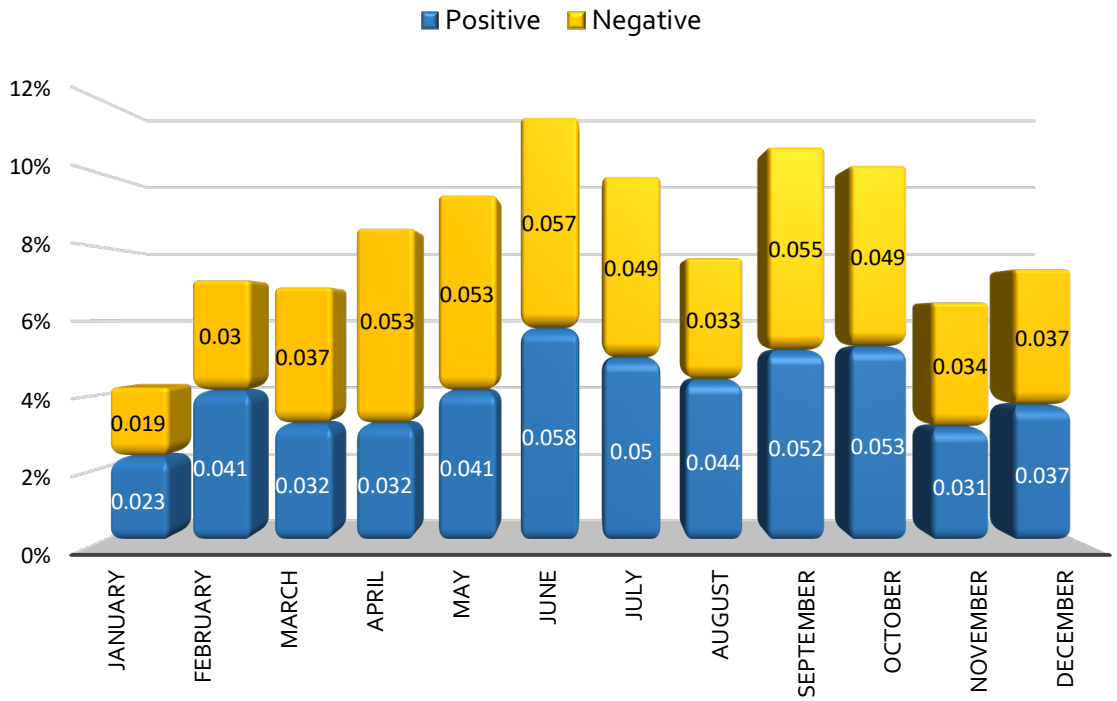
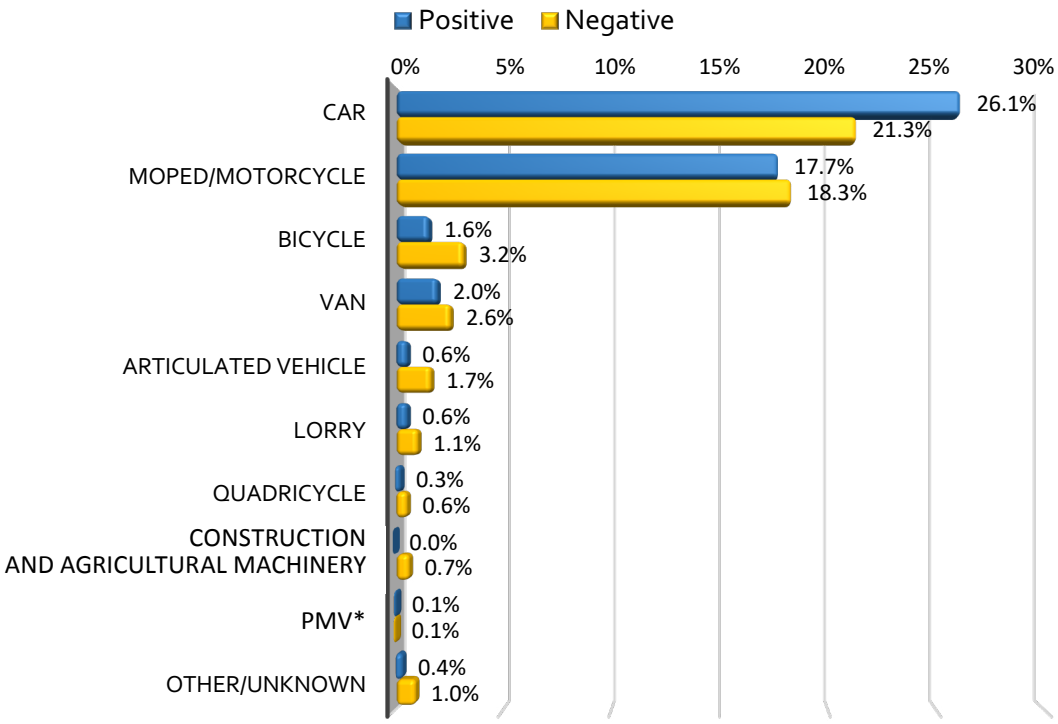
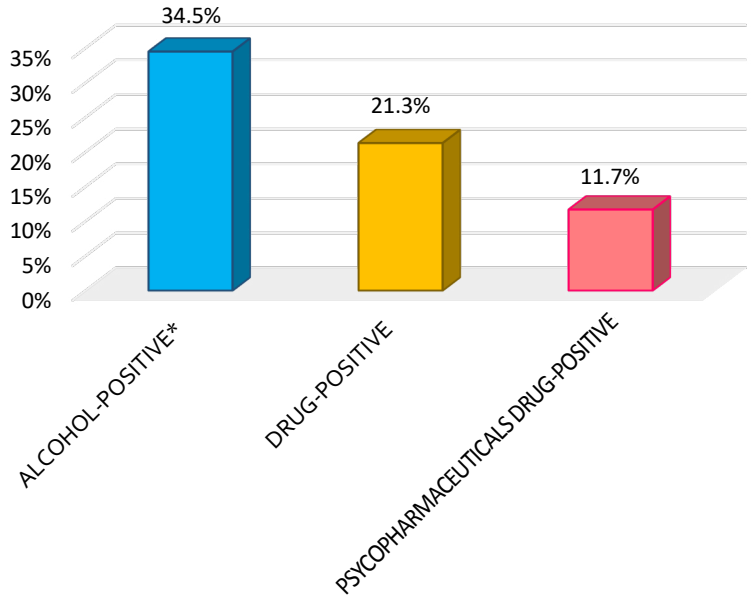


FIGURE 9: PERCENTAGE DISTRIBUTION ACCORDING TO TOXICOLOGICAL RESULT AND VEHICLE TYPE (812 DRIVERS)



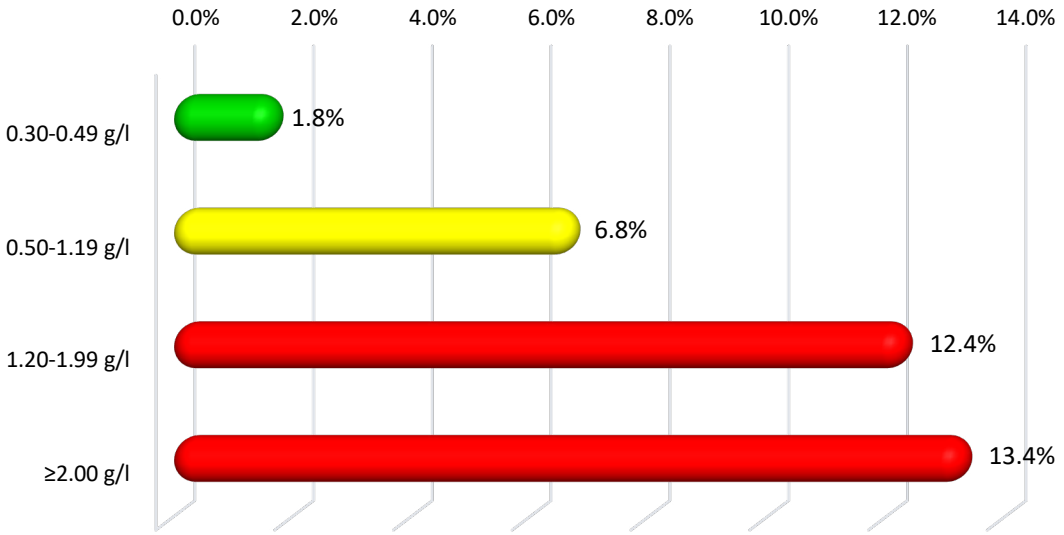
* PMV: Personal Mobility Vehicle.

FIGURE 10: DRIVERS (n = 812). PERCENTAGE DISTRIBUTION ACCORDING TO TYPE OF SUBSTANCE DETECTED (possible combinations not considered)



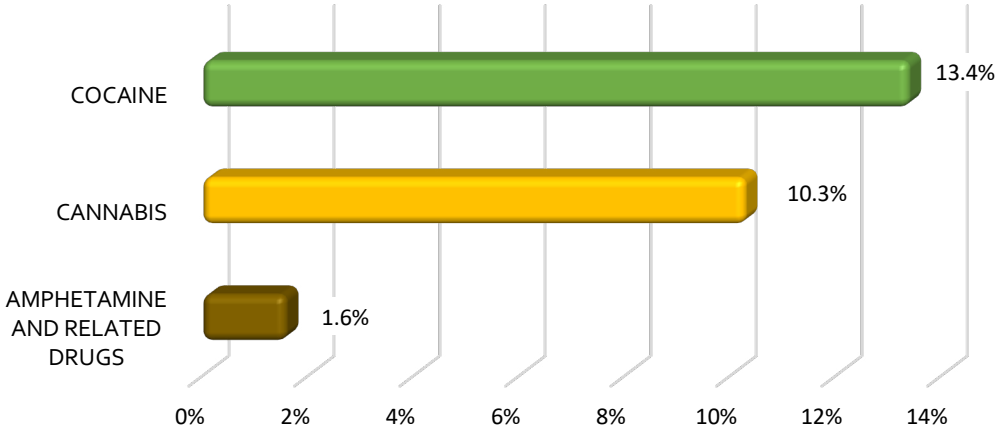
* Alcohol-positive: blood alcohol concentration equal to or greater than 0.30 g/l [1].

FIGURE 11: DRIVERS (n = 812). DISTRIBUTION BY BLOOD ALCOHOL LEVEL



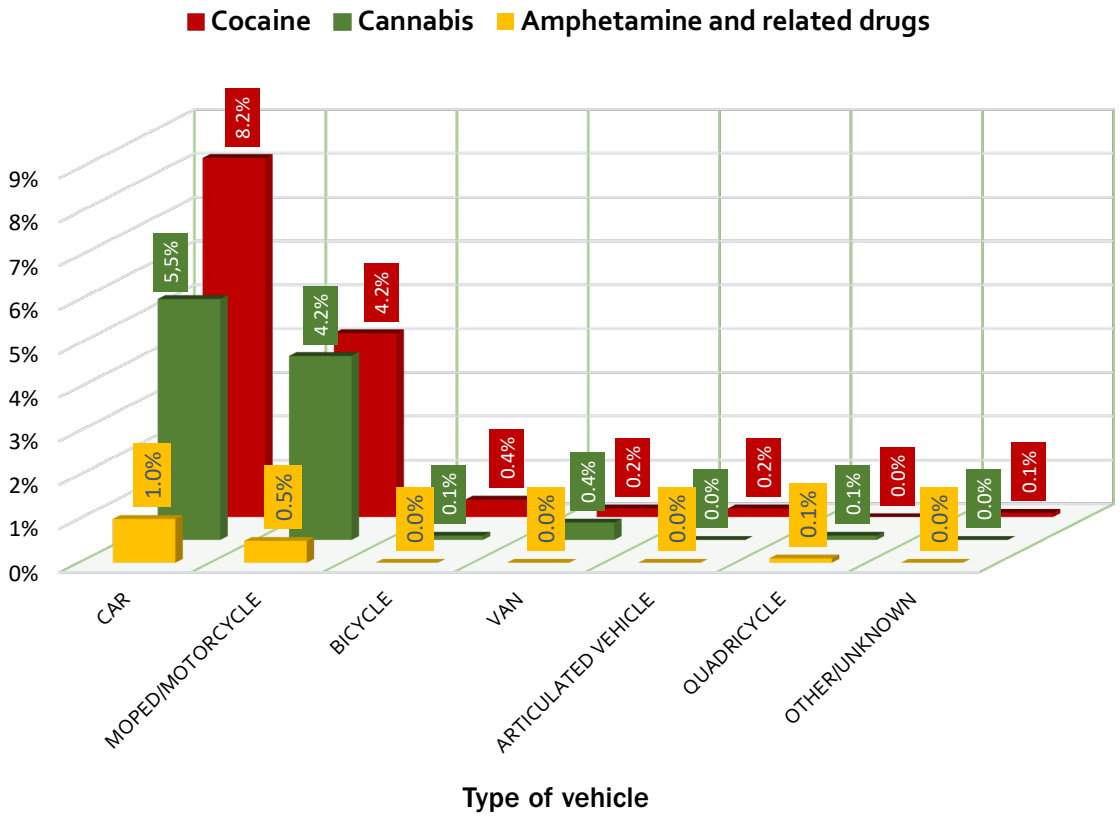
Twenty-five point eight percent of the drivers showed a blood alcohol level equal to or greater than 1.20 g/l.

FIGURE 12: DRIVERS (n = 812). PERCENTAGE DISTRIBUTION OF DETECTED DRUGS



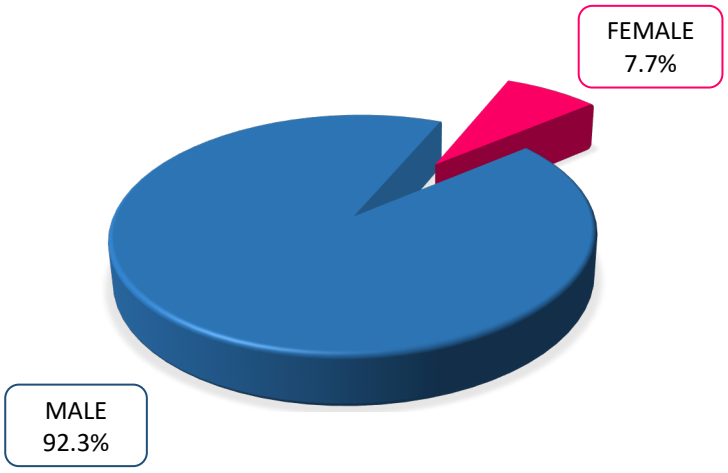
Regardless of whether there was combined use of drugs of abuse, alcohol and/or psyco-pharmaceuticals drugs, the most commonly used drug on its own was cannabis (**13.4%**), followed by cocaine (**10.4%**).

FIGURE 13: DRIVERS (n = 812). PERCENTAGE DISTRIBUTION ACCORDING TO DETECTED DRUG AND VEHICLE TYPE



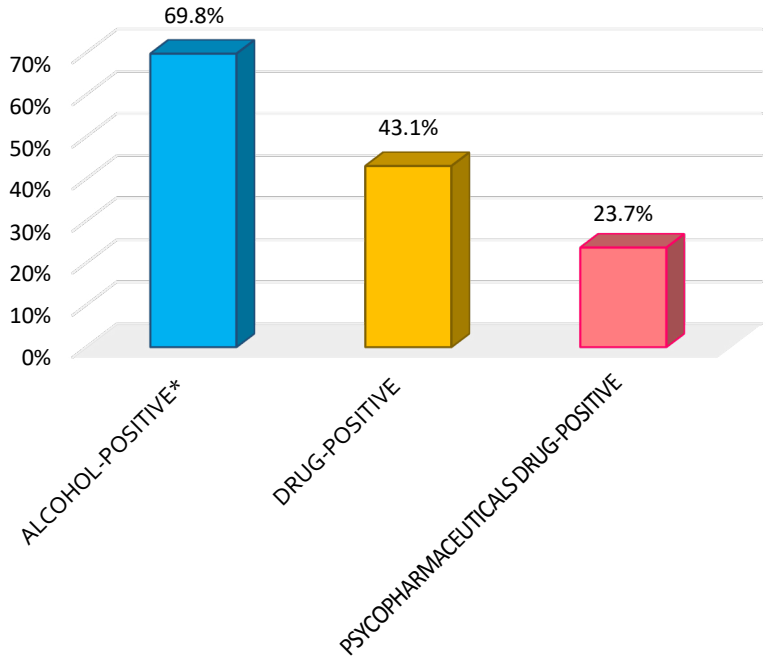
DRIVERS: CASES WITH POSITIVE TOXICOLOGICAL RESULTS (n = 401)

FIGURE 14: POSITIVE DRIVERS (n = 401). PERCENTAGE DISTRIBUTION BY GENDER



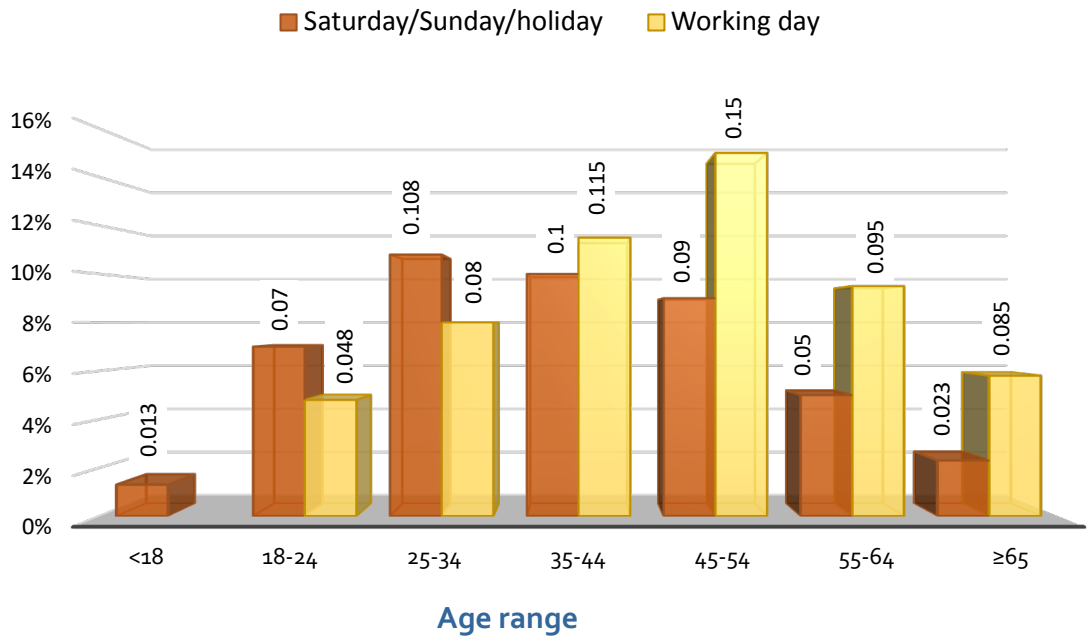
92.3% of drivers with positive results were male.

FIGURE 15: POSITIVE DRIVERS (n = 401). PERCENTAGE DISTRIBUTION BY TYPE OF SUBSTANCE DETECTED
(possible combinations not considered)



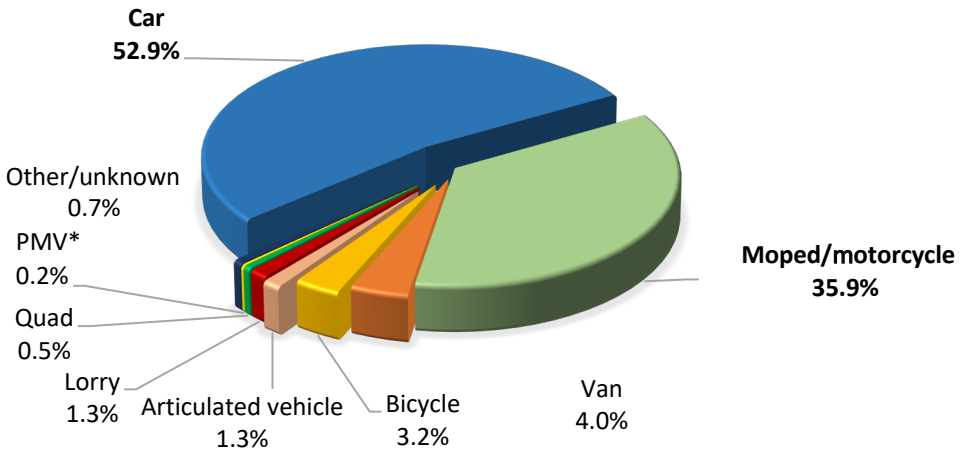
* Alcohol-positive: blood alcohol concentration equal to or greater than 0.30 g/l [1].

FIGURE 16: POSITIVE DRIVERS (n = 401). PERCENTAGE DISTRIBUTION BY AGE RANGE AND DAY OF WEEK



Sixty-four point three percent of the drivers with positive toxicological results were in the 25-54 years age range, and **54.1%** of deceased drivers with positive toxicological results in the entire national territory occurred on working days, regardless of the age range. In the <18-34 age bracket, drivers with positive toxicological results died mostly on Saturdays, Sundays and public holidays (**19.1%** compared to **12.8%** on working days). However, in the 35-65 age bracket, most fatal accidents occurred on working days (**41.8%** versus **26.3%** on Saturdays, Sundays and public holidays).

FIGURE 17: POSITIVE DRIVERS (n = 401).
PERCENTAGE DISTRIBUTION BY TYPE OF VEHICLE



* VMP: Personal Mobility Vehicle

Fifty-two point nine percent of the drivers with positive toxicological results were driving a car and **35.9%** a motorcycle or moped.

FIGURE 18: POSITIVE DRIVERS (n = 401). CLASSIFICATION
OF RESULTS BY TYPE AND/OR COMBINATION OF SUBSTANCES DETECTED

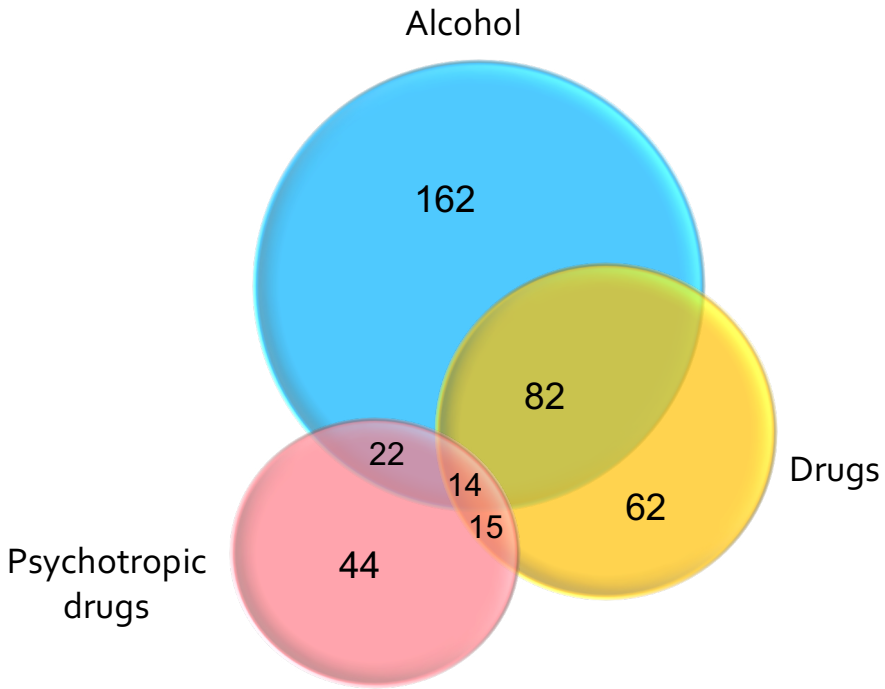
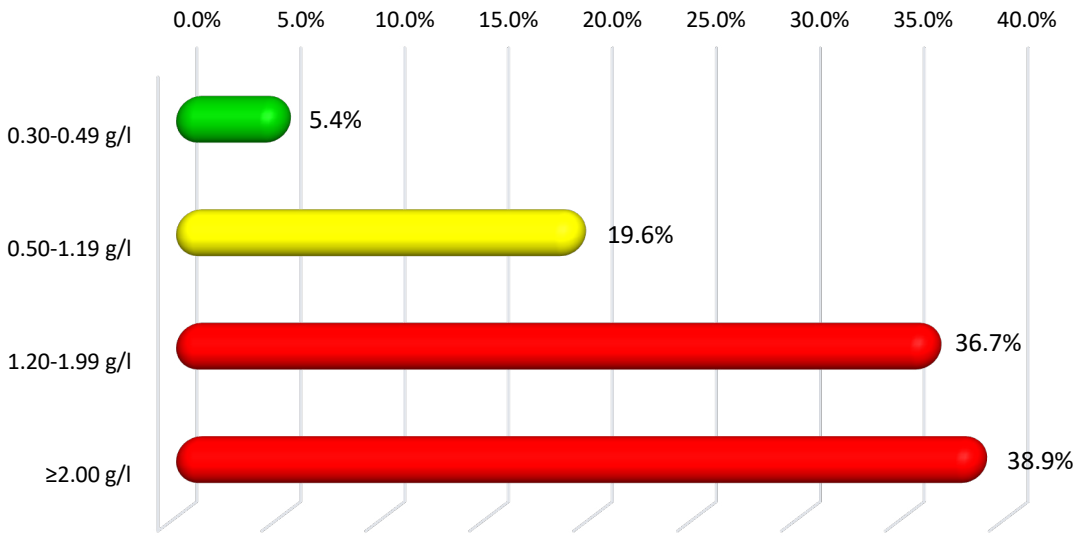
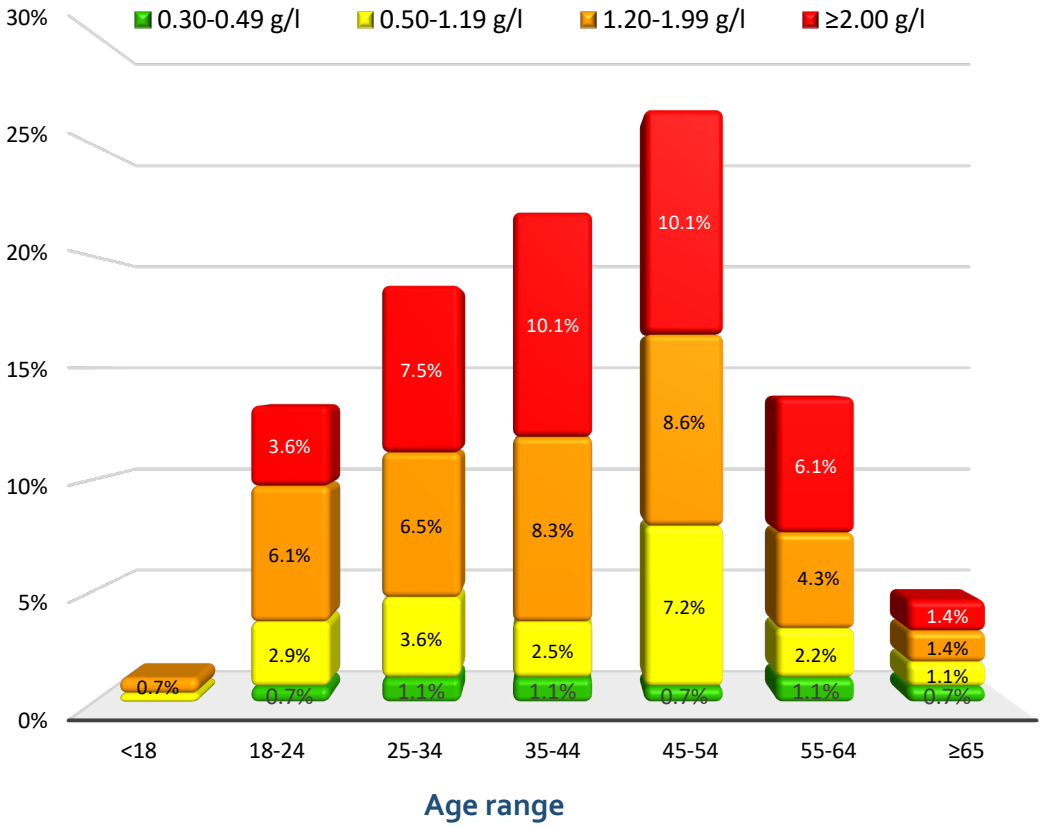


FIGURE 19: ALCOHOL-POSITIVE DRIVERS (n = 280). DISTRIBUTION BY BLOOD ALCOHOL LEVEL



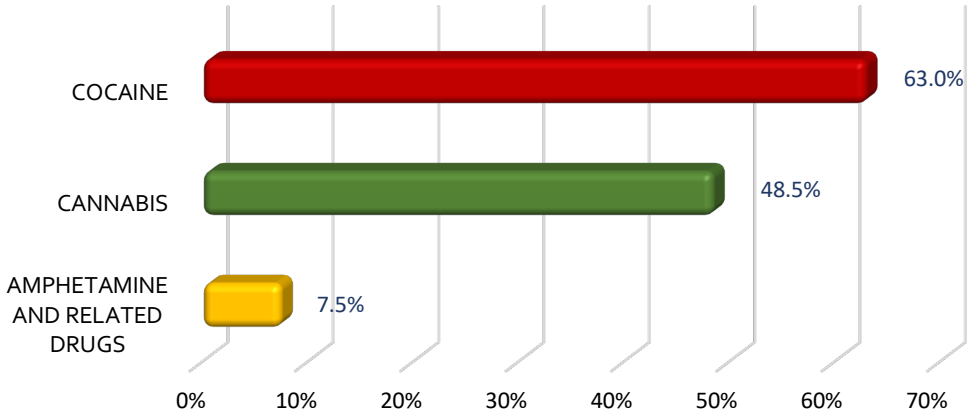
Seventy-five percent of the drivers positive for alcohol showed a blood alcohol concentration equal to or greater than a 1.20 g/l.

FIGURE 20: ALCOHOL-POSITIVE DRIVERS (n = 280).
DISTRIBUTION BY BLOOD ALCOHOL LEVEL AND AGE RANGES



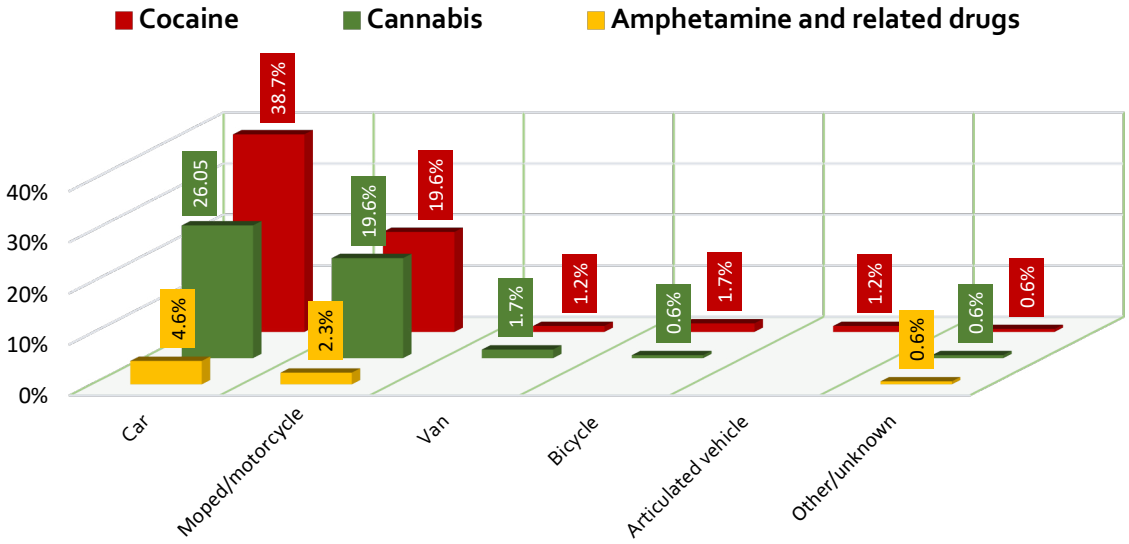
Fifty-one point one percent % of the drivers with positive results for alcohol, with a blood alcohol concentration equal to or greater than 1.20 g/l, are within the age range of 25-54 years.

FIGURE 21: DRUG-POSITIVE DRIVERS (n = 173).
PERCENTAGE DISTRIBUTION OF DRUGS DETECTED



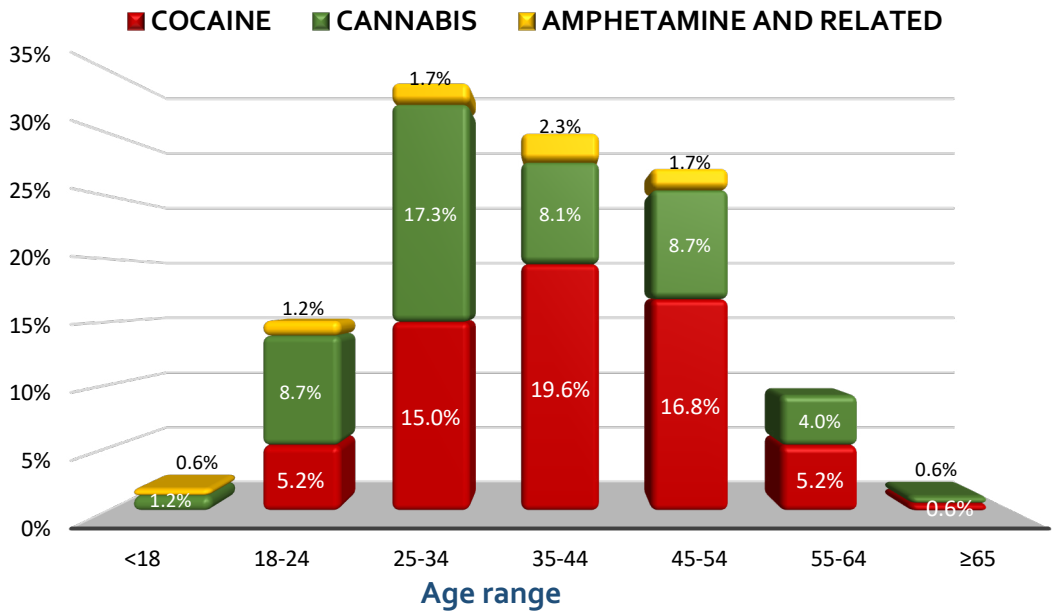
Regardless of whether there was combined use of drugs of abuse, alcohol and/or psychotropic drugs, the most commonly used drug on its own was cannabis (**63.0 %**), followed by cocaine (**48.5 %**).

FIGURE 22: DRUG-POSITIVE DRIVERS (n = 173).
PERCENTAGE DISTRIBUTION BY DETECTED DRUG AND TYPE OF VEHICLE



The highest percentages correspond to the consumption of cocaine (**58.4 %**) and/or cannabis (**45.7 %**), in car and moped/motorcycle drivers.

FIGURE 23: DRUG-POSITIVE DRIVERS (n = 173).
PERCENTAGE DISTRIBUTION BY DETECTED DRUG AND AGE RANGES



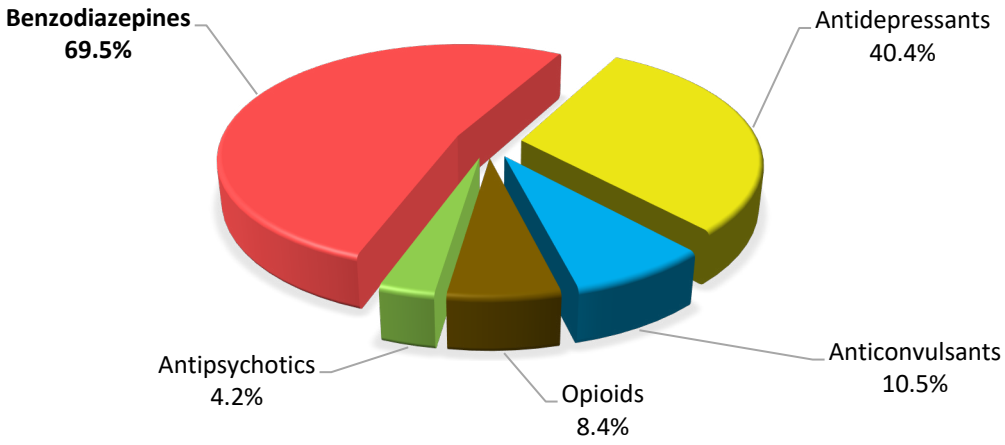
The highest percentages are for cocaine (**51.4%**) and/or cannabis use (**34.1%**), among drivers within the 25-54 years age range. Cannabis was the most commonly used drug in the <18-34 years age range, while cocaine was the most commonly used drug in the 35-64 years age range.

TABLE 1: ALCOHOL AND DRUG-POSITIVE DRIVERS (n = 96).
DISTRIBUTION OF CASES BY DETECTED DRUG

The most frequent detected combinations were:	
Alcohol and cocaine	49.0%
Alcohol and cannabis	25.0%
Alcohol, cocaine, and cannabis	20.8%
Alcohol, cannabis, and amphetamine derivatives	2.1%
Alcohol, cocaine, cannabis, and amphetamine derivatives	1.0%
Alcohol, cannabis, and amphetamine derivatives	1.0%
Alcohol and amphetamine derivatives	1.0%

The most prevalent combined consumption of alcohol and drugs of abuse was alcohol and cocaine (**49.0%**), followed by alcohol and cannabis (**25.0%**) and alcohol, cocaine, and cannabis (**20.8%**).

FIGURE 24: PSYCOPHARMACEUTICALS DRUG-POSITIVE DRIVERS (n = 95). PERCENTAGE DISTRIBUTION OF DETECTED PSYCHOTROPIC DRUGS



The term “opioids” refers to drugs (tramadol, oxycodone, methadone, etc.) that bind to opioid receptors in the central nervous system, excluding heroin.

Pedestrians (n = 180)

FIGURE 25: PEDESTRIANS (n = 180). PERCENTAGE DISTRIBUTION BY GENDER

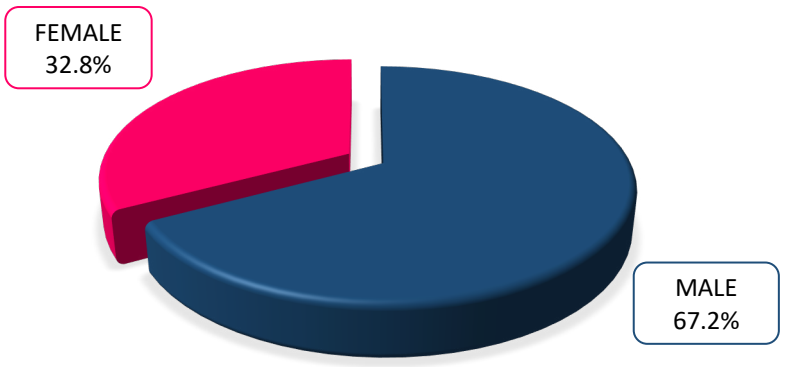


FIGURE 26: PEDESTRIANS (n = 180). PERCENTAGE DISTRIBUTION BY AGE RANGE

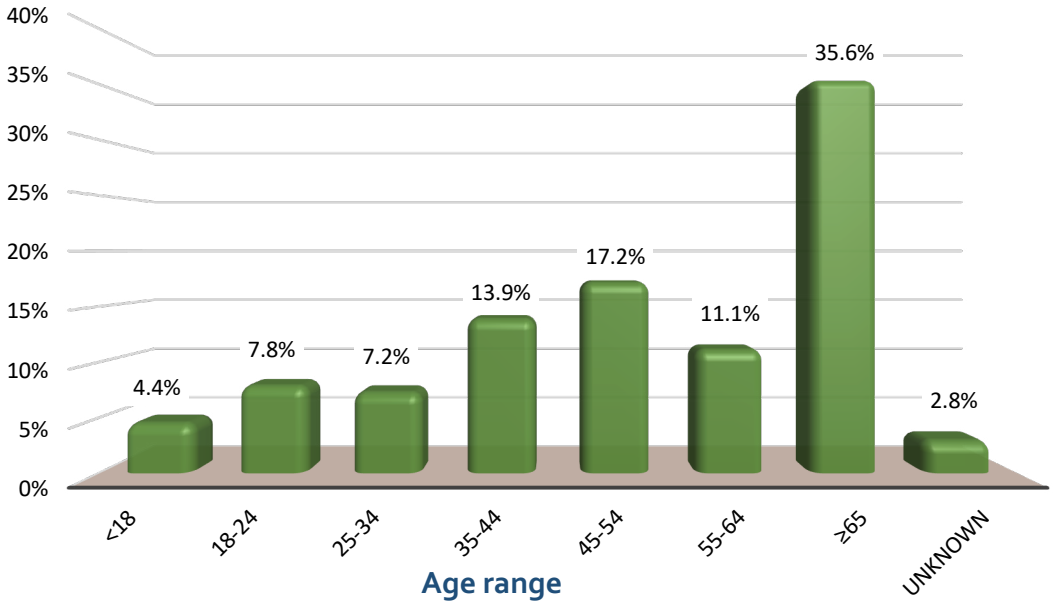
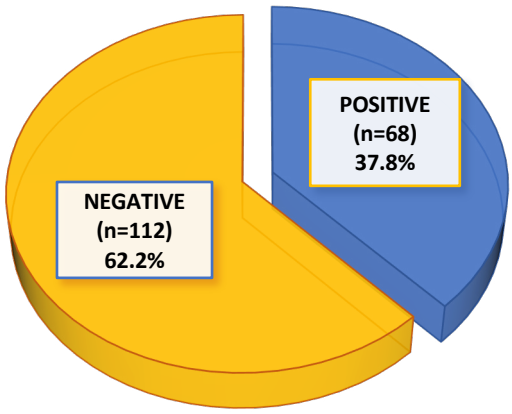
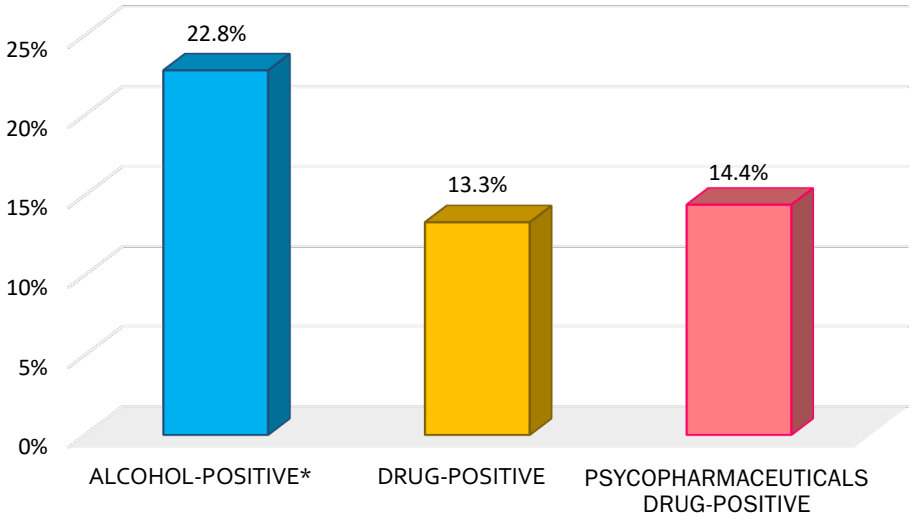


FIGURE 27: PEDESTRIANS (n = 180).
PERCENTAGE DISTRIBUTION BY TOXICOLOGICAL RESULT



Of 180 pedestrians who died from road traffic injuries and subjected to an autopsy, 68 (**37.8%**) showed positive toxicological results for alcohol, drugs of abuse, and psychotropic drugs, alone or in combination.

FIGURE 28: PEDESTRIANS (n = 180).
PERCENTAGE DISTRIBUTION BY TYPE OF SUBSTANCE DETECTED
(excluding possible combinations)



* Alcohol-positive: blood alcohol concentration equal to or greater than 0.30 g/l [1].

FIGURE 29: PEDESTRIANS (n = 180). DISTRIBUTION BY BLOOD ALCOHOL LEVEL

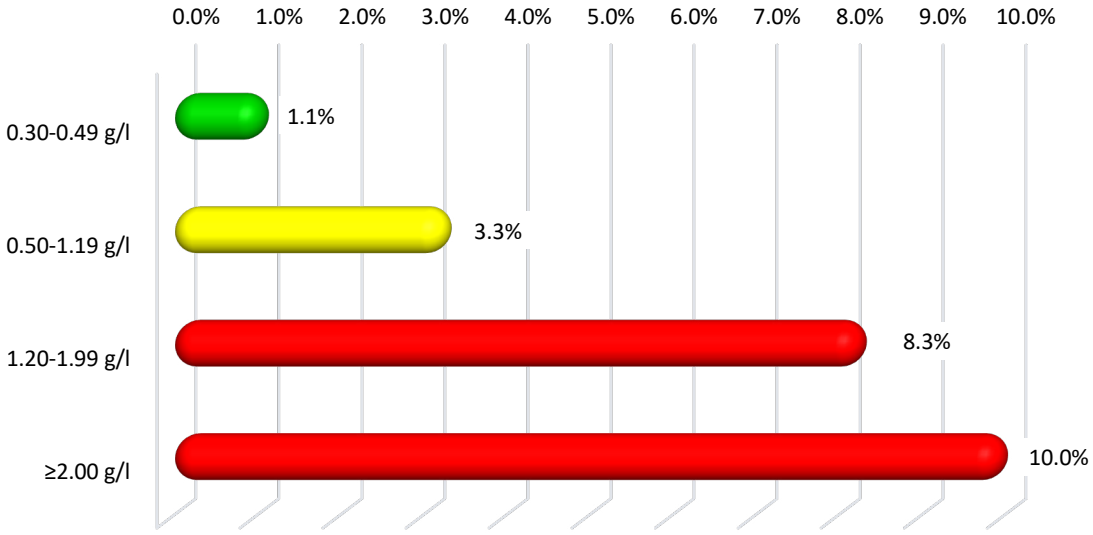
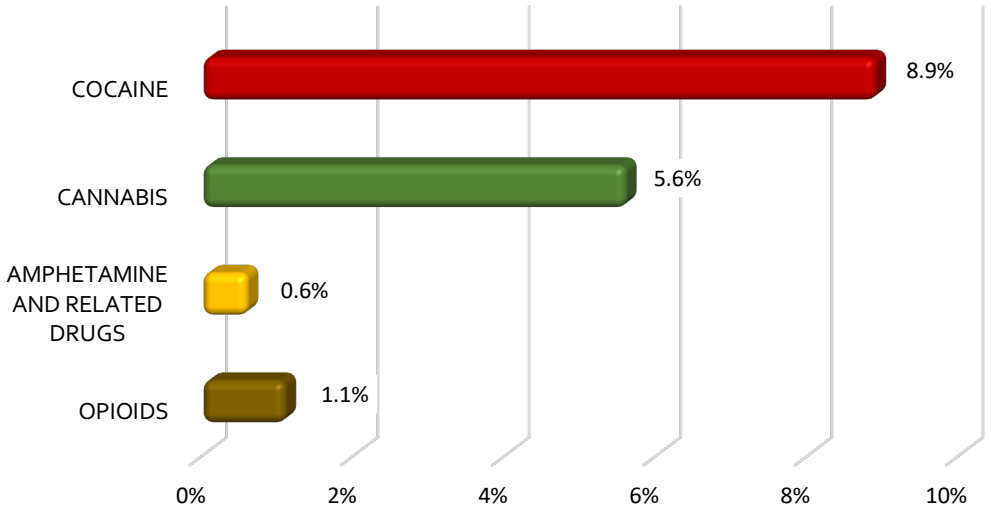
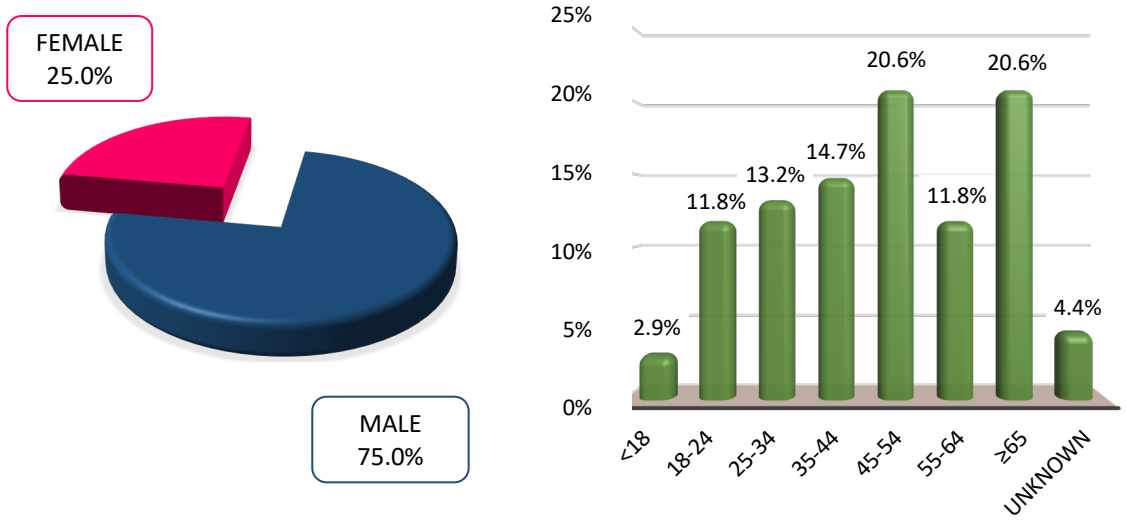


FIGURE 30: PEDESTRIANS (n = 180). PERCENTAGE DISTRIBUTION OF DRUGS DETECTED



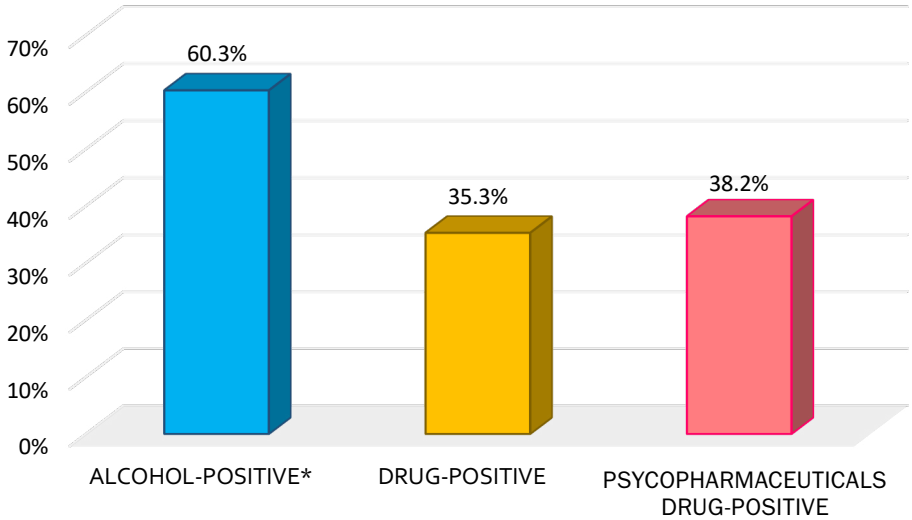
PEDESTRIANS. CASES WITH POSITIVE TOXICOLOGICAL RESULTS (n = 68)

FIGURES 31 AND 32: POSITIVE PEDESTRIANS (n = 68). PERCENTAGE DISTRIBUTION BY GENDER AND AGE RANGES



Seventy-five percent of the pedestrian road traffic fatalities with positive toxicology results were males.

FIGURE 33: POSITIVE PEDESTRIANS (n = 68). PERCENTAGE DISTRIBUTION BY TYPE OF SUBSTANCE DETECTED (excluding possible combinations)



* Alcohol-positive: blood alcohol concentration equal to or greater than 0.30 g/l.

FIGURE 34: POSITIVE PEDESTRIANS (n = 68). CLASSIFICATION OF RESULTS ACCORDING TO TYPE AND COMBINATION OF DETECTED SUBSTANCES

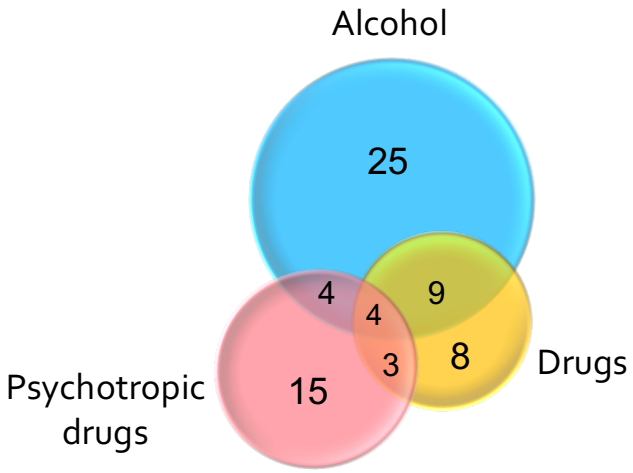
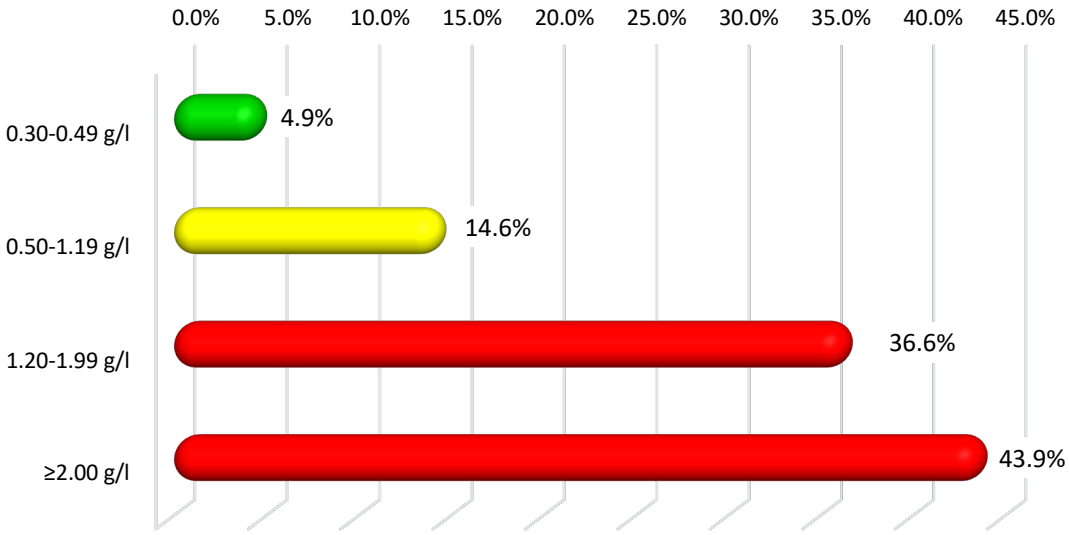


FIGURE 35: ALCOHOL-POSITIVE PEDESTRIANS (n = 41). DISTRIBUTION BY BLOOD ALCOHOL LEVEL



Eighty point five percent of the pedestrian fatalities who tested positive for alcohol had a blood alcohol concentration equal to or greater than 1.20 g/l.

FIGURE 36: ALCOHOL-POSITIVE PEDESTRIANS (n = 41).
DISTRIBUTION BY BLOOD ALCOHOL LEVEL AND AGE

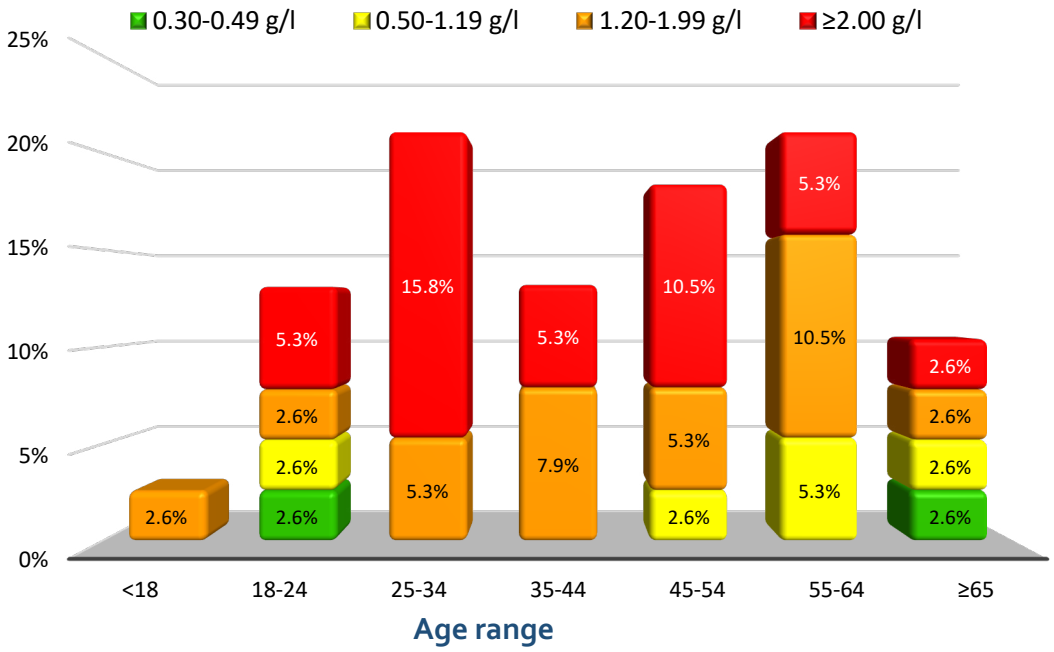
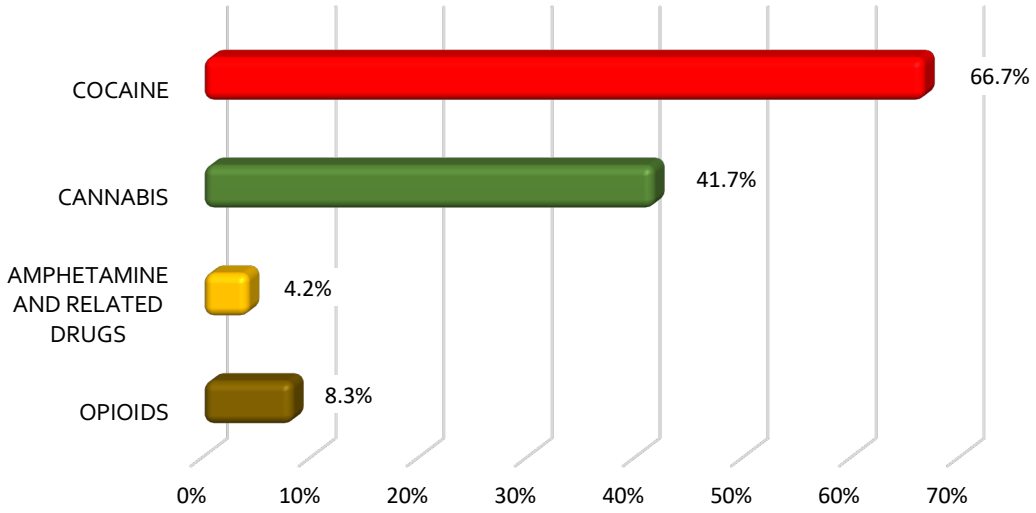


FIGURE 37: DRUG-POSITIVE PEDESTRIANS (n = 24).
PERCENTAGE DISTRIBUTION OF DRUGS DETECTED



Regardless of whether there was combined use of drugs of abuse, alcohol and/or psyco-pharmaceuticals drugs, cocaine alone was the most commonly used drug (**66.7%**).

FIGURE 38: DRUG-POSITIVE PEDESTRIANS (n = 24).
PERCENTAGE DISTRIBUTION BY DRUG DETECTED AND AGE RANGES

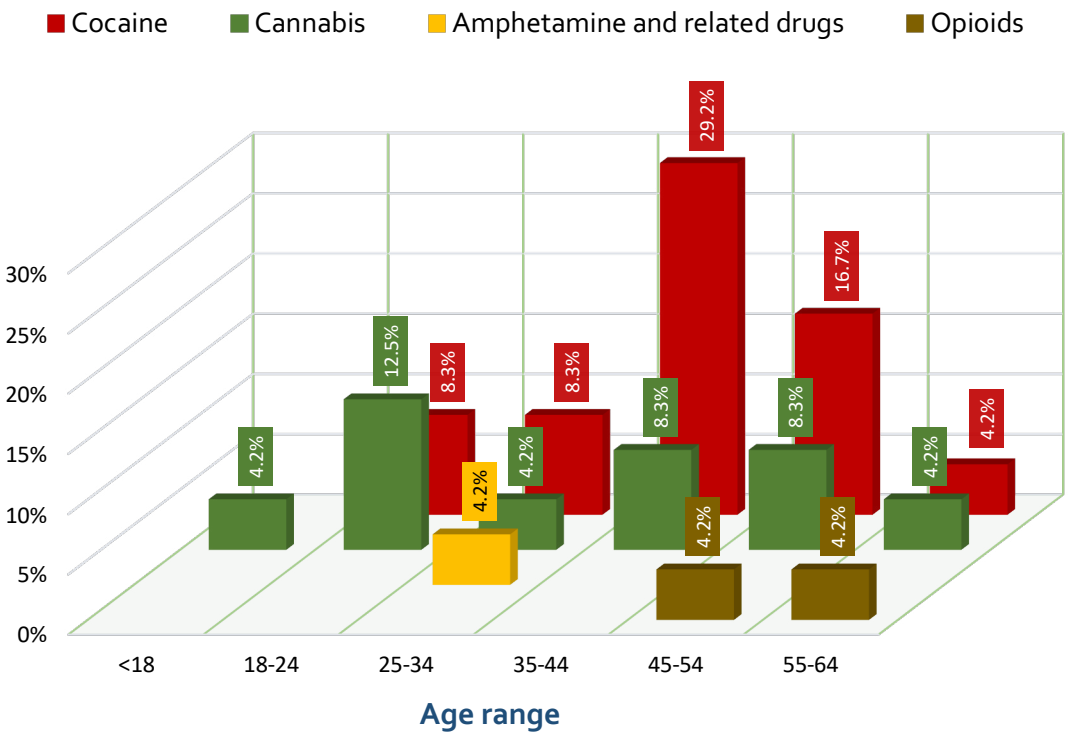
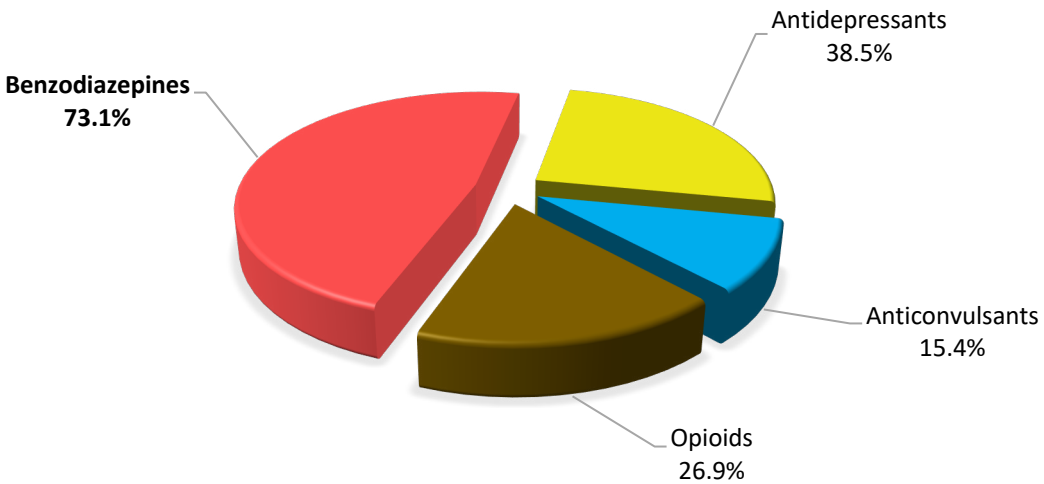


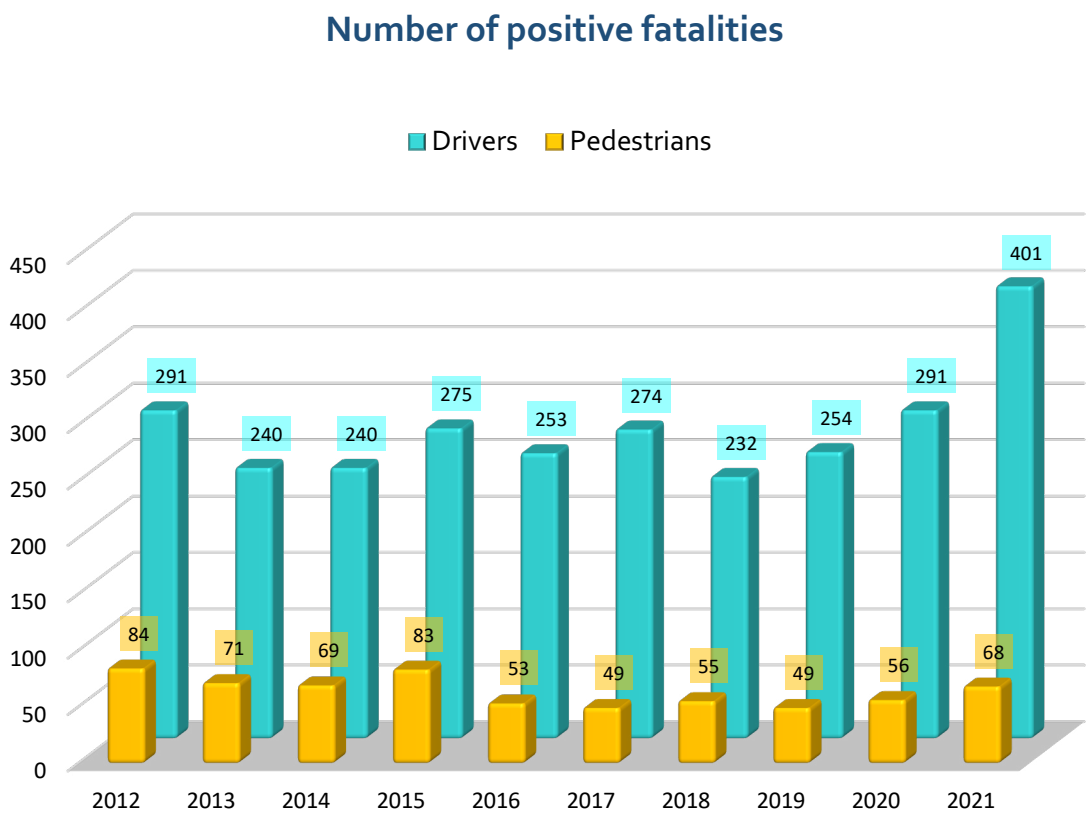
FIGURE 39: PSYCOPHARMACEUTICALS DRUG-POSITIVE PEDESTRIANS (n = 26).
PERCENTAGE DISTRIBUTION OF DETECTED PSYCHOTROPIC DRUGS



The term “opioids” refers to drugs (tramadol, oxycodone, methadone, etc.) that bind to opioid receptors in the central nervous system, excluding heroin.

Comparative study

FIGURE 40: CHANGE OVER TIME IN NUMBER OF FATALITIES ANALYSED



This graph, presenting absolute data, shows a very considerable increase in the number of driver fatalities in 2021 compared to previous years. This is not due to an increase in road traffic accident rate, but to an increase in the total number of victims analysed from a toxicological point of view, since the data for 2021 includes not only the victims analysed by the INTCF, but also those analysed by seven Institutes of Legal Medicine and Forensic Sciences.

FIGURE 41: CHANGE OVER TIME IN PERCENTAGE OF DRIVERS BY TOXICOLOGICAL RESULT

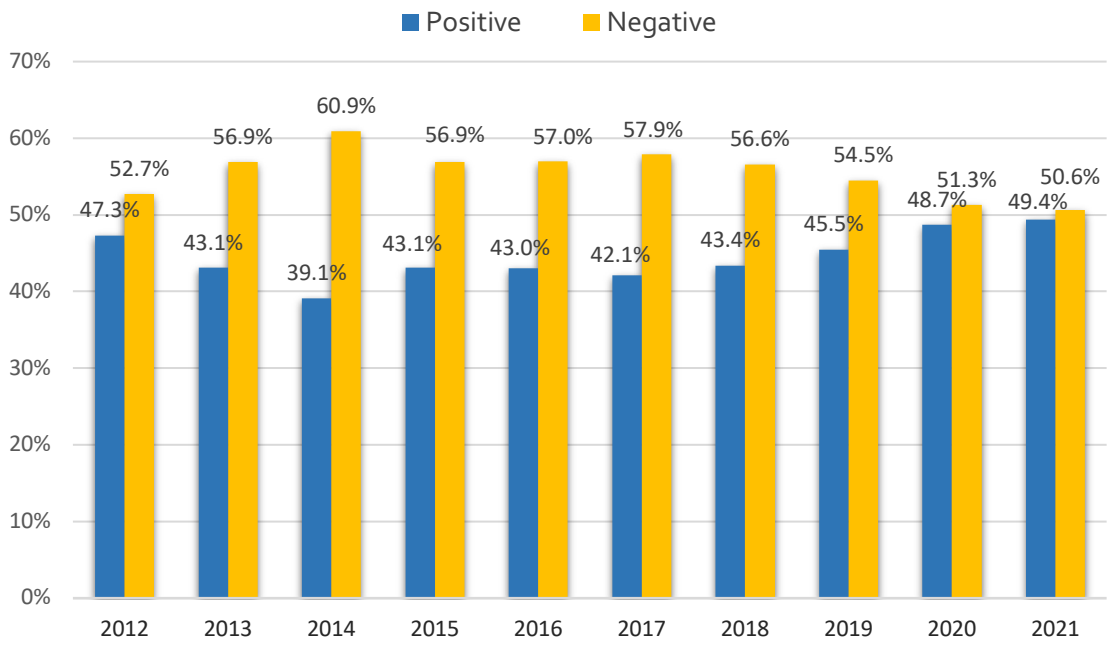


FIGURE 42: CHANGE OVER TIME IN PERCENTAGE OF PEDESTRIANS BY TOXICOLOGICAL RESULT

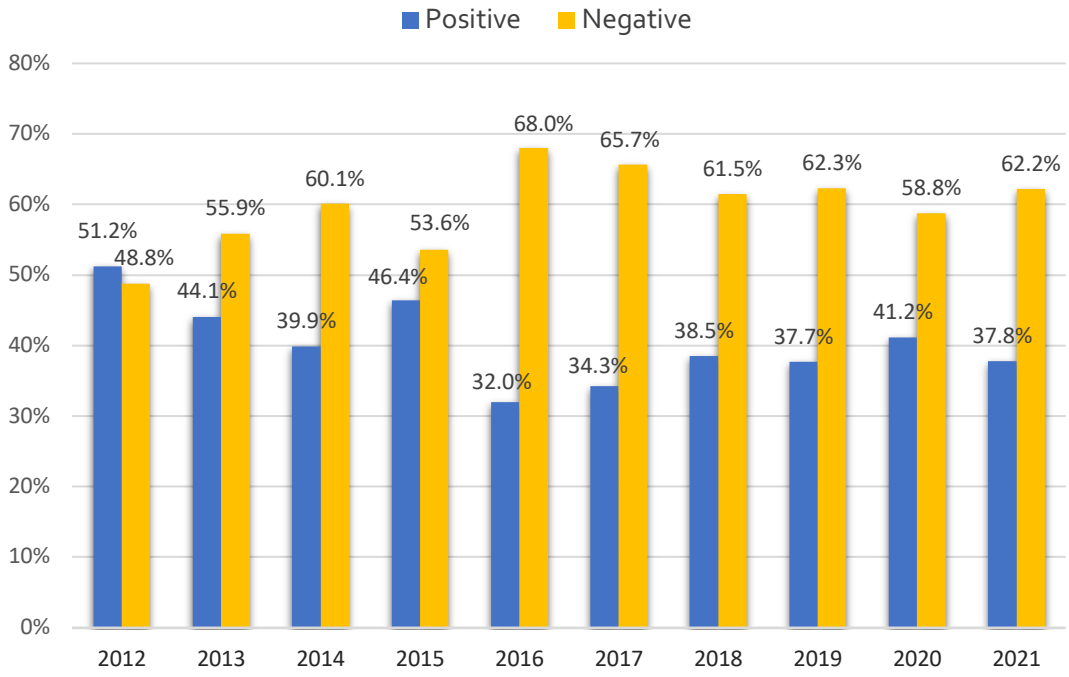
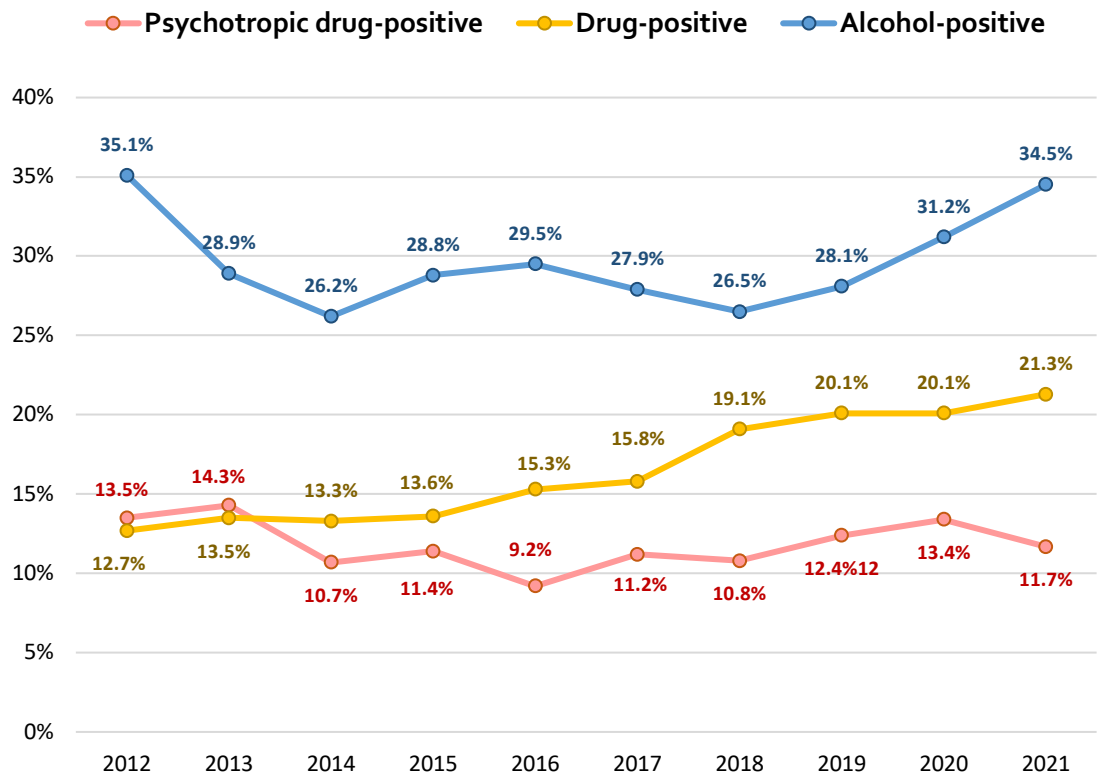


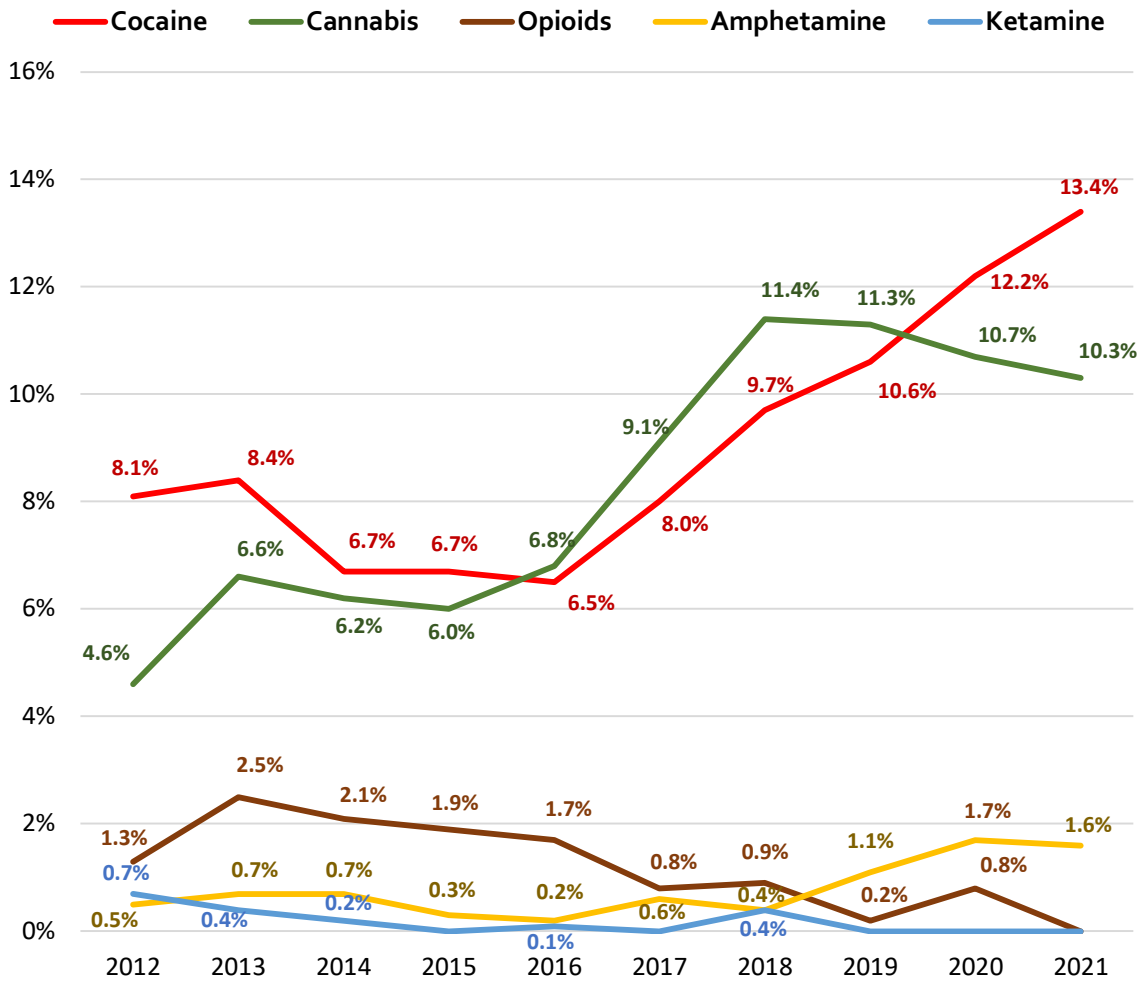
FIGURE 43: CHANGE OVER TIME IN PERCENTAGE OF POSITIVE DRIVERS BY TOXICOLOGICAL RESULT



The comparative study of the last ten years on the number of drivers with positive toxicological results shows an increase in 2021 of **2.2%** compared to 2012.

With regard to alcohol consumption, there was an increase of **3.3%** in 2021 in drivers who died in road traffic accidents compared to 2020. With regard to drug use, an upward trend can be observed, reaching an increase of **8.6%** compared to 2012, and increasing slightly (**1.2%**) with respect to 2020. Finally, regarding psycopharmaceuticals drugs, a slight increase (**1.7%**) was observed compared to 2020.

FIGURE 44: CHANGE OVER TIME IN PERCENTAGE OF POSITIVE DRIVERS BY TYPE OF DRUG



Since 2016, there has been a marked upward trend in the use of cannabis and cocaine among drivers who died in road traffic accidents. In the case of cannabis, use increased by **6.8%** between 2016 and 2018, and a slight downward trend of **1.1%** was observed between 2018 and 2021.

Final considerations

SUMMARY OF FINAL CONSIDERATIONS WITH MAJOR MEDICAL-LEGAL AND SOCIAL IMPACT

From the information obtained and presented in the report, we can extract the following conclusions of major impact, not only in the medical-legal sphere, but also for their important implications in the area of road safety.

DRIVERS

An increase was detected in alcohol, drugs of abuse, and psycopharmaceuticals drug consumption among drivers who died in road traffic accidents during 2021.

Of **812** drivers who died in road traffic accidents and underwent an autopsy and a toxicology analysis, **401** drivers, representing **49.4%** (FIGURE 8), showed positive toxicology results for alcohol, drugs of abuse, or psycopharmaceuticals drugs, alone or in combination. If we compare this data with the prevalence data for alcohol and drug consumption in the general population of drivers who underwent a drug test (**12%** according to DGT data in 2018 [2], or around **7%** in European drivers [3]), we can see the great impact that alcohol and drug consumption has on traffic accident fatalities. The prevalence of drug consumption in the group of deceased drivers is over **37%** higher than in drivers of the general population in whom the presence of drugs was detected.

Alcohol continues to be the most consumed substance in deceased drivers, followed by cocaine and cannabis. Psycopharmaceuticals drugs rank third.

The overall data for percent distribution by type of substance detected in total deceased drivers was the following: **34.5%** were positive for alcohol, **21.3%** positive for drugs, and **11.7%** positive for psycopharmaceuticals drugs (FIGURE 10).

Deceased drivers with positive toxicological results were predominantly males.

A vast majority of cases (**92.3%**) with positive toxicological results corresponded to male drivers, and only **7.7%** to female drivers (FIGURE 14), which is an epidemiological finding of great importance in road accident prevention campaigns.

Most of the drivers with positive toxicological results were driving a car, motorbike, or moped.

The majority (**88.3%**) of drivers with positive toxicological results were driving a car (**52.9%**) or a motorcycle (**35.9%**) (FIGURE 17).

The age range of the majority of drivers with positive toxicological results was 25-54 years old.

Sixty-four point six percent of the drivers with positive toxicology results were in the 25-54 years age range. (FIGURE 16).

In the <18-34 years age bracket, fatal accidents involving drivers with positive toxicological results occurred mostly on Saturdays, Sundays, and public holidays, while in the 35-65 age bracket, fatal accidents occurred mostly on working days.

Fifty-four point one percent of fatal accidents of drivers with positive toxicological results in the entire national territory occurred on working days, while the remaining **45.7%** occurred on Saturdays, Sundays, and public holidays, regardless of the age bracket (FIGURE 16). In the <18-34 years age bracket, drivers with positive toxicological results died mostly on Saturdays, Sundays, and public holidays (**19.1%** compared to **12.8%** on working days). However, in the 35-65 age bracket, most fatal accidents occurred on working days (**41.8%** versus **26.3%** on Saturdays, Sundays, and public holidays).

Alcohol remains the most commonly detected substance within the group of deceased drivers with positive toxicological results. The majority of deceased drivers who tested positive for alcohol showed a very high blood alcohol concentration, equal to or greater than 1.2 g/l, which correlates with very severe intoxication.

The percent distribution within the group of deceased drivers with positive toxicological results (n = 401), according to the type of substance detected, was as follows: **69.8%** (n = 280) were positive for alcohol, **43.1%** (n = 173) were positive for drugs, and **23.7%** (n = 95) were positive for psycopharmaceuticals drugs (FIGURE 15).

It is important to highlight that **75.0%** of the deceased drivers who tested positive for alcohol had a very high blood alcohol concentration, equal to or greater than 1.2 g/l, which correlates with very severe intoxication (FIGURE 19).

The overall data for the entire national territory shows that the most commonly detected drug of abuse among deceased drivers was cocaine, followed by cannabis. Cannabis, however, was the most detected drug in the age range of <18-34 years, while cocaine was the most detected drug in the 35-64 years age range.

Regarding cases positive for drugs of abuse (n = 173), and regardless of whether there was combined use of drugs of abuse, alcohol, and psychotropic drugs, cocaine alone was the most commonly used drug in the entire national territory (**63.0%**), followed by cannabis (**48.5%**) (FIGURE 21). Cannabis was the most commonly detected drug in the <18-34 years age range, while cocaine was the most commonly detected drug in the 35-64 years age range (FIGURE 23).

Overall data indicate that the most commonly detected psycopharmaceuticals drugs in deceased drivers were benzodiazepines, followed by antidepressants, anticonvulsants and opioids.

The percent distribution within the group of deceased drivers who tested positive for psycopharmaceuticals drugs (n = 95) by type of substance detected was as follows: **69.5%** were positive for benzodiazepines, **40.0%** were positive for antidepressants, and **8.4%** for opioids (FIGURE 24).

The most prevalent combined use of alcohol and drugs of abuse was alcohol and cocaine, followed by alcohol and cannabis, and alcohol, cocaine, and cannabis.

The most prevalent simultaneous detections of alcohol and drugs of abuse (n = 52) were simultaneous presence of alcohol and cocaine (**49.0%**), followed by alcohol and cannabis (**25.0%**), and alcohol, cocaine and cannabis (**20.8%**) (FIGURE 18 and TABLE 1).

The comparative study over the last 10 years on the number of drivers with positive toxicological results shows an upward trend in alcohol and cocaine detection and a slight decrease in cannabis and psycopharmaceuticals drug detection in the last four years.

The comparative study over the last 10 years on the number of drivers with positive toxicological results shows an increase in 2021 of **2.2%** compared to 2012 (FIGURE 41).

Regarding alcohol consumption, there was an increase of **3.3%** in 2021 in consumption of alcohol by drivers who died in road traffic accidents compared to 2020. With regard to drug detection, an upward trend can be observed, reaching an increase of **8.6%** compared to 2012, and increasing slightly (**1.2%**) with respect to 2019. Finally, with regard to psycopharmaceuticals drugs, a slight increase (**0.7%**) is observed compared to 2019 (FIGURE 43).

Since 2016, there has been a marked upward trend (**6.9%**) in cocaine detection among drivers who died in a road traffic accident. For cannabis, its presence decreases by **1%** during 2021 compared to 2018 (FIGURE 44).

PEDESTRIANS

In 2021, there was a **3.4%** decrease in the proportion of pedestrian road traffic fatalities with positive toxicological results for alcohol, drugs of abuse, and psycopharmaceuticals drugs, alone or in combination, compared to 2020.

Of 180 pedestrians killed in road traffic accidents and autopsied, 68 (equivalent to **37.8%**) tested positive for alcohol, drugs of abuse and psycopharmaceuticals drugs, alone or in combination (FIGURE 27).

The gender distribution of deceased pedestrians with positive toxicological results is different from the distribution of deceased drivers: **75%** of deceased pedestrians from road traffic accidents with positive toxicological results were male and **25%** were female (FIGURE 31).

The age range distribution revealed a higher prevalence in 45-54 year-old pedestrians and 65 years and over.

The age range distribution revealed a higher prevalence in pedestrians in the 45-54 years old range (**20.6%**) and 65 years and over (**20.6%**) age ranges (FIGURE 32).

Alcohol continues to be the most commonly consumed substance by pedestrians killed in road traffic accidents, closely followed by psychotropic drugs, and thirdly by drugs, of abuse.

The highest prevalence of pedestrians testing positive was for alcohol (**60.3%**), followed by psycopharmaceuticals drugs (**38.2%**) and drugs of abuse (**35.8%**) (FIGURE 33).

Most of the deceased pedestrians who tested positive for alcohol had a very high blood alcohol concentration equal to or greater than 1.2 g/l, which correlates with very severe intoxication.

It is noteworthy that **80.5%** of deceased pedestrians with positive results for alcohol had a blood alcohol concentration equal to or greater than 1.20 g/l (FIGURE 35).

Overall data indicate that the most commonly detected psycopharmaceuticals drugs in deceased pedestrians were benzodiazepines, followed by antidepressants, opioids, and anticonvulsants.

The percent distribution within the group of deceased pedestrians with positive results for psycopharmaceuticals drugs (n = 26) by type of substance detected was as follows: **73.1%** were positive for benzodiazepines, **38.5%** were positive for antidepressants, **26.9%** for opioids, and **15.4%** were positive for antiepileptic drugs (FIGURE 39).

Methodology

1. NATIONAL INSTITUTE OF TOXICOLOGY AND FORENSIC SCIENCES

1.1. Analytical techniques used and participation in intercomparison exercises

- Enzyme immunoassay.
- Headspace gas chromatography with flame ionisation detection (HSGCFID).
- High-performance liquid chromatography with diode array detector (HPLCDAD).
- Gas chromatography coupled to mass spectrometry (GCMS).
- Gas chromatography coupled to tandem mass spectrometry (GCMSMS).
- Ultra-performance liquid chromatography coupled to the tandem mass spectrometry (UPLCMSMS).
- Liquid chromatography coupled to high-resolution mass spectrometry (LCHRMS).

All reported results for drugs and psycopharmaceuticals drugs [4] have been confirmed by analytical techniques based on mass spectrometry [514].

All analytical results have been obtained within the quality system implemented at the INTCF according to **ISO 17025**, with the INTCF specifically accredited by the **Spanish National Accreditation Body (ENAC)** for the quantitative determination of ethyl alcohol in biological fluids, among others [15].

The following is a description of the national and international intercomparison exercises in which the Chemistry and Drugs Services of the different INTCF Departments participate annually and whose results are essential to externally evaluate the competence of our laboratories in this type of drug of abuse testing.

TABLE 4: PARTICIPATION IN INTERCOMPARISON EXERCISES OF THE CHEMISTRY AND DRUGS SERVICES OF THE DIFFERENT INTCF DEPARTMENTS

	Barcelona	Madrid	Seville	La Laguna
Programme: Blood Ethyl Alcohol Intercomparison Exercise Organiser: INTCF Seville Frequency: Quarterly Parameters/samples: Ethyl alcohol and other volatile compounds in blood and plasma	X	X	X	X
Programme: Whole Blood Alcohol / Volatiles Survey (AL1) Organiser: College of American Pathologists Frequency: Quarterly Parameters/samples: Blood ethyl alcohol, volatiles, and ethylene glycol	X	X		
Programme: Toxicology Programme Organiser: LGC Standards. Frequency: Annual Parameters/samples: Identification and quantification of ethanol in blood			X	
Programme: Vitreous Fluid (VF) Organiser: College of American Pathologists Frequency: Semi-annual Parameters/samples: Ethyl alcohol, potassium, and sodium in vitreous fluid		X		
Programme: Forensic Toxicology Criminalistics (FTC) Organiser: College of American Pathologists Frequency: Semi-annual Parameters/samples: Drugs in blood and urine	X	X		
Programme: Forensic Blood Toxicology Proficiency Testing (Quartz). Organiser: LGC Frequency: Quarterly Parameters/samples: Drugs of abuse and psychotropic drugs in blood		X	X	X
Programme: Blood Drug Analysis (CTS-5661) Organiser: Collaborative Testing Services Frequency: Annual Parameters/samples: Drugs of abuse and psychotropic drugs in blood		X		
Programme: International Quality Assurance Programme (IQAP-UNODC) Biological Specimens Group. Organiser: United Nations Office on Drugs and Crime (UNODC) Samples: 4 urine samples Frequency: Biannual Parameters: Identification and quantification of most common drugs of abuse		X	X	

2. INSTITUTE OF LEGAL MEDICINE AND FORENSIC SCIENCES OF CATALONIA

2.1. Analytical techniques used and participation in intercomparison exercises

- Enzyme immunoassay.
- Headspace gas chromatography with flame ionisation detection (HSGCFID); detection and quantification of ethanol.
- Gas chromatography coupled to mass spectrometry (GCMS); detection and quantification of drugs of abuse and psychotropic drugs.

- High performance liquid chromatography coupled to tandem mass spectrometry (HPLCMSMS); detection and quantification of drugs of abuse and psychotropic drugs.

The intercomparison exercises which the IMLCFCs have participated in during 2021 were:

- Blood Ethyl Alcohol intercomparison Exercise (EIAS), organised by the INTCF Seville Department.
- UNODC-BS: Detection of psychotropic substances in urine. 2 participations.
- LGC Standards: Detection and quantification of drugs and psychotropic drugs (4 participations), detection and quantification of alcohol and volatile drugs (2 participations), detection and quantification of carboxyhaemoglobin, paracetamol and ethanol (12 participations), detection and quantification of GHB in urine (2 participations), detection and quantification of benzodiazepines and Z drugs (3 participations).

3. BASQUE INSTITUTE OF FORENSIC MEDICINE

3.1. Analytical techniques used and participation in intercomparison exercises

- Enzyme immunoassay.
- Headspace gas chromatography with flame ionisation detection (HSGCFID).
- Ultra-performance liquid chromatography coupled to the tandem mass spectrometry (UPLCMSMS).

All the reported results on drugs and psychotropic drugs have been confirmed with analytical techniques based on mass spectrometry.

The ethanol analytical results have been obtained with a method validated internally by the laboratory where a double column for confirmation is used. Results are always compared with certified reference materials and the interlaboratory exercises in which it is participating.

Drug abuse analytical results have always been obtained using methods compared with certified reference materials and the interlaboratory exercises in which it is participating.

- Intercomparison exercise of ethyl alcohol in blood and plasma. Organiser: INTCF Seville. Frequency: Quarterly. Parameters/samples: Ethyl alcohol and other volatile compounds in blood and plasma.
- Toxicology Programme. Organiser: LGC Standards. Frequency: Monthly. Parameters/samples: Quantification of COHb, ethanol and paracetamol in blood.
- Programme: Forensic Blood Toxicology Proficiency Testing (Quartz). Organiser: LGC. Frequency: Quarterly. Parameters/samples: Identification and quantification of drugs of abuse and psychotropic drugs in blood.

4. INSTITUTE OF LEGAL MEDICINE AND FORENSIC SCIENCES OF ARAGON

4.1. Analytical techniques used and participation in intercomparison exercises

- Headspace gas chromatography with flame ionisation detection (HSGCFID).
- Gas chromatography with mass spectrometry detection (GCMS).

The intercomparison exercises which the IMLA has participated in during 2021 were:

- The IMLA laboratory participates in the Blood Ethyl Alcohol Intercomparison Exercise organised by the National Institute of Toxicology and Forensic Sciences.

5. INSTITUTE OF LEGAL MEDICINE AND FORENSIC SCIENCES OF MURCIA

5.1. Analytical techniques used and participation in intercomparison exercises

- Headspace gas chromatography with flame ionisation detection (HSGCFID).
- Gas chromatography coupled to mass spectrometry (GCMS).

The intercomparison exercises which the IMLCFM has participated in during 2021 were:

- Blood Ethyl Alcohol Intercomparison Exercise (EIAS), organised by the INTCF Seville Department.

6. INSTITUTE OF LEGAL MEDICINE AND FORENSIC SCIENCES OF BALEARIC ISLANDS

6.1. Analytical techniques used and participation in intercomparison exercises

- Enzyme immunoassay.
- Headspace gas chromatography with flame ionisation detection (HSGCFID); detection and quantification of ethanol.
- Gas chromatography coupled to mass spectrometry (GCMS); detection and quantification of drugs of abuse and psychotropic drugs.

The intercomparison exercises performed by the IMLCFIB in 2021 were as follows:

- Blood Ethyl Alcohol Intercomparison Exercise (EIAS), organised by the INTCF Seville Department.
- UNODC ICE PROGRAMME: An interlaboratory exercise for detection of psychotropic substances in urine (20201BS).
- FTC-B 2021 Forensic Toxicology Criminalistics Programme, organised by the College of American Pathologists: Interlaboratory exercise for detection of psychotropic substances in blood.

7. INSTITUTE OF LEGAL MEDICINE AND FORENSIC SCIENCES OF VALENCIA

7.1. Analytical techniques used and participation in intercomparison exercises

- Enzyme immunoassay.
- Headspace gas chromatography with flame ionisation detection (HSGCFID).

The intercomparison exercises performed by the IMLCFV in 2021 were as follows:

- Blood Alcohol Intercomparison Exercise. Organiser: INTCF Seville. Frequency: Quarterly. Parameters/samples: Ethyl alcohol and other volatile compounds in blood and plasma.

8. LUIS CONCHEIRO INSTITUTE OF FORENSIC SCIENCES (INCIFOR)

8.1. Analytical techniques used and participation in intercomparison exercises

- Thermo Fisher Indiko Plus enzyme immunoassay.
- Headspace gas chromatography with flame ionisation detection (HSGCFID); detection and quantification of ethanol.
- High-performance liquid chromatography with diode array detector (HPLC-DAD) for the detection and quantification of drugs of abuse and psychotropic drugs.
- Gas chromatography coupled to mass spectrometry (GCMS); detection and quantification of drugs of abuse and psychotropic drugs.

The controls and intercomparison exercises in which the INCIFOR periodically participates are as follows:

- Three INT controls per year. Controls are for the determination of ethanol, methanol and other volatile samples in blood and plasma samples. They perform the statistical study based on ISO/IEC 17043, but do not have accreditation.
- Two controls per year of LGC ethanol/methanol and other volatile blood measurements that are accredited according to ISO/IEC 17043.
- An annual LGC urine ethanol control accredited according to ISO/IEC 17043.

9. DATA ANALYSIS AND STATISTICAL TREATMENT

The data received in each request (date of accident, date of death, role, age, gender, type of vehicle, autonomous community, province, requesting body, sending body, etc.) and the data from the toxicological studies obtained by the INTCF were recorded in the LabWare Laboratory Information Management System (LIMS) of the INTCF.

LIMS queries were performed through different searches using the Data Explorer module and data were exported to a standardised Microsoft Excel 2016 template.

The data were crosschecked with those recorded independently by the DGT, and a selection of cases was made.

The analytical data received from the different IMLCFs were compiled together in the same standardised Microsoft Excel 2016 template to obtain the final statistical data and graphs.

References

REFERENCES

1. Real Decreto 1428/2003, de 21 de noviembre, por el que se aprueba el Reglamento General de Circulación para la aplicación y desarrollo del texto articulado de la Ley sobre Tráfico, Circulación de Vehículos a Motor y Seguridad Vial, aprobado por el Real Decreto Legislativo 339/1990, de 2 de marzo. Available in: https://www.boe.es/buscar/pdf/2003/BOE-A-2003-23514-consolidado.pdf (last access: 27 de junio de 2022).
2. Revisión sistemática sobre drogas y conducción. Observatorio Nacional de Seguridad Vial. Noviembre de 2021 Dirección General de Tráfico. Available in: https://www.dgt.es/export/sites/web-DGT/.galleries/Images/conoce-la-dgt/que-hacemos/conocimiento-investigacion/revision-sistematica-sobre-drogas-y-conduccion/REVISION-SISTEMATICA-DROGAS.pdf (last access: 27 de junio de 2022).
3. Drug use, impaired driving and traffic accidents. European Monitoring Centre for Drugs and Drug Addiction, 2014. Available in: http://www.emcdda.europa.eu/attachements.cfm/att_229259_EN_TDXD14016ENN.pdf (last access: 27 de junio de 2022).
4. Logan B.K.*, D'Orazio A.L., Mohr A.L.A., Limoges J.F., Miles A.K., Scarneo C.E., Kerrigan S., Liddicoat L.J., Scott K.S., Huestis M.A. Recommendations for Toxicological Investigation of Drug-Impaired Driving and Motor Vehicle Fatalities-2017 Update. *J Anal Toxicol.* 2018 42(2):63-68.
5. Martínez M.A*. Criterios cualitativos en toxicología forense. *Rev. Esp. Med. Legal.* 2012 38(2): 68-75.
6. Martínez M.A*. Criterios cuantitativos en toxicología forense. *Rev. Esp. Med. Legal.* 2014 40(1): 30-38.
7. Society of Forensic Toxicologists. What is Forensic Toxicology. Available in: http://www.abft.org/files/WHAT%20IS%20FORENSIC%20TOXICOLOGY.pdf (last access: 27 de junio de 2022).
8. García-Rodríguez S.*, Giménez M.P. Recursos humanos en un laboratorio de toxicología forense. *Rev Toxicol.* 2005 22: 1-11.
9. The International Association of Forensic Toxicologists (TIAFT). Laboratory Guidelines (source: TIAFT-Bulletin XXXI, number 4, p. 23-26). Available in: http://www.tiaft.org/tiaft-guidelines.html (last access: 27 de junio de 2022).
10. Society of Forensic Toxicologists / American Academy of Forensic Sciences (SOFT/AAFS). Forensic Toxicology Laboratory Guidelines, 2006 Version. Available in: http://www.duirob.com/old%20duirob.com%20taken%20down%202010/articles/SOFT%20Guidelines%202006.pdf (last access: 27 de junio de 2022).
11. Society of Toxicological and Forensic Chemistry (GTFCH). Guidelines and recommendations. Available in: https://www.gtfch.org/cms/index.php/en/guidelines (last access: 27 de junio de 2022).

12. European Union Decision 2002/657/EC. Available in: https://eur-lex.europa.eu/legal-content/ES/TXT/?uri=celex%3A32002D0657 (last access: 27 de junio de 2022).

13. U.S. Department of Health and Human Services, Food and Drug Administration (FDA). Center for Veterinary Medicine, May 1, 2003. Guidance for Industry. Mass Spectrometry for Confirmation of the Identity of Animal Drug Residues (FDA Guidance Document 118). Available in: https://www.fda.gov/regulatory-information/search-fda-guidance-documents/cvm-gfi-118-mass-spectrometry-confirmation-identity-animal-drug-residues (last access: 27 de junio de 2021).

14. World Anti-Doping Agency. WADA-Technical Document-TD2003IDCR. Available in: https://www.wada-ama.org/sites/default/files/td2019dl_final_eng_clean.pdf (last access: 27 de junio de 2022).

15. Norma UNE EN ISO/IEC 10725: 2017. Requisitos generales relativos a la competencia de los laboratorios de ensayo y calibración.

Collaborate:

Instituto Nacional de Toxicología y Ciencias Forenses
José Echegaray, 4. 28232 Las Rozas. Madrid.