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TOXICOLOGICAL FINDINGS IN ROAD TRAFFIC FATALITIES

2023 Report

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Toxicological findings in road traffic fatalities

2023 Report

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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 Institute of Forensic Sciences Luis Concheiro (INCIFOR), with the collaboration of the National Road Safety Observatory (ONSV) of the General Directorate of Traffic (DGT), present the annual report on deaths that occurred in traffic accidents during 2023 and that have been investigated from a toxicological-forensic point of view throughout Spain.

For the third consecutive year, this report includes not only toxicological analyses carried out by the INTCF, but also those carried out by institutes of legal medicine and forensic sciences (IMLCF) equipped with a chemical-toxicological analysis laboratory, with the incorporation of toxicological data provided by a total of seven IMLCF. This provides the most comprehensive information possible on toxicological analyses in road traffic fatalities.

Statistical data in this report (as well as the data for the years 2020, 2021 and 2022) are available to the different Administrations and citizens on the Justice in Data website (https://datos.justicia.es/intcf) developed by the Directorate General for Digital Transformation (DGTD) of the Justice Administration. Therefore, the different autonomous regions can easily explore the toxicological findings in road traffic fatalities within their own territory.

Data presented in relation to toxicological findings come from requests made by the various judicial bodies. Information presented in this report refers to the toxicological analyses carried out by the INTCF (centre of reference for toxicology) and by the IMLCFs equipped with a chemical-toxicological analysis laboratory (IMLCFC, IVML, IMLCFA, IMLCFM, IMLCFV, IMLCFIB and INCIFOR) on *post-mortem* samples from 862 drivers and 200 pedestrians killed in road accidents in 2023. Its purpose is to show the results of toxicological analyses relating to the presence of alcohol, drugs of abuse and psychopharmaceuticals and the incidence of the use of each of these three groups of substances either individually or in combination. The study also relates these toxicological findings to several epidemiological variables, such as gender, age, type of vehicle or the day of the week on which the fatal accident occurred. These data, like those presented in previous reports, provide highly pertinent information for those working in road accident prevention. Finally, a comparative study with *post-mortem* toxicological data obtained in previous years shows the evolution of some of the parameters evaluated.

The INTCF would like to express its sincere thanks to all INTCF and IMLCF staff of forensic doctors, medical doctors, specialist technicians and laboratory assistants

involved in the chemical-toxicological analyses related to these cases. In particular, we would like to 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 Díez and Mª Inmaculada Frías Tejera).

- We are also grateful to the following IMLCFs for their contribution in the collection and submission of *post-mortem* samples to the INTCF for analysis. Without this collaboration, it would not have been possible to prepare this report:
- Institute of Legal Medicine and Forensic Sciences of Andalusia
- Institute of Legal Medicine and Forensic Sciences of Castile-León
- Institute of Legal Medicine and Forensic Sciences of Castile-La Mancha
- Institute of Legal Medicine of Galicia (IMELGA)
- Institute of Legal Medicine and Forensic Sciences of the Community of Madrid
- Institute of Legal Medicine and Forensic Sciences of the Canary Islands
- Institute of Legal Medicine and Forensic Sciences of Extremadura
- Institute of Legal Medicine and Forensic Sciences of Navarre
- Institute of Legal Medicine and Forensic Sciences of Asturias
- Institute of Legal Medicine and Forensic Sciences of Cantabria
- Institute of Legal Medicine and Forensic Sciences of La Rioja

Institute of Legal Medicine and Forensic Sciences of Ceuta and Melilla

Our thanks also go to the ONSV for its work in the detailed review of each of the cases presented in accordance with the criteria established by the DGT.

As Director of the INTCF, I would also like to express my special thanks to the staff of the Computer Systems Section of the Madrid, Seville and Barcelona Departments for configuring and performing the statistical searches in the INTCF LIMS system and to Beatriz Ibor Alonso for her efforts in the compilation and final processing of all data.

Finally, I would like to thank the work of Antonio Alonso Alonso, Director of the INTCF until January 2024, who made this report what it is today, making the information available on the data website, and to Carolina Sánchez de la Torre Hernández, Director of the Madrid Department of the INTCF, promoter and reviewer of all the contents of this report on Toxicological Findings in Road Traffic Fatalities 2023.

Jorge González Fernández
Director of the INTCF

GENERAL DATA
(n = 1,197)

FIGURE 1: NUMBER OF FATALITIES (n = 1,197) ANALYSED BY THE DIFFERENT BODIES

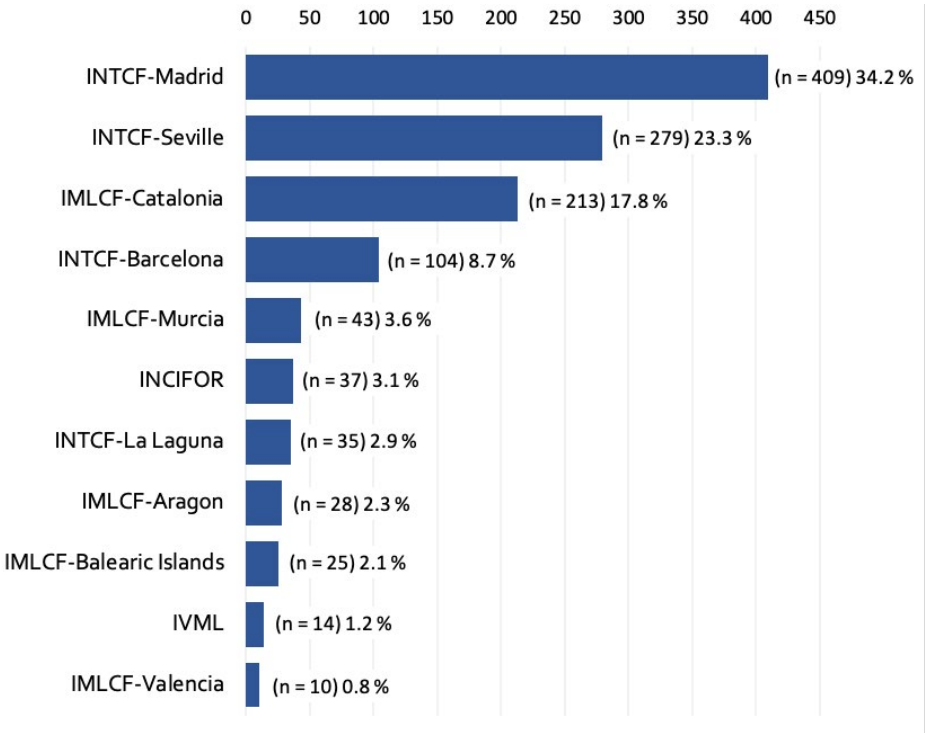


FIGURE 2: INTCF SCOPE OF ACTION

FIGURE 3: DISTRIBUTION BY AUTONOMOUS COMMUNITY
(Fatalities per 100,000 inhabitants)

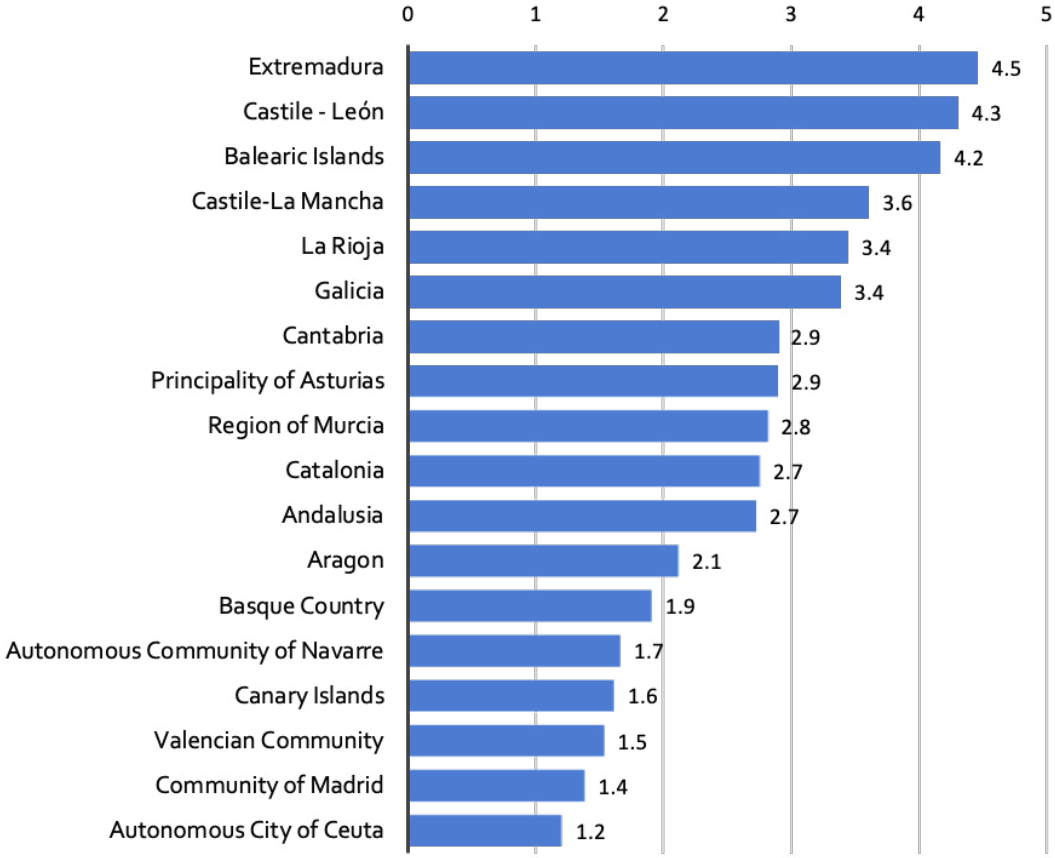
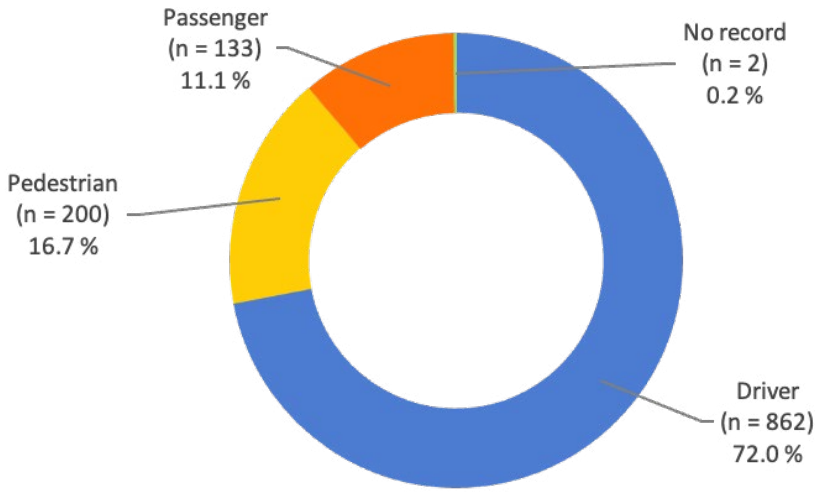


FIGURE 4: PERCENTAGE DISTRIBUTION OF THE NUMBER OF FATALITIES
(n = 1,197) BY ROLE IN THE INCIDENT



TOTAL NUMBER OF DRIVERS KILLED

(n = 862)

FIGURES 5 and 6: DISTRIBUTION BY GENDER AND AGE RANGE (862 DRIVERS)

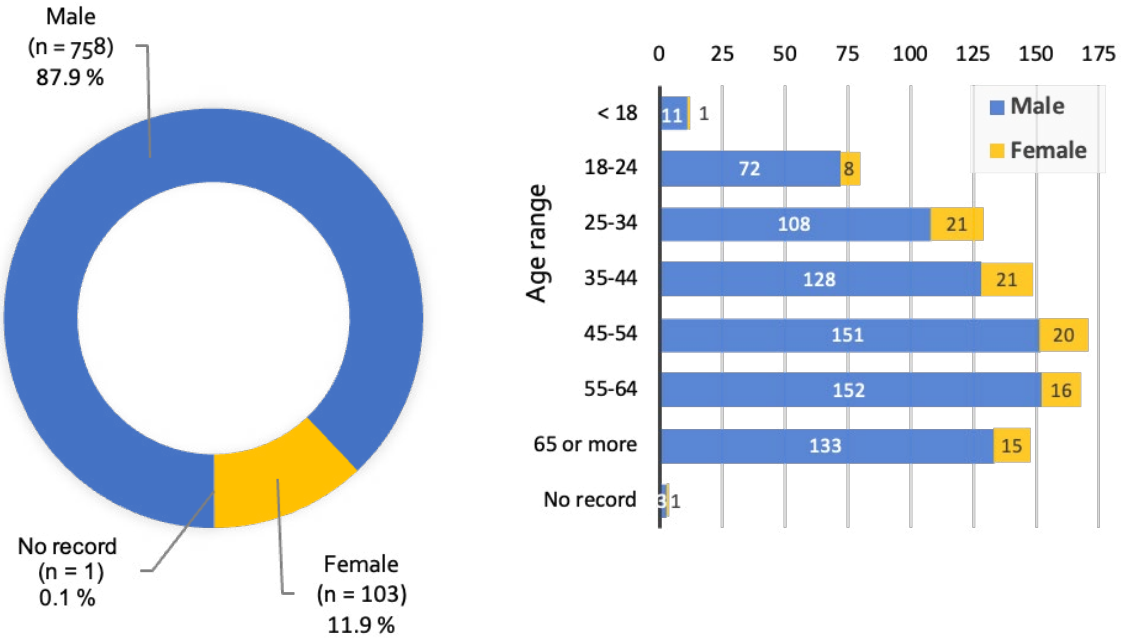


FIGURE 7: DISTRIBUTION BY TYPE OF VEHICLE (862 DRIVERS)

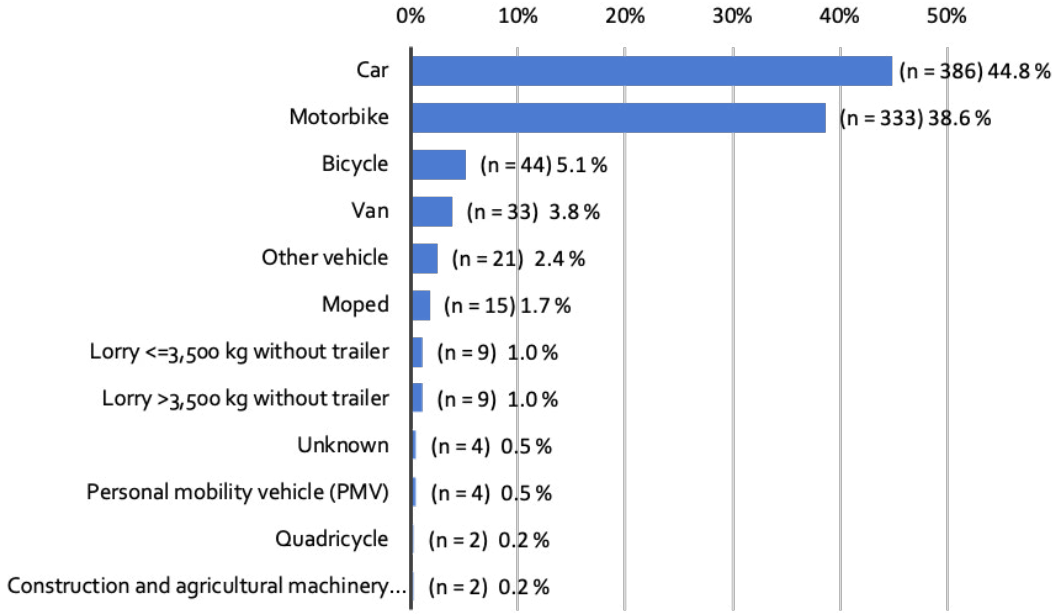


FIGURE 8 A: PERCENTAGE DISTRIBUTION ACCORDING TO TOXICOLOGY RESULT (862 DRIVERS) (blood alcohol threshold: 0.30 g/l)

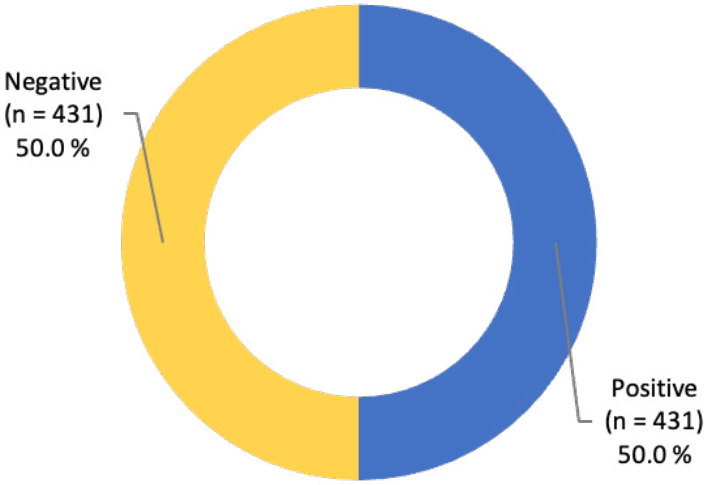
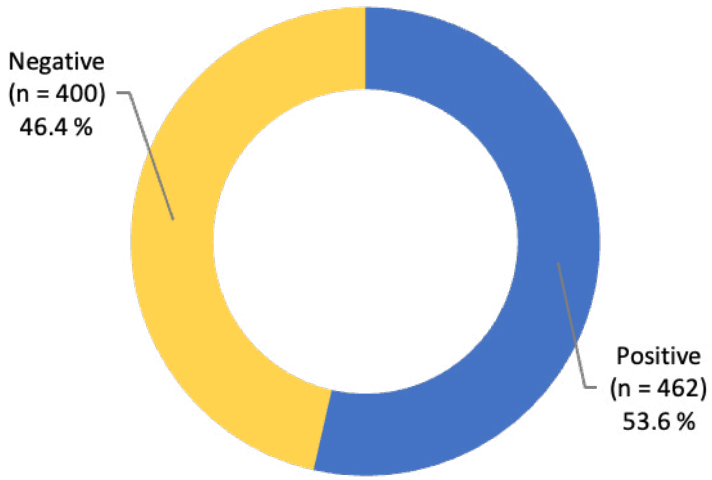


FIGURE 8 B: PERCENTAGE DISTRIBUTION ACCORDING TO TOXICOLOGY RESULT (862 DRIVERS) (blood alcohol threshold: 0.10 g/l)



In previous editions of this report, a positive result was considered as the presence of any drug of abuse or psychotropic drug, regardless of the quantity, or a blood alcohol concentration equal to or above 0.30 g/l (the BAC limit for novice and professional drivers) [1] detected above the detection thresholds, as shown in Figure 8 A.

Since the last edition of this report, as well as on the justice data web-based portal, we wanted to show total "positive" data according to strictly toxicological criteria and thresholds with respect to alcohol, i.e. including cases in which the presence of any drug of abuse or psychopharmaceuticals is detected, regardless of the quantity, or a

blood alcohol concentration above 0.10 g/l (as a detection threshold according to international criteria [2]), as shown in figure 8 B.

The aim is, therefore, to provide more objective scientific data and, at the same time, in accordance with the idea that "the only really safe alcohol level is 0.0 g/l", a criterion applied in Law 18/2021, of 20 December, which amends the consolidated text of the Traffic, Circulation of Motor Vehicles and Road Safety Act, approved by Royal Legislative Decree 6/2015, of 30 October, on the subject of points-based driving permits and licences [3] for underage drivers.

FIGURE 9: DISTRIBUTION ACCORDING TO TOXICOLOGY RESULT AND TYPE OF VEHICLE (862 DRIVERS)

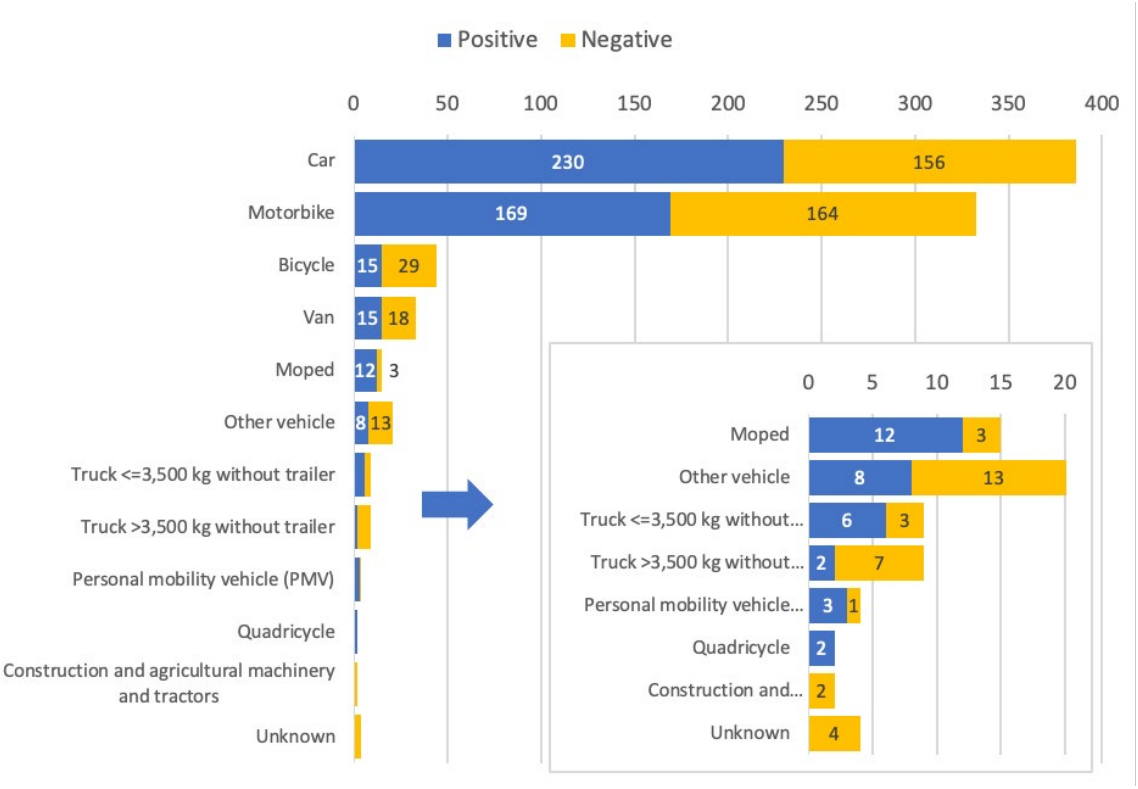


FIGURE 10: DRIVERS (n = 862).
PERCENTAGE DISTRIBUTION BY TYPE OF SUBSTANCE DETECTED
(without taking into account possible associations)
(alcohol detection threshold of 0.10 g/l))

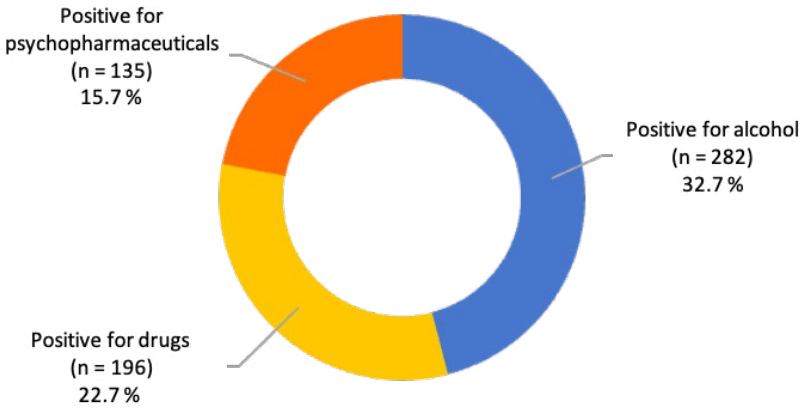
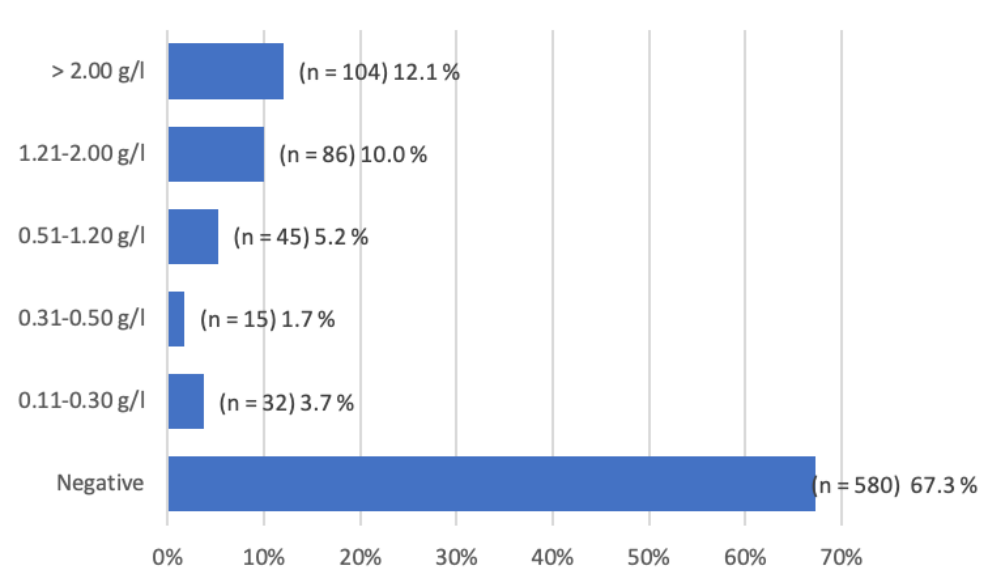
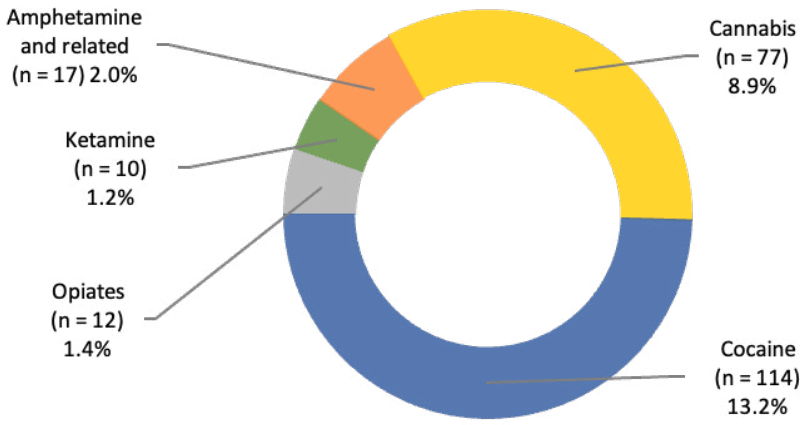


FIGURE 11: DRIVERS (n = 862).
DISTRIBUTION ACCORDING TO BLOOD ALCOHOL LEVEL



22.1 % of drivers had a BAC of 1.20 g/l or more.

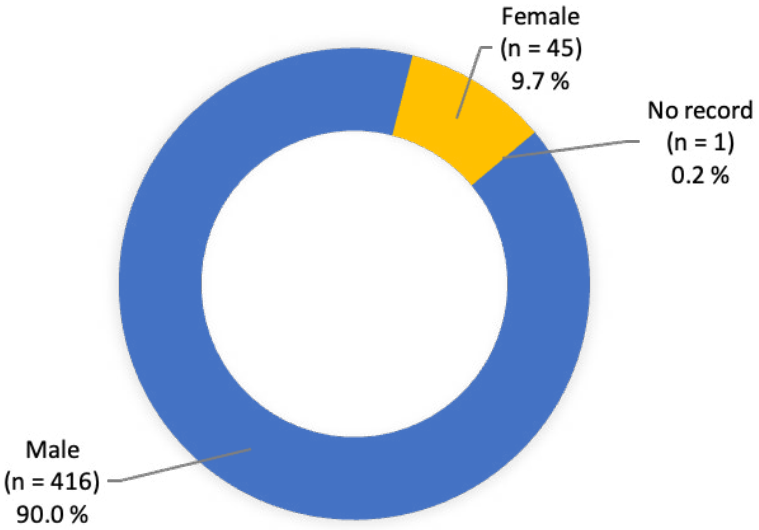
FIGURE 12: DRIVERS (n = 862).
PERCENTAGE DISTRIBUTION OF DRUGS DETECTED
(without taking into account possible associations)



Regardless of whether there was associated use of drugs of abuse, alcohol and/or psychopharmaceuticals, cocaine (**13.2 %**) was the most commonly used drug on its own, followed by cannabis (**8.9 %**).

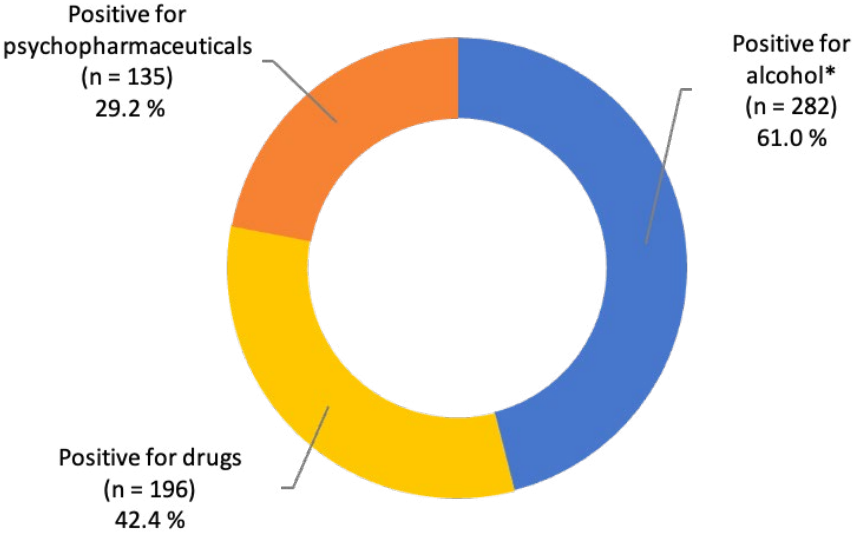
DRIVERS: CASES WITH POSITIVE TOXICOLOGICAL RESULTS (n = 462)

FIGURE 13: POSITIVE DRIVERS (n = 462).
PERCENTAGE DISTRIBUTION BY GENDER



Males accounted for **90.0 %** of drivers with positive drug tests.

FIGURE 14: POSITIVE DRIVERS (n = 462).
PERCENTAGE DISTRIBUTION BY TYPE OF SUBSTANCE DETECTED
(without taking into account possible associations)



* Positive for alcohol: blood alcohol concentration greater than 0.10 g/l

FIGURE 15: POSITIVE DRIVERS (n = 462).
CLASSIFICATION OF RESULTS ACCORDING TO THE TYPE AND/OR COMBINATION OF SUBSTANCES DETECTED

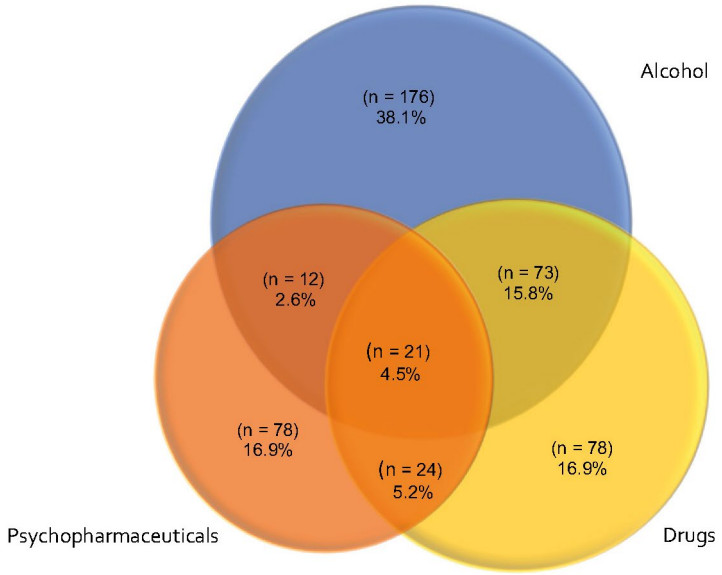
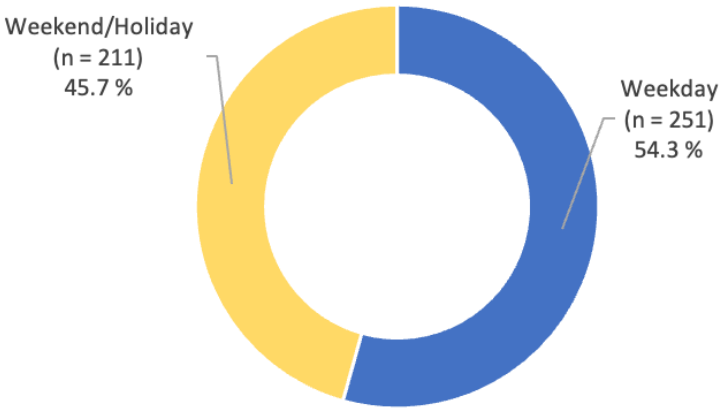


FIGURE 16: POSITIVE DRIVERS (n = 462).
DISTRIBUTION BY DAY OF THE WEEK



For the purposes of this report, weekends are considered to be from Friday at 22:00 to Monday at 08:00, as well as public holidays (local, regional and national holidays).

FIGURE 17: POSITIVE DRIVERS (n = 462).
PERCENTAGE DISTRIBUTION BY AGE RANGE AND DAY OF THE WEEK

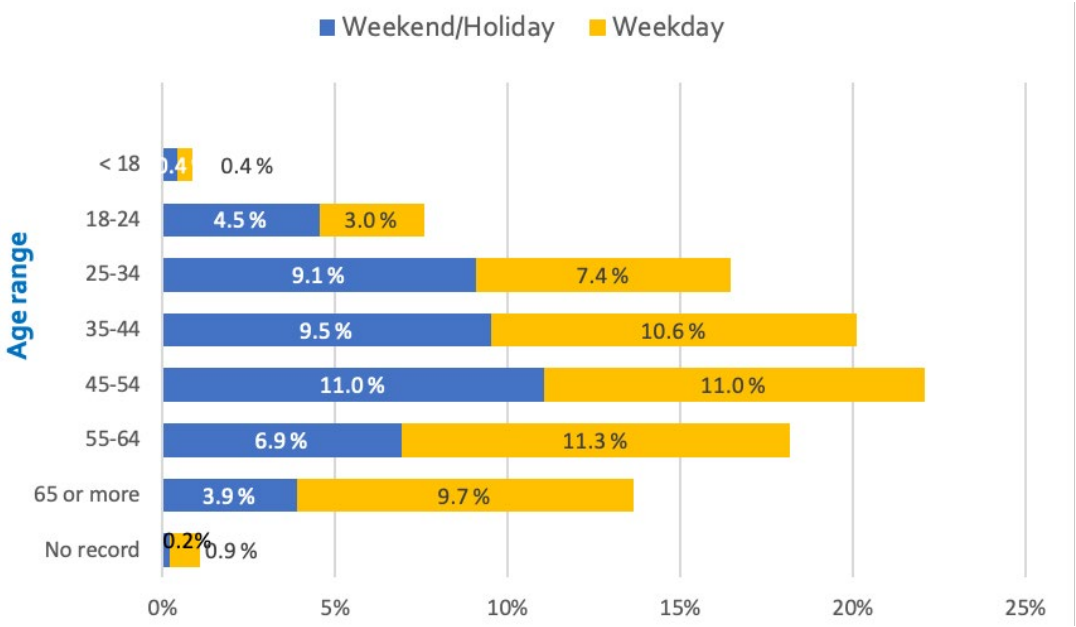


FIGURE 18: POSITIVE DRIVERS (n = 462).
DISTRIBUTION BY TYPE OF VEHICLEL

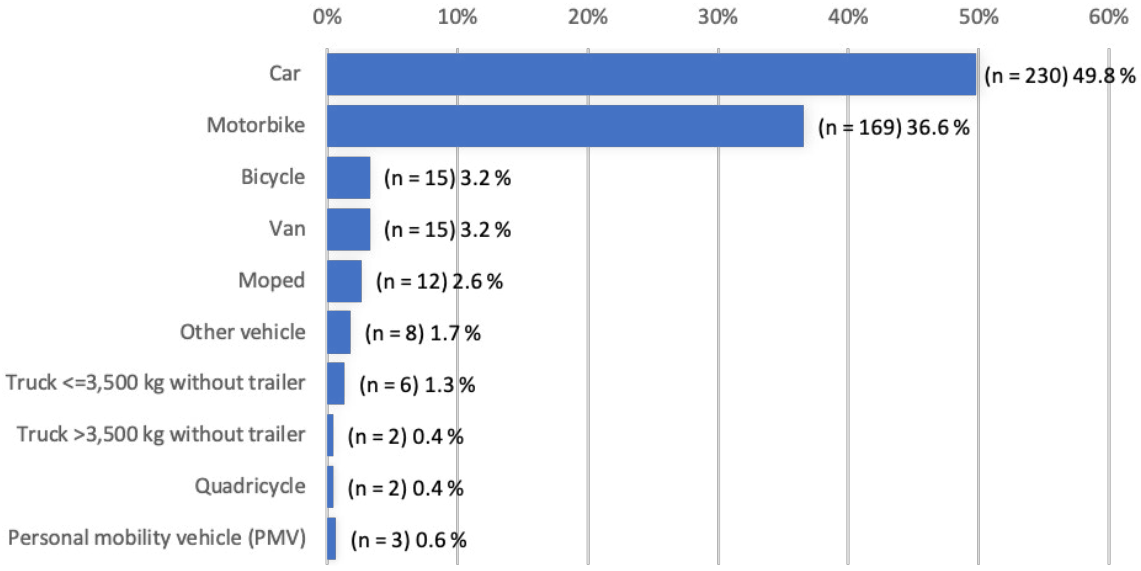
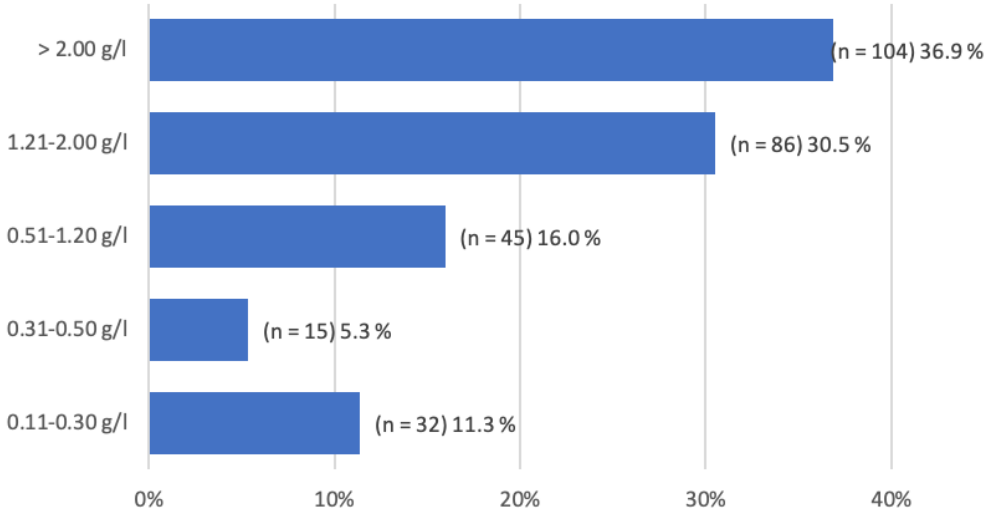
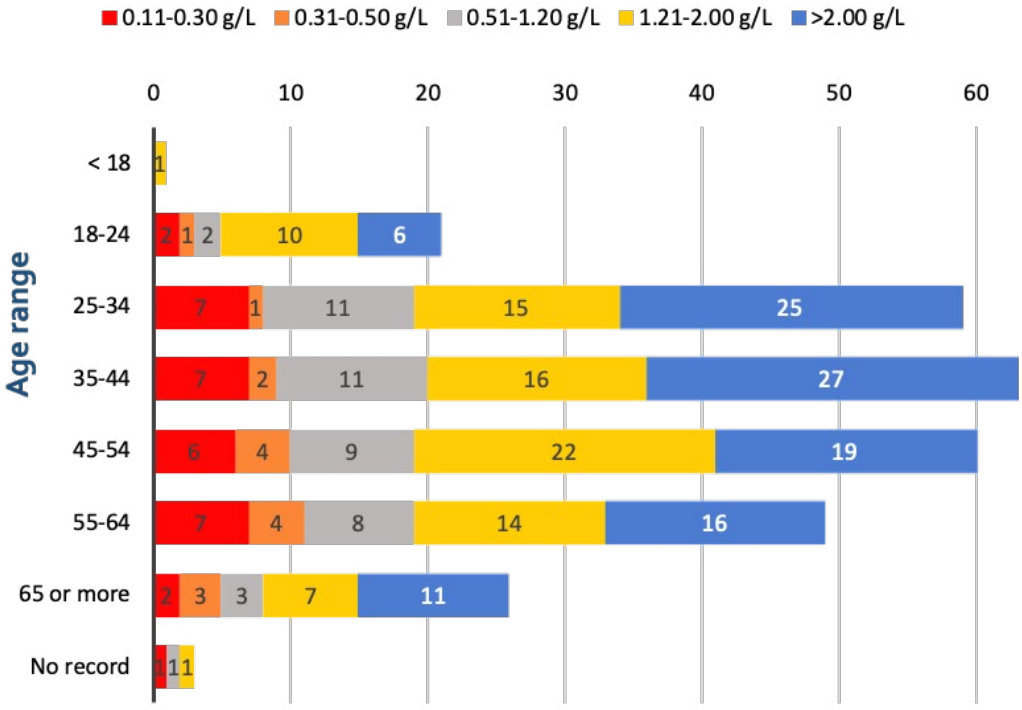


FIGURE 19: ALCOHOL POSITIVE DRIVERS (n = 282).
DISTRIBUTION ACCORDING TO BLOOD ALCOHOL LEVEL



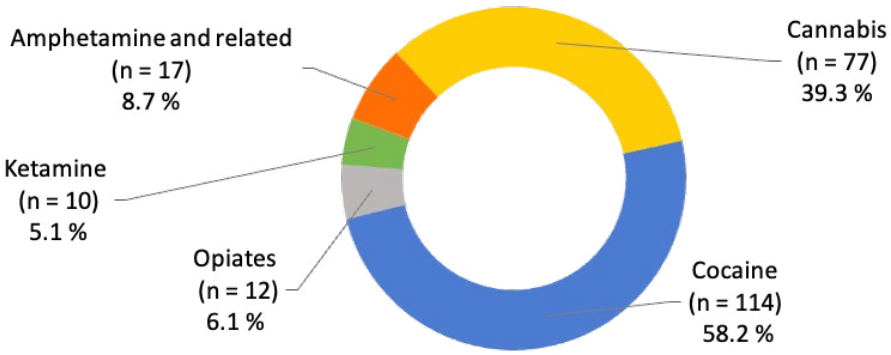
67.4 % of drivers who tested positive for alcohol had a BAC of over 1.20 g/l.

FIGURE 20: ALCOHOL POSITIVE DRIVERS (n = 282).
DISTRIBUTION ACCORDING TO BAC AND AGE RANGE



44.3 % of drivers who tested positive for alcohol with a BAC over 1.20 g/l are in the 25-54 age group.

FIGURE 21: DRUG POSITIVE DRIVERS (n = 196).
PERCENTAGE DISTRIBUTION OF DRUGS DETECTED
(without taking into account possible associations)



Regardless of whether there was associated use of drugs of abuse, alcohol and/or psychopharmaceuticals cocaine (**58.2 %**) was the most commonly used drug on its own, followed by cannabis (**39.3 %**).

FIGURE 22: DRUG POSITIVE DRIVERS (n = 196).
DISTRIBUTION ACCORDING TO DRUG DETECTED AND VEHICLE TYPE

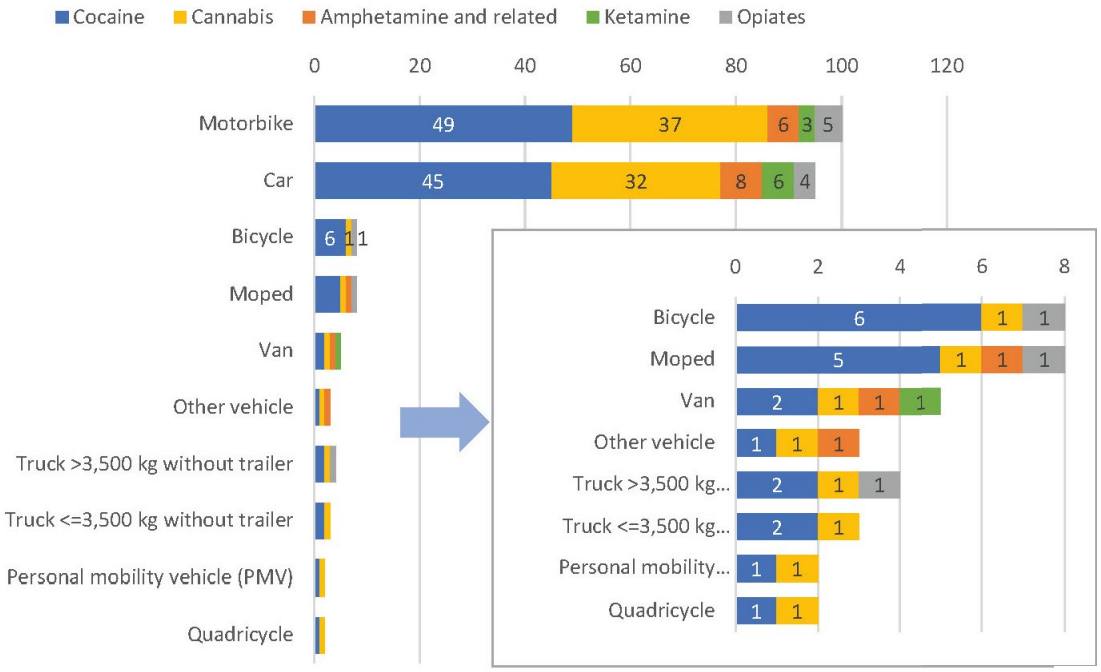
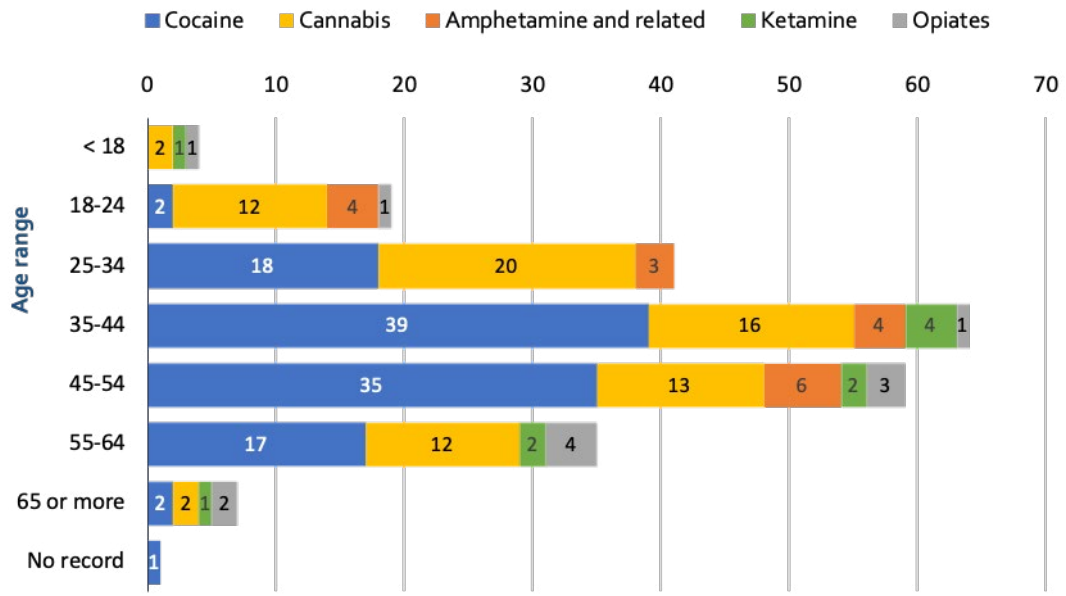


FIGURE 23: DRUG POSITIVE DRIVERS (n = 196).
DISTRIBUTION ACCORDING TO DRUG DETECTED AND AGE RANGE
(without taking into account possible associations)



The highest percentages are for cocaine (**46.9 %**) and/or cannabis use (**25.0 %**) in drivers between 25-54 years old. Cannabis was the most commonly used drug up to the age of **34**, while cocaine was the most commonly used drug in the **35-64** age group.

FIGURE 24: ALCOHOL AND DRUG POSITIVE DRIVERS (n = 94).
DISTRIBUTION OF CASES BY DRUG DETECTED. MOST FREQUENT COMBINATIONS

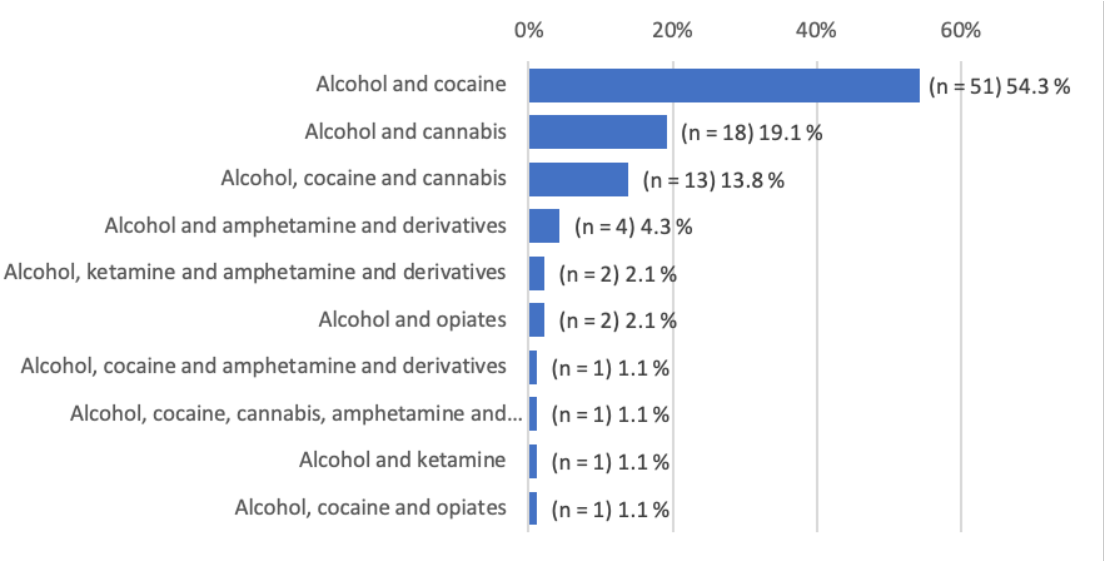
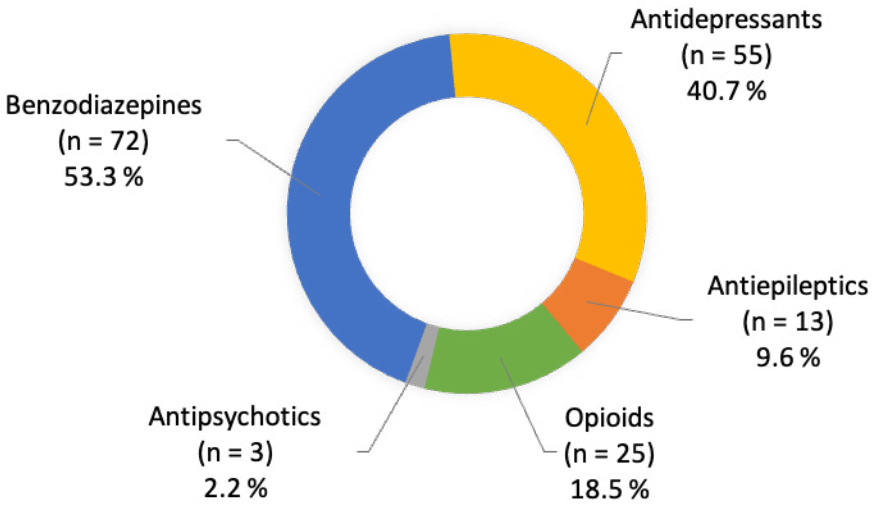


FIGURE 25: PSYCHOTROPIC DRUG POSITIVE DRIVERS (n = 135).
PERCENTAGE DISTRIBUTION OF PSYCHOPHARMACEUTICALS DETECTED
(without taking into account possible associations)



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

PEDESTRIANS (n = 200)

FIGURE 26: PEDESTRIANS (n = 200).
PERCENTAGE DISTRIBUTION BY GENDER

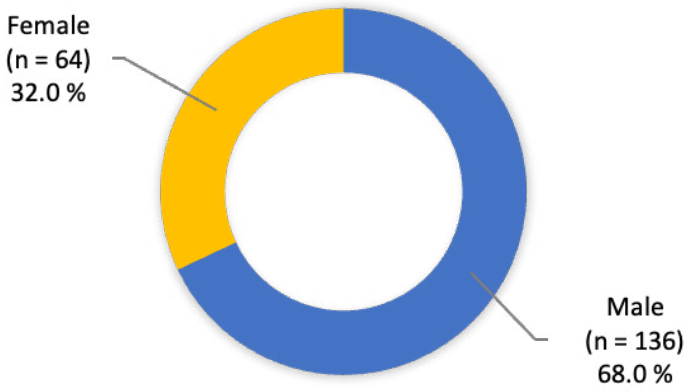


FIGURE 27: PEDESTRIANS (n = 200).
DISTRIBUTION BY AGE RANGE

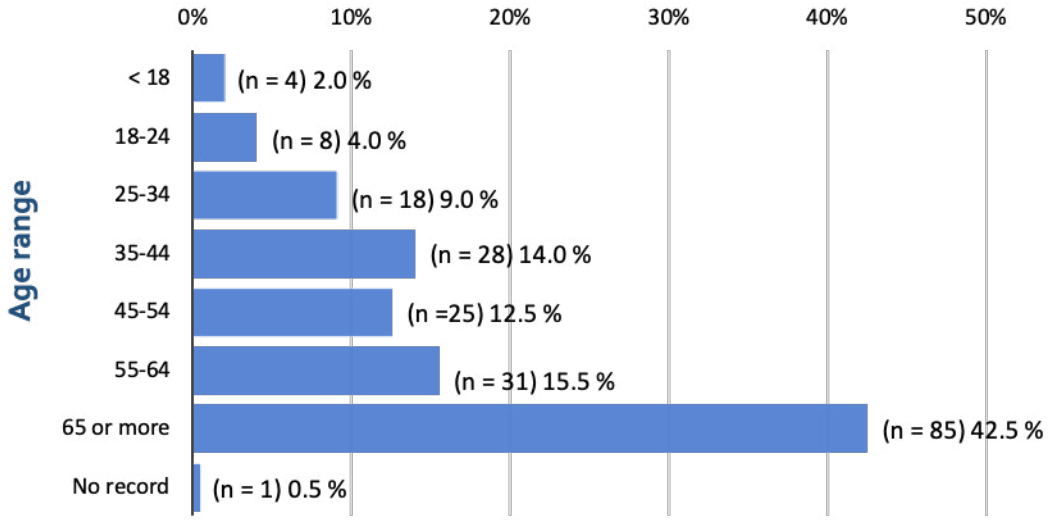
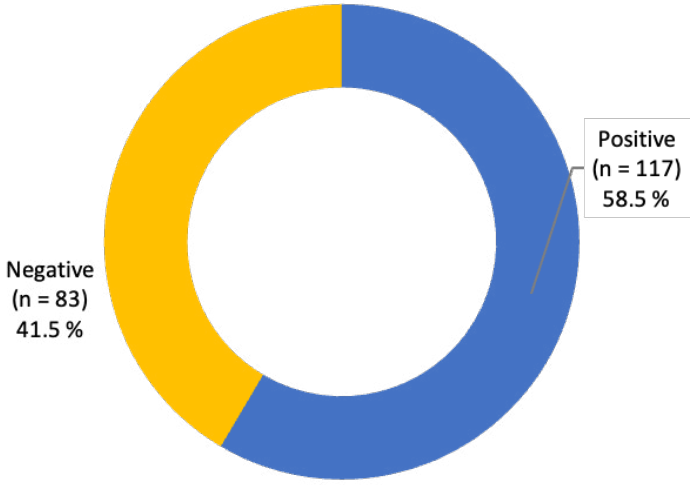
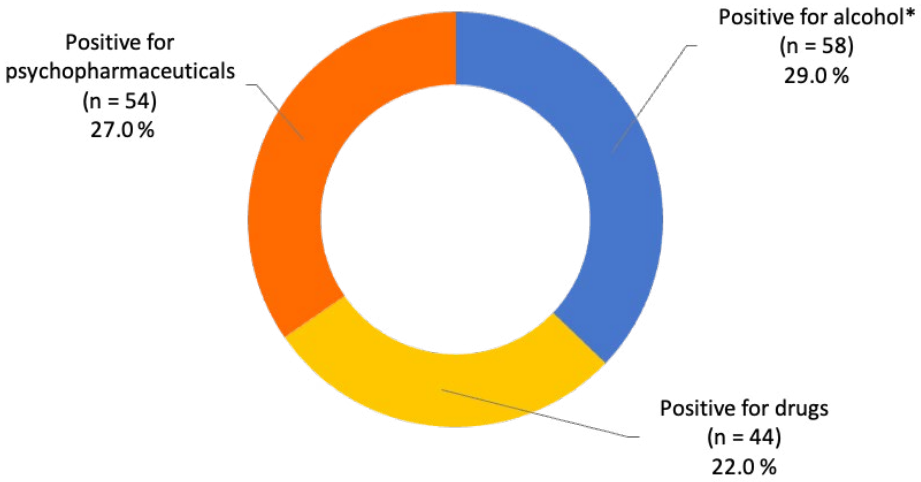


FIGURE 28: PEDESTRIANS (n = 200).
PERCENTAGE DISTRIBUTION ACCORDING TO TOXICOLOGY RESULT



Of 200 pedestrians killed in road traffic accidents and autopsied, 117 (**58.5 %**) tested positive for alcohol, drugs of abuse and psychopharmaceuticals, either alone or in combination.

FIGURE 29: PEDESTRIANS (n = 200).
PERCENTAGE DISTRIBUTION BY TYPE OF SUBSTANCE DETECTED
(without taking into account possible associations)



* Positive for alcohol: blood alcohol concentration greater than 0.10 g/l.

FIGURE 30: PEDESTRIANS (n = 200).
DISTRIBUTION ACCORDING TO BLOOD ALCOHOL LEVEL

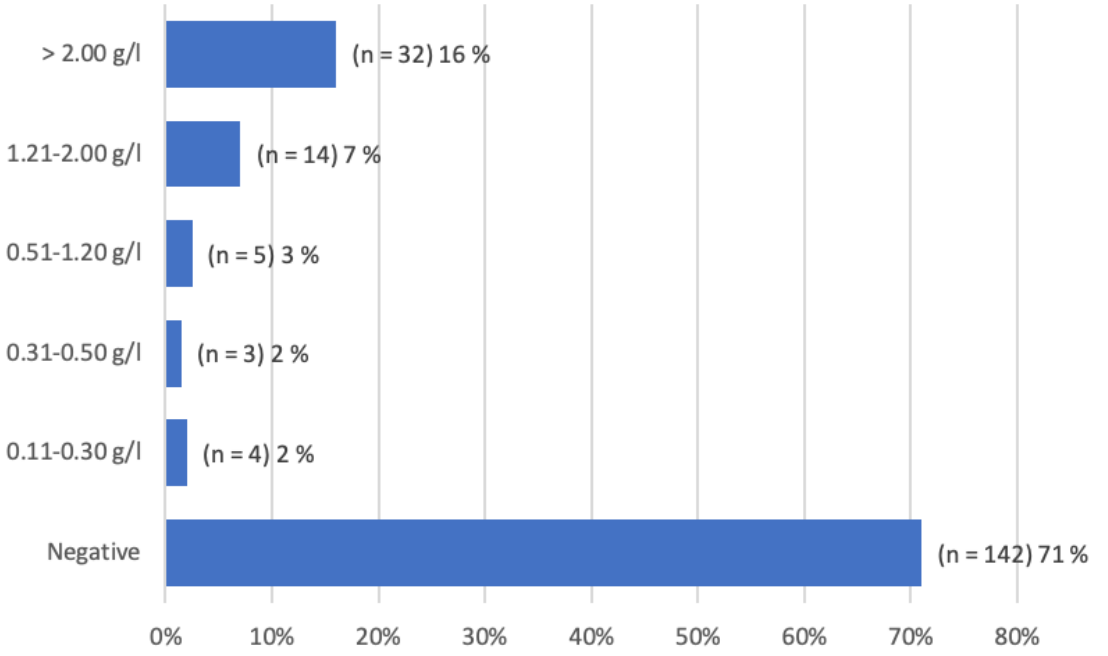
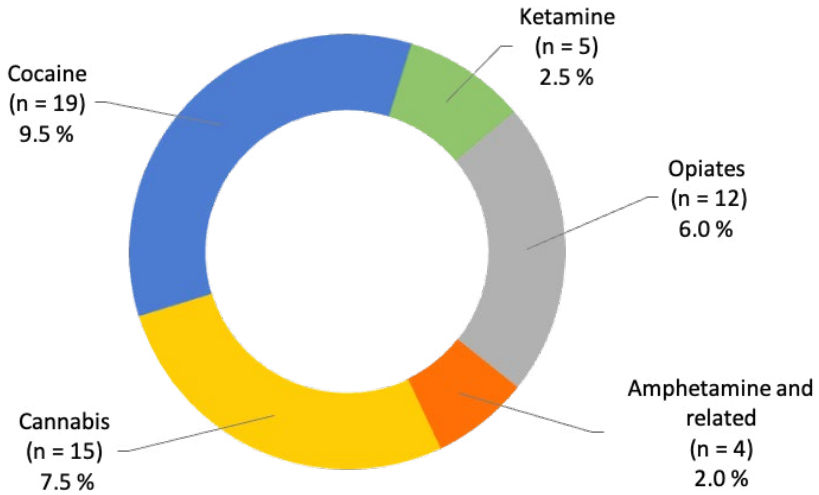
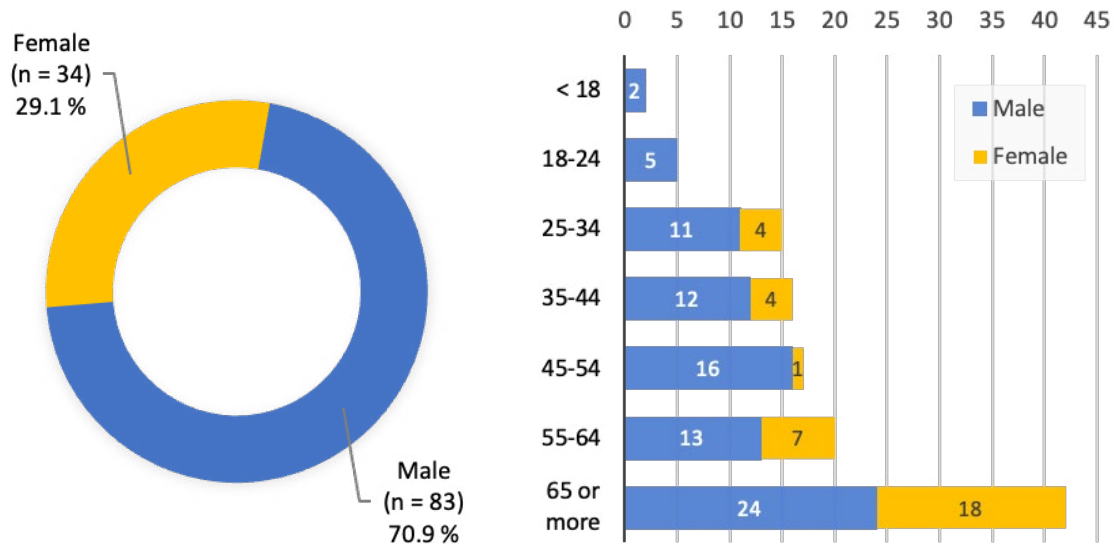


FIGURE 31: PEDESTRIANS (n = 200).
PERCENTAGE DISTRIBUTION OF DRUGS DETECTED
(without taking into account possible associations



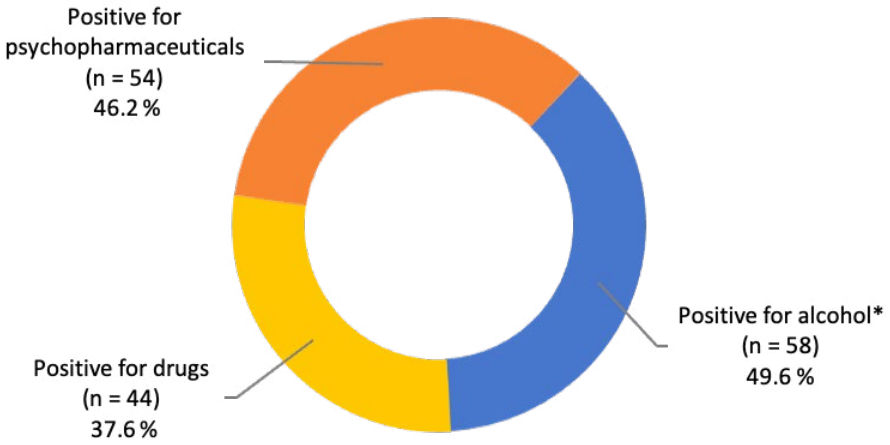
PEDESTRIANS. CASES WITH A POSITIVE TOXICOLOGICAL RESULT (n = 117)

FIGURES 32 and 33: POSITIVE PEDESTRIANS (n = 117). DISTRIBUTION BY GENDER AND AGE RANGE



70.9 % of pedestrians killed in traffic accidents with positive toxicology results were male.

FIGURE 34: POSITIVE PEDESTRIANS (n = 117). PERCENTAGE DISTRIBUTION BY TYPE OF SUBSTANCE DETECTED (without taking into account possible associations)



* Positive for alcohol: blood alcohol concentration greater than 0.10 g/l.

FIGURE 35: POSITIVE PEDESTRIANS (n = 117). CLASSIFICATION OF RESULTS ACCORDING TO THE TYPE AND/OR COMBINATION OF SUBSTANCES DETECTED

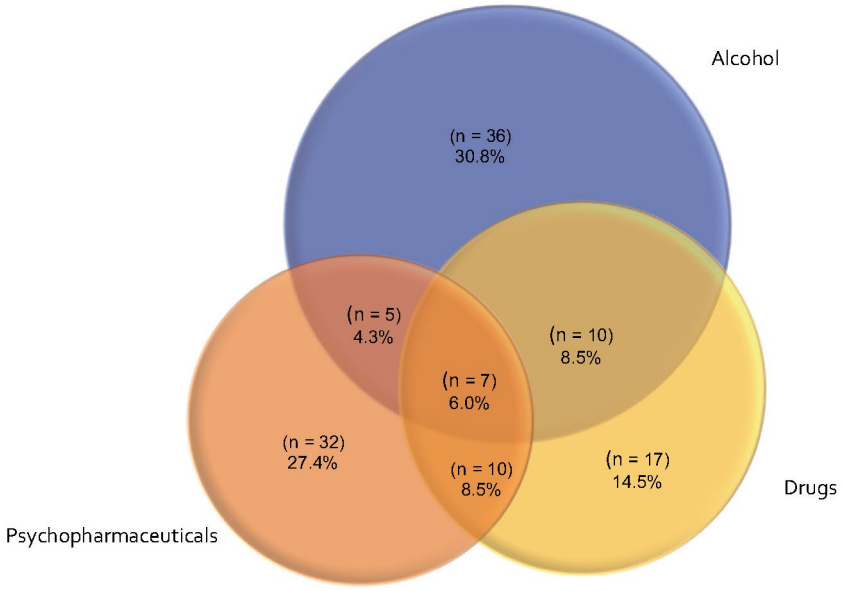
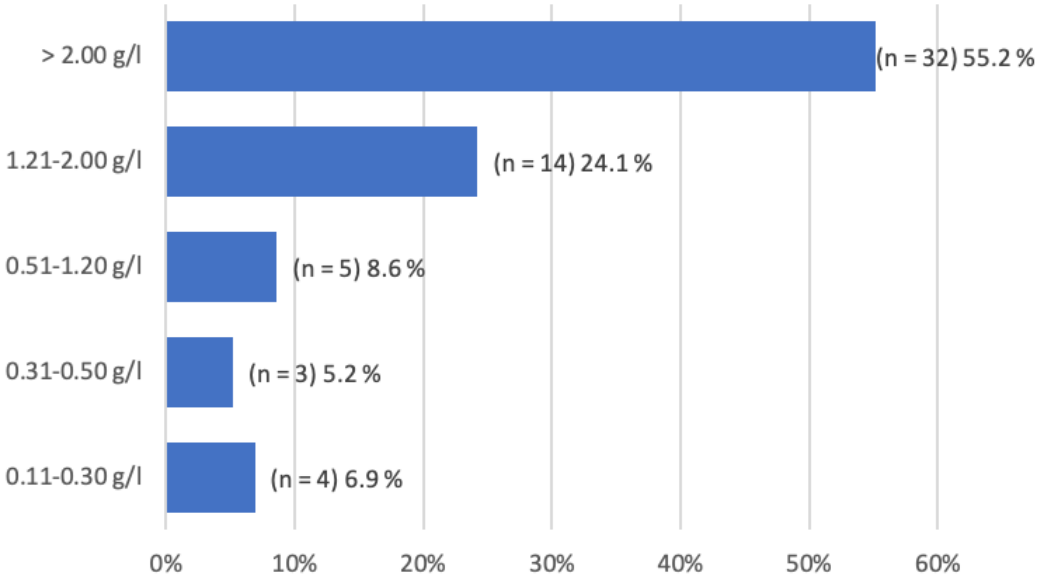


FIGURE 36: ALCOHOL POSITIVE PEDESTRIANS (n = 58). DISTRIBUTION ACCORDING TO BLOOD ALCOHOL LEVEL



79.3 % of deceased pedestrians who tested positive for alcohol had a BAC of 1.20 g/l or more.

FIGURE 37: ALCOHOL POSITIVE PEDESTRIANS (n = 58).
DISTRIBUTION ACCORDING TO BLOOD ALCOHOL LEVEL AND AGE

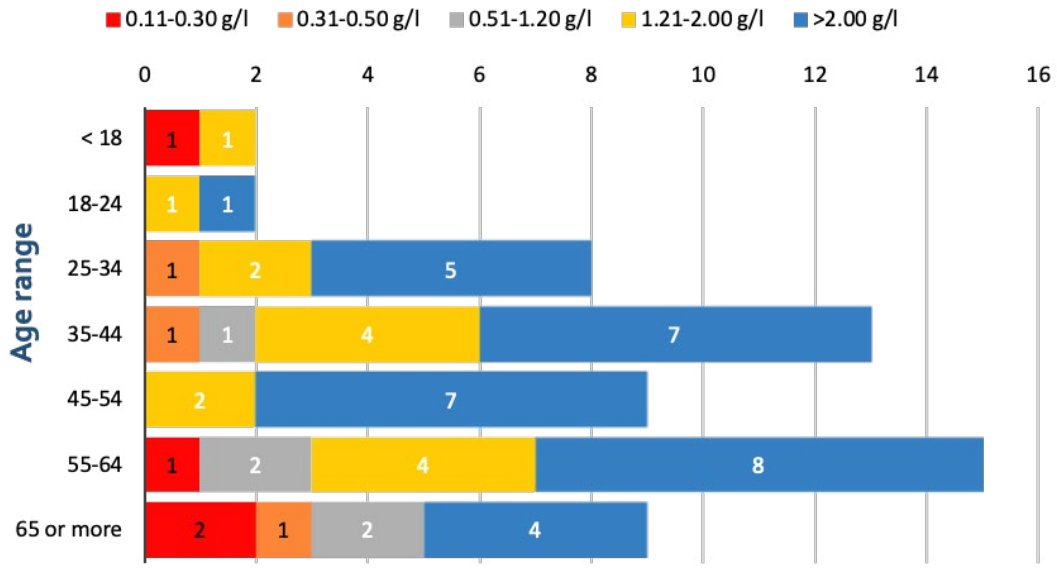
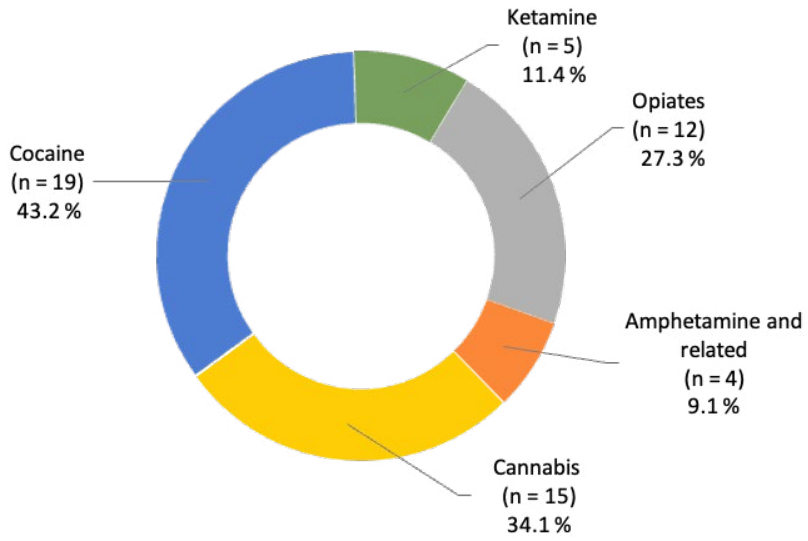


FIGURE 38: DRUG POSITIVE PEDESTRIANS (n = 44).
PERCENTAGE DISTRIBUTION OF DRUGS DETECTED
(without taking into account possible associations)



Regardless of whether there was associated use of drugs of abuse, alcohol and/or psychotropic drugs, cocaine alone was the most commonly used drug (**43.2 %**).

FIGURE 39: DRUG POSITIVE PEDESTRIANS (n = 44).
DISTRIBUTION ACCORDING TO DRUG DETECTED AND AGE RANGE
(without taking into account possible associations)

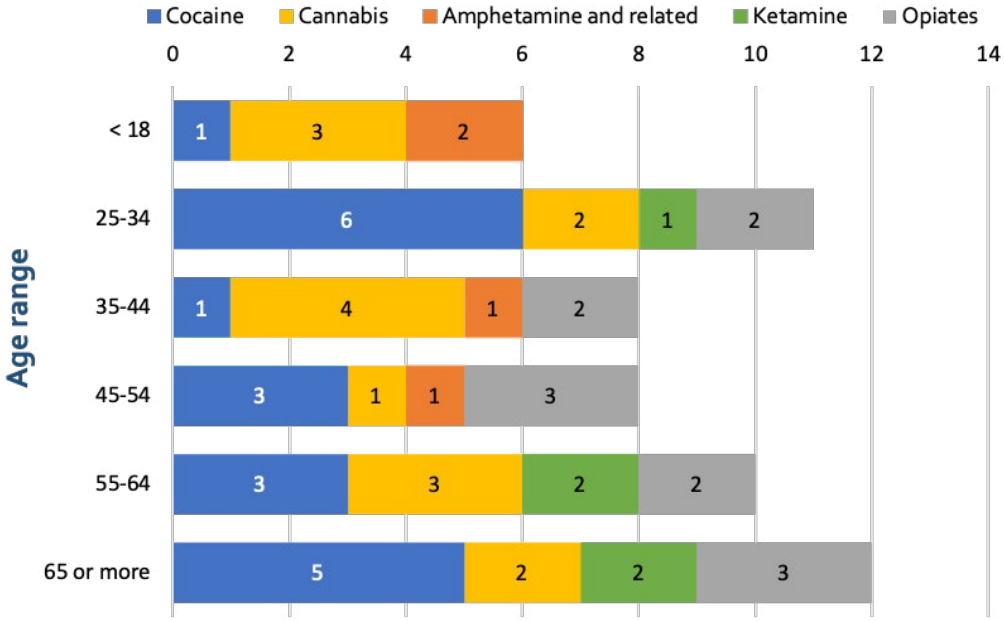
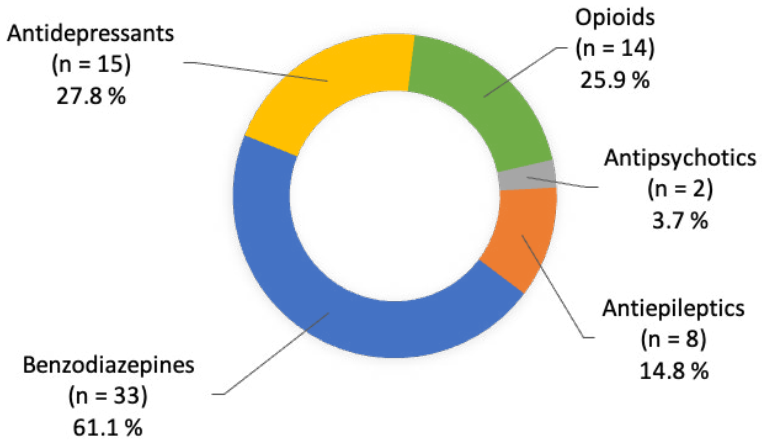


FIGURE 40: PSYCHOTROPIC DRUG POSITIVE PEDESTRIANS (n = 54).
PERCENTAGE DISTRIBUTION OF PSYCHOPHARMACEUTICALS DETECTED



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

COMPARATIVE STUDY IN RELATION TO PREVIOUS YEARS

FIGURE 41: EVOLUTION OVER TIME OF THE PERCENTAGE OF DRIVERS ACCORDING TO TOXICOLOGY RESULT
(blood alcohol threshold: 0.30 g/l)

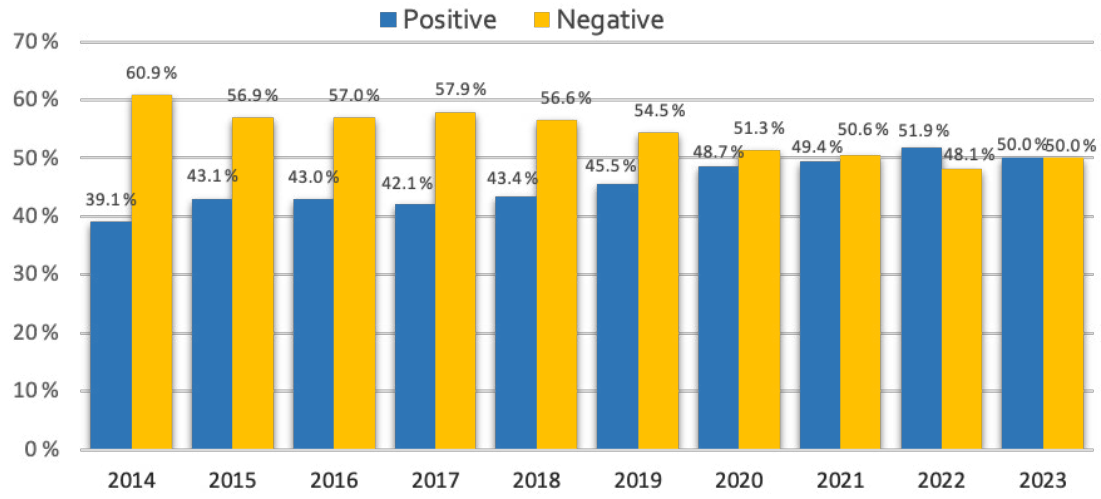


FIGURE 42: EVOLUTION OVER TIME OF THE PERCENTAGE OF PEDESTRIANS ACCORDING TO TOXICOLOGY RESULT

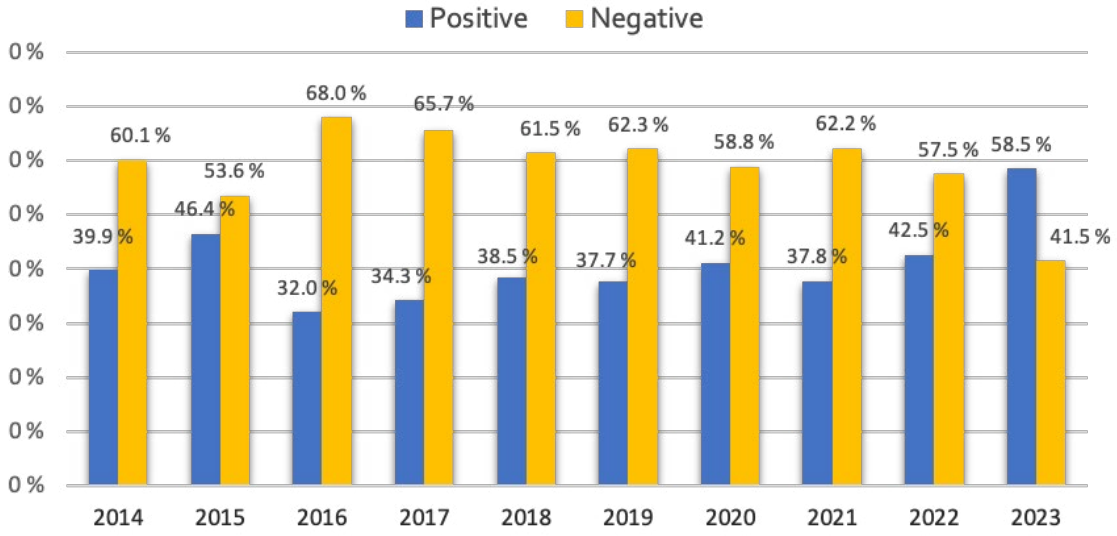
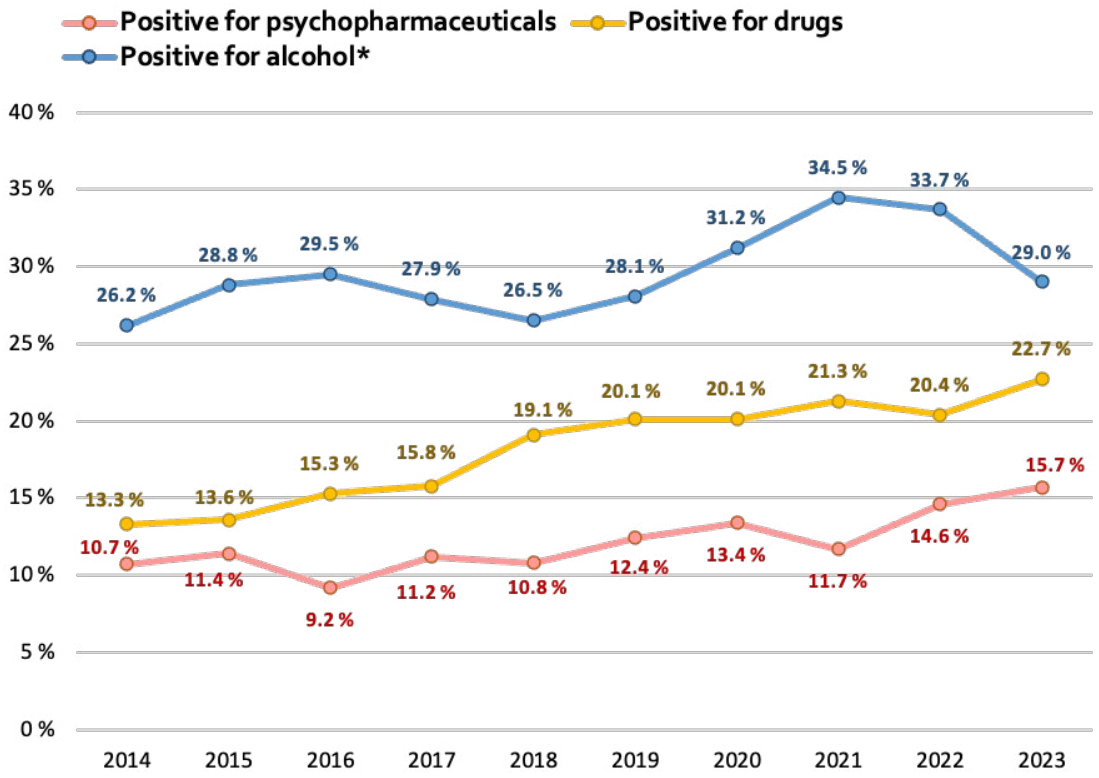


FIGURE 43: EVOLUTION OVER TIME OF THE PERCENTAGE OF POSITIVE DRIVERS ACCORDING TO TOXICOLOGY RESULT



* Positive for alcohol: blood alcohol concentration of 0.30 g/l or more.

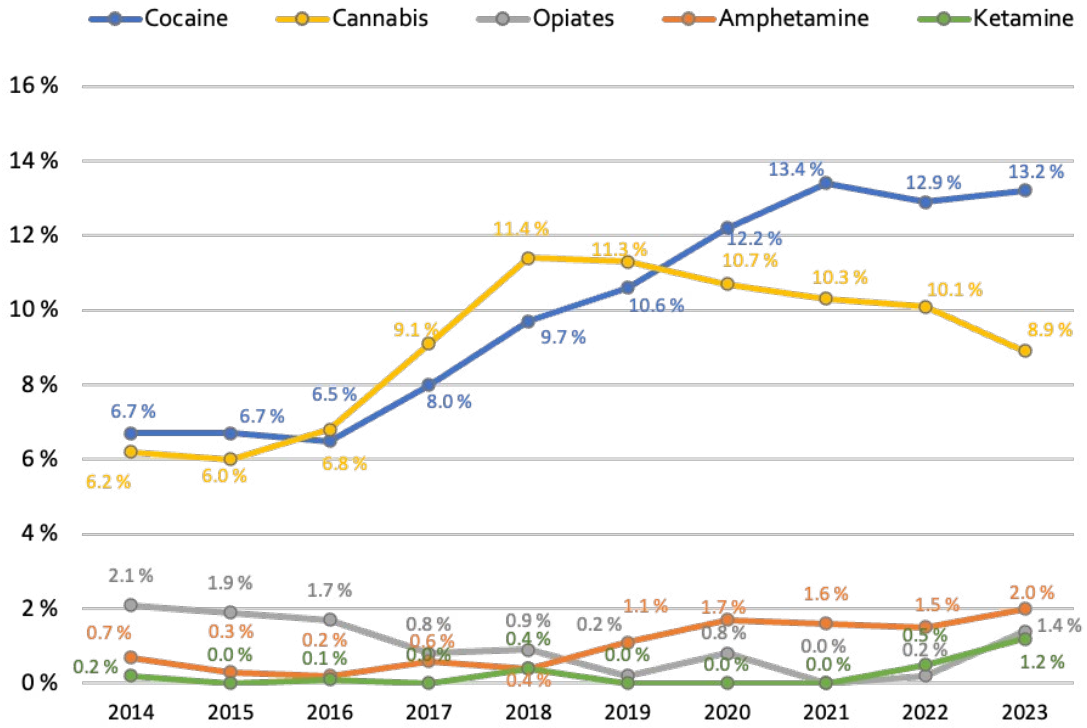
The comparative study of the last ten years for the number of drivers with positive toxicology results shows an increase of **10.9 %** in 2023 compared to 2014.

With regard to alcohol consumption, 2023 saw a **4.7 %** drop in the number of drivers killed in road accidents compared to 2022.

An upward trend is observed in drug use, with a **9.4 %** increase compared to in 2014 and **2.3 %** up compared to 2022.

Finally, there is a **1.1 %** increase for psychopharmaceuticals compared to 2022.

FIGURE 44: EVOLUTION OVER TIME OF THE PERCENTAGE OF POSITIVE DRIVERS BY DRUG TYPE



Since 2016, there has been a marked upward trend (**6.7 %**) in cocaine use among drivers who died in road traffic accidents. Cannabis use rose by **4.6 %** between 2016 and 2018, with a downward trend of **2.5 %** from 2018 to 2023.

FINAL CONSIDERATIONS

SUMMARY OF FINAL OBSERVATIONS WITH THE GREATEST MEDICAL-LEGAL AND SOCIAL IMPACT

Data obtained and presented in the report lead us to draw the following conclusions that have the greatest impact, not only in the medical-legal sphere but also because of their significant impact in terms of road safety.

DRIVERS

Alcohol continues to be the most commonly detected substance in driver fatalities, followed by cocaine and cannabis, and, thirdly, by psychopharmaceuticals. Moreover, in 2023 there is a decrease in the detection of alcohol and an increase in drugs of abuse and psychotropic drugs among drivers killed in road accidents compared to 2022.

Of the 862 drivers killed in road accidents and subjected to autopsy and toxicological analysis, 462 drivers, i.e. 53.6 % (figure 8 B) tested positive for alcohol (blood alcohol threshold 0.10 g/l), drugs of abuse and/or psychotropic drugs, either alone or in combination, compared to 52.8 % in 2022.

The slight increase of 0.8 % in 2023 compared to 2022 in drivers with a positive toxicological result is due to an increase in the detection of drugs of abuse (22.7 % versus 20.4 %) and psychopharmaceuticals (15.7 % versus 14.6 %), while alcohol detected among drivers fell (32.7 % versus 35.5 %) (figure 10).

Drivers who died with positive toxicological results were predominantly male.

An overwhelming majority of cases (90.0 %) with positive toxicological results were male drivers and only 9.7 % were female drivers (figure 13), which is obviously an epidemiological fact of great significance in the development of road accident prevention campaigns.

Most drivers with positive toxicological results were driving a passenger car or motorbike.

Therefore, 49.8 % of positive drivers were driving a passenger car and 36.6 % were riding a motorbike (figure 18).

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

58.5 % of drivers with positive toxicological results were in the 25-54 age group (figure 17).

In the 18-34 age group, fatal accidents involving drivers with positive toxicological results occurred most frequently on Saturdays, Sundays and holidays. In the age range of drivers between 45 and 54, fatal accidents occur with the same distribution on weekdays and holidays, while the incidence is higher on weekdays in the 55 to 64 age range.

54.3 % of fatal accidents involving drivers testing positive nationwide occurred on weekdays, while the remaining 45.7 % occurred on Saturdays, Sundays and holidays, regardless of age group (figure 16). In the 18-34 age group, more drug-positive driver fatalities occurred on Saturdays, Sundays and holidays (13.6 % compared to 10.4 % on weekdays) while in the 55-64 age group, fatalities occurred more on weekdays (11.3 % compared to 6.9 % on Saturdays, Sundays and holidays).

Alcohol is still the most commonly detected substance in drivers killed with positive toxicological results. Most deceased drivers who tested positive for alcohol had a very high BAC level of 1.20 g/l or higher, which correlates with very severe intoxication.

The percentage distribution within the group of drivers killed with positive toxicological results (n = 462) according to the type of substance detected was as follows: 61.0 % were positive for alcohol (threshold above 0.10 g/l), 42.4 % were positive for drugs and 29.2 % were positive for psychotropic drugs (figure 14).

It is worth noting that 67.4 % of deceased drivers who tested positive for alcohol had a very high BAC level, equal to or higher than 1.20 g/l, which correlates with very severe intoxication (figure 19).

Overall data for the whole of Spain indicate that the drug of abuse most detected among deceased drivers was cocaine, followed by cannabis. Cannabis, however, was the most detected drug in the <18-24 age group, while cocaine was the most detected drug in the 35-64 age group.

With regard to cases testing positive for drugs of abuse (n = 196), and regardless of whether there was associated use of drugs of abuse, alcohol and/or psychopharmaceuticals, cocaine alone was the most detected drug nationwide (58.2 %), followed by cannabis (39.3 %) (figure 21). Cannabis was the most commonly detected drug in the <18-24 age group, while cocaine was the most commonly detected drug in the 35-64 age group (figure 23).

Overall data indicate that the most commonly detected psychopharmaceuticals in drivers killed were benzodiazepines, followed by antidepressants, opioids and antiepileptics.

The percentage distribution within the group of drivers killed with positive results for psychopharmaceuticals (n = 135) according to the type of substance detected was as follows: 53.3 % were positive for benzodiazepines, 40.7 % were positive for antidepressants, 18.5 % for opioids, and 9.6 % for antiepileptic drugs alone or in combination (figure 25).

The most prevalent associated alcohol and drugs of abuse findings were, firstly, the simultaneous presence of alcohol and cocaine, followed by the simultaneous presence of alcohol and cannabis, and alcohol, cocaine and cannabis.

The most prevalent simultaneous alcohol and drugs of abuse (n = 94) were, firstly, alcohol and cocaine together (54.3 %), followed by alcohol and cannabis together (19.1 %), and alcohol, cocaine and cannabis (13.8 %) (figure 24).

The comparative study of the last ten years for the number of drivers with positive toxicological results shows an increase in 2023 compared to 2014.

The comparative study of the last ten years for the number of drivers with positive toxicological results shows an increase of 10.9 % in 2023 compared to 2014 (figure 41).

Alcohol consumption fell by 4.7 % in 2023 compared to 2022.

An upward trend is observed in drug use, with a 9.4 % increase compared to 2014 and a rise (2.3 %) compared to 2022.

Finally, there is an increase (1.1 %) for psychopharmaceuticals compared to 2022 (figure 43).

Since 2016, there has been a marked upward trend (6.7 %) in cocaine use among drivers who died in road traffic accidents. Cannabis use rose by 4.6 % between 2016 and 2018, with a downward trend of 2.5 % from 2018 to 2023 (figure 44).

PEDESTRIANS

In 2023, there is a 16.0 % rise in the proportion of pedestrians killed in road traffic accidents with positive toxicological results for alcohol, drugs of abuse and/or psychopharmaceuticals, alone or in combination, compared to 2022.

Of 200 pedestrians killed in road traffic accidents and autopsied, 41.5 % tested positive for alcohol, drugs of abuse and psychopharmaceuticals, either alone or in combination (figure 28).

The gender distribution of pedestrian fatalities with positive toxicological results is different from the distribution of driver fatalities. 70.9 % of pedestrian fatalities with positive toxicology results are male and 29.1 % are female (figure 32).

Distribution by age range revealed a higher prevalence among pedestrians aged 65 years and over (35.9 %) (figure 33).

Alcohol and psychopharmaceuticals are still the substances most commonly detected in pedestrian road traffic fatalities, followed by drugs of abuse.

The highest prevalence of pedestrians testing positive was for alcohol (49.6 %) and psychotropic drugs (46.2 %) followed by drugs of abuse (37.6 %) (figure 34).

Most deceased pedestrians who tested positive for alcohol had a very high BAC level of 1.20 g/l or higher, which correlates with very severe intoxication.

It is noteworthy that 79.3 % of deceased pedestrians who tested positive for alcohol had a BAC of 1.20 g/l or more (figure 36).

Overall data indicate that the most commonly detected psychopharmaceuticals in pedestrians killed were benzodiazepines, followed by antidepressants, opioids and anti-epileptics.

The percentage distribution within the group of pedestrians killed with positive results for psychopharmaceuticals (n = 54) according to the type of substance detected was as follows: 61.1 % were positive for benzodiazepines, 27.8 % were positive for antidepressants, 25.9 % for opioids, and 14.8 % were positive for antiepileptic drugs (figure 40).

METHODOLOGY

1. NATIONAL INSTITUTE OF TOXICOLOGY AND FORENSIC SCIENCES

1.1. Analytical techniques used and participation in intercomparison exercises

Analytical techniques used

- Enzyme immunoassay.
- Headspace gas chromatography with flame ionisation detection (HS-GC-FID).
- High-performance liquid chromatography with diode-array detector (HPLC-DAD).
- Gas chromatography coupled with mass spectrometry (GC-MS).
- Gas chromatography coupled with tandem mass spectrometry (GC-MSMS).
- Ultra performance liquid chromatography paired with tandem mass spectrometry (UPLC-MSMS).
- Liquid chromatography coupled with high resolution mass spectrometry (LC-HRMS).

All reported results for drugs and psychopharmaceuticals [4] have been confirmed by analytical techniques based on mass spectrometry [5-14].

All analytical results have been obtained within the quality system implemented at the INTCF in accordance with the **ISO 17025** standard; INTCF, specifically, is accredited by the **National Accreditation Body** (**ENAC**) for the quantitative determination of ethyl alcohol in biological fluids, among other analyses [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 external evaluation of the competence of our laboratories in this type of drug of abuse testing.

TABLE 1: PARTICIPATION IN INTERCOMPARISON EXERCISES OF THE CHEMISTRY AND DRUGS SERVICES OF THE DIFFERENT INTCF DEPARTMENTS

	Barcelona	Madrid	Seville	La Laguna
Programme: Blood Alcohol Intercomparison Exercise **Organiser:** INTCF Seville **Frequency:** every four months **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:** every four months **Parameters/samples**ethyl alcohol, volatile compounds and ethylene glycol in blood	X	X		
Programme: Toxicology **Organiser:** LGC Standards **Frequency:** yearly **Parameters/samples**Identification and quantification of ethanol in blood			X	
Programme: Vitreous Fluid (VF) **Organiser:** College of American Pathologists **Frequency:** biannual **Parameters/samples:** ethyl alcohol, potassium and sodium in vitreous humour		X		
Programme: Forensic Toxicology Criminalistics (FTC) **Organiser:** College of American Pathologists **Frequency:** biannual **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 psychopharmaceuticals in blood		X	X	X
Programme: Blood Drug Analysis (CTS-5661) **Organiser:** Collaborative Testing Services **Frequency:** yearly **Parameters/samples** drugs of abuse and psychopharmaceuticals 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

Analytical techniques used

- Enzyme immunoassay.
- Headspace gas chromatography with flame ionisation detection (HS-GC-FID), detection and quantification of ethanol.
- Gas chromatography coupled with mass spectrometry (GC-MS), detection and quantification of drugs of abuse and psychotropic drugs.
- High-performance liquid chromatography coupled with tandem mass spectrometry (HPLC-MSMS), detection and quantification of drugs of abuse and psychotropic drugs.

The IMLCFC has participated in the following intercomparison exercises in 2023:

- Blood Ethyl Alcohol Intercomparison Exercise (BAIE) organised by the INTCF Seville Department.
- UNODC-BS: detection of psychoactive substances in urine (2 exercises).
- LGC STANDARDS: detection and quantification of drugs, psychotropic drugs, carboxyhaemoglobin, paracetamol, alcohol and volatiles (14 exercises).

3. BASQUE INSTITUTE OF FORENSIC MEDICINE

3.1. Analytical techniques used and participation in intercomparison exercises

Analytical techniques used

- Enzyme immunoassay.
- Headspace gas chromatography with flame ionisation detection (HS-GC-FID).
- Ultra performance liquid chromatography paired with tandem mass spectrometry (UPLC-MSMS).

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

Analytical results for ethanol have been obtained with a method validated internally by the laboratory using a double column for confirmation. Results are always checked against certified reference material and the inter-laboratory exercises they take part in.

Analytical results for drugs of abuse have always been obtained using methods tested with certified reference material and the inter-laboratory exercises they take part in.

The IVML has participated in the following intercomparison exercises in 2023:

- Blood and Plasma Ethyl Alcohol Intercomparison Exercise. Organised by: INTCF Seville. Frequency: four-monthly. Parameters/samples: ethyl alcohol and other volatile compounds in blood and plasma.
- Toxicology Programme. Organised by: LGC Standards. Frequency: monthly. Parameters/samples: quantification of COHb, ethanol and paracetamol in blood.
- Programme: Forensic Blood Toxicology Proficiency Testing (Quartz). Organised by: LGC Frequency: quarterly. Parameters/samples: identification and quantification of drugs of abuse and psychotropic drugs in blood
- Drugs of Abuse in Urine (DAU) Programme. Organised by: LGC Standards. Frequency: quarterly. Parameters/samples: screening of drugs of abuse in urine using immunoassay and chromatography techniques.

4. INSTITUTE OF LEGAL MEDICINE AND FORENSIC SCIENCES OF ARAGON

4.1. Analytical techniques used and participation in intercomparison exercises

Analytical techniques used

- Headspace sampler gas chromatography and flame ionisation detection (HS-GC-FID).
- Gas chromatography with mass spectrometry detection (GC-MS).

The IMLA laboratory has participated in the following intercomparison exercises in 2023:

- Blood Ethyl Alcohol Intercomparison Exercise organised by the INTCF.

5. INSTITUTE OF LEGAL MEDICINE AND FORENSIC SCIENCES OF MURCIA

5.1. Analytical techniques used and participation in intercomparison exercises

Analytical techniques used

- Headspace gas chromatography with flame ionisation detection (HS-GC-FID).
- Gas chromatography coupled with mass spectrometry (GC-MS).

The IMLCFM has participated in the following intercomparison exercises in 2023:

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

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

6.1. Analytical techniques used and participation in intercomparison exercises

Analytical techniques used

- Enzyme immunoassay.
- Headspace gas chromatography with flame ionisation detection (HS-GC-FID), detection and quantification of ethanol.
- Gas chromatography coupled with mass spectrometry (GC-MS), detection and quantification of drugs of abuse and psychotropic drugs.

The IMLCFIB carried out the following intercomparison exercises in 2023:

- Blood Ethyl Alcohol Intercomparison Exercise (BAIE) organised by the INTCF Seville Department.
- UNODC ICE PROGRAM: Interlaboratory Exercise on Psychoactive Substances in Urine (2023-BS).
- FTC-B 2023 Forensic Toxicology, Criminalistics Programme organised by the College of American Pathologists: Interlaboratory Exercise on Psychoactive Substances in Blood.

7. INSTITUTE OF LEGAL MEDICINE AND FORENSIC SCIENCES OF VALENCIA

7.1. Analytical techniques used and participation in intercomparison exercises

Analytical techniques used

- Enzyme immunoassay.
- Headspace gas chromatography with flame ionisation detection (HS-GC-FID).

The IMLCFV carried out the following intercomparison exercises in 2023:

- Blood Ethyl Alcohol Intercomparison Exercise. Organised by: INTCF Seville. Frequency: four-monthly. 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

Analytical techniques used

- Thermo Fisher Indiko Plus enzyme immunoassay.

- Agilent headspace gas chromatography with flame ionisation detection (HS-GC-FID) for the 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 with mass spectrometry (GC-MS) for the detection and quantification of drugs of abuse and psychotropic drugs.

INCIFOR regularly takes part in the following intercomparison exercises:

- Three INTCF intercomparison exercises per year. Controls are for the determination of ethanol, methanol and other volatiles in blood and plasma samples.
- Two intercomparison exercises per year for the determination of ethanol/methanol and other volatiles in blood by LGC, accredited according to ISO/IEC 17043.
- An annual LGC urine ethanol intercomparison exercise, accredited according to ISO/IEC 17043.

9. STATISTICAL DATA ANALYSIS AND PROCESSING

Data received in each request (date of accident, date of death, role, age, gender, type of vehicle, autonomous region, province, requesting body, issuing body, etc), as well as data from the toxicological studies obtained by the INTCF, were recorded in the INTCF LIMS Labware (Laboratory Information Management System) information management system.

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

Data were cross-checked with those recorded independently by the DGT and cases were selected.

Analytical data received from the different IMLCFs and INTCF departments were all compiled in the same standardised Microsoft Excel template.

Statistical data and final figures were obtained manually by using filters and creating charts in Excel, as well as by using the advanced analytics tool Qlik Sense.

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