

Supplementary information for the article:

Drivers who tested positive for cannabis in oral fluid: A longitudinal analysis of administrative data for Spain between 2011 and 2016

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SUPPLEMENTARY METHODS

Real-world context

This study aimed to characterize drivers who were positive for drugs in Spain and was performed using routinely collected data. According to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) requirements adopted in the REporting of studies Conducted using Observational Routine collected health Data [RECORD] standards,[1, 2, 3] the following explanations complementing the Methods section of the article for which this supplementary information has been elaborated are presented.

The selection of study participants (RECORD item 6) followed the nationwide regulated procedure for detecting drugged driving: drivers provide a first oral fluid (OF) sample and, in the case of a positive result, a second OF sample for confirmation analysis, which is sent to accredited toxicology laboratories for quantification of the detected substances using chromatographic techniques. [4, 5]

The current OF delta-9-tetrahydrocannabinol (THC) cut-offs set for the available screening devices in Spain (Table S1) are not taken into account in the confirmation analysis. THC concentrations below this limit are reported to the infringers (Table S2), who are finally punished (any amount of drug in the body is forbidden according to our zero tolerance regulations^{(a), (b)}).

Based on the lower limit of quantification (LOQ) (the ISO/IEC 17025 requirements are satisfied for testing and calibration), all confirmed positive results for driving-impairing substances included on the Driving under the Influence of Drugs, Alcohol and Medicines

(DRUID) project core substance list (amphetamines, cocaine, THC, opioids, benzodiazepines and Z-drugs)[6] that were collected from 2011 to 2016 were accessed (Table S3).

To avoid selection bias (RECORD item 9), no information was available regarding drivers who tested negative on the roadside.

Data curation

In addition to the STROBE requirement for statistical methods provided in the manuscript, information on data access and cleaning methods and linkage is supplied below (RECORD item 12).

The original database on confirmed roadside drug tests was requested from Dirección General de Tráfico on 20 July 2015 (data for years 2011 to 2014) and 1 March 2017 (data for years 2015 and 2016). As the data were initially collect for nonresearch purposes, improvements were made (a unified coding strategy for recording positive cases; a unified electronic format for records). Nevertheless, in the anonymized database that was made available, identification based on incomplete records was necessary: information on age and gender was available starting in 2016, but records without this information were also included in the analysis. In the case of repeated measures (duplicates) that were identified by equal THC concentrations, records with the most complete information were included (duplicate records with missing information were thus removed). In any case, no duplicate records were found.

As there is no other database containing information on drug-positive drivers, in this study, linkage of databases was not performed. [7]

Table S1

Oral fluid drug-testing devices used in Spain and their THC cut-offs for detecting cannabis use

| Devices | THC cut-off (ng/mL) | Year range | Tests performed (n)[‡] |
|---------------------------------|--------------------------------|-------------------|--|
| Dräger DrugTest® 5000 | 25.0 | 2011 to 2016 | 44 012 |
| Alere™ DDS®2 Mobile Test System | 25.0 | 2015 to 2016 | 13 055 |
| DrugWipe® 5S | 30.0 | 2015 to 2016 | 6531 |

[‡]Between 2011 and 2016, the drug-testing device was unknown for 1646 tests.

THC, delta-9-tetrahydrocannabinol.

Table S2**Limits of quantification for THC in confirmation analyses**

| Time range | Lower LOQ (ng/mL) | Upper LOQ (ng/mL) |
|-----------------------------|--------------------------|--------------------------|
| Before February 2015 | 2.0 | None |
| March 2015 to February 2017 | 5.0 | 400.0 |

Confirmation analysis was carried out using liquid chromatography (LC) or gas chromatography with mass spectrometry (MS).

LOQ, limit of quantification; THC, delta-9-tetrahydrocannabinol.

Table S3**Tests performed between 2011 and 2016**

| Total/confirmed tests during the period/per year (n) | THC-positive results (n/%) | Median/Q1–Q3 of THC concentration (ng/mL) |
|---|-----------------------------------|--|
| 179 645 / 65244 in 2011 to 2016 | 51 869 / 79.5 | 113.8 / 30.6–359.4 |
| 743 / 62 in 2011 | 40 / 64.5 | 278.8 / 85.4–1094.6 |
| 3487 / 1087 in 2012 | 830 / 76.4 | 176.8 / 54.2–570.2 |
| 4563 / 2017 in 2013 | 1627 / 80.7 | 153.4 / 45.7–467.0 |
| 29 643 / 9991 in 2014 | 8082 / 80.9 | 113.5 / 37.9–317.7 |
| 76 040 / 25 966 in 2015 | 20 976 / 80.8 | 125.3 / 32.4–398.8 |
| 65 169 / 26 121 in 2016 | 20 314 / 77.8 | 98.5 / 24.7–328.1 |
| Kruskal-Wallis <i>H</i> test (p) 2011 to 2016 | | 453.1 (0.0001) |
| Cohen's <i>d</i> effect size (judgment) | | –6.472 (large) |

Q, quartile; THC, delta-9-tetrahydrocannabinol.

Table S4

Distribution of means and standard deviations of THC concentration in the oral fluid of the THC-positive drivers by age

| Age ranges | Mean \pm SD of THC concentration (ng/mL) | | |
|------------|--|-------------------|-------------------|
| | All THC-positive cases | Men | Women |
| 15–20 | 160.2 \pm 153.8 | 159.7 \pm 153.9 | 163.1 \pm 153.5 |
| 21–25 | 158.4 \pm 152.2 | 159.4 \pm 152.5 | 129.7 \pm 140.7 |
| 26–30 | 167.9 \pm 154.6 | 169.2 \pm 154.9 | 145.8 \pm 147.3 |
| 31–35 | 162.9 \pm 154.7 | 164.2 \pm 154.9 | 139.8 \pm 148.2 |
| 36–40 | 163.8 \pm 158.3 | 165.5 \pm 158.8 | 103.7 \pm 124.3 |
| 41–45 | 159.1 \pm 156.8 | 159.8 \pm 157.0 | 129.9 \pm 142.9 |
| 46–50 | 160.8 \pm 160.5 | 163.9 \pm 161.5 | 60.2 \pm 99.0 |
| 51–55 | 170.9 \pm 161.6 | 173.6 \pm 161.6 | 10.3 \pm 10.6 |
| 56–60 | 184.7 \pm 161.6 | 181.8 \pm 164.4 | 228.1 \pm 118.8 |
| 61–65 | 126.4 \pm 158.1 | 126.4 \pm 158.1 | 0 |

SD, standard deviation; THC, delta-9-tetrahydrocannabinol.

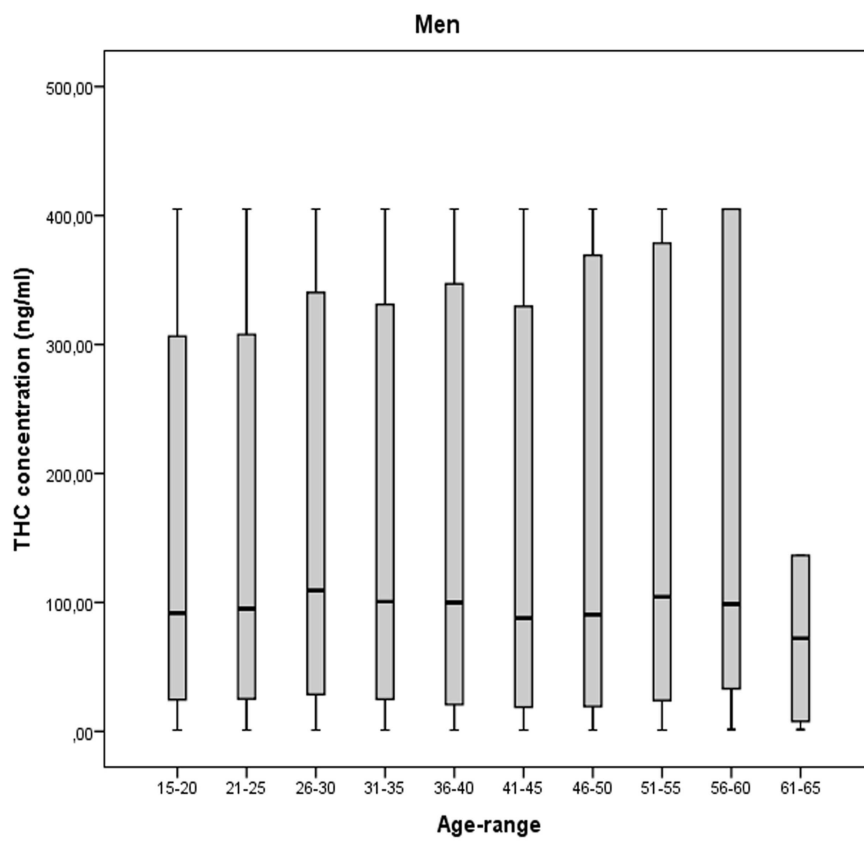
Table S5**THC concentration deciles for all confirmed THC-positive tests**

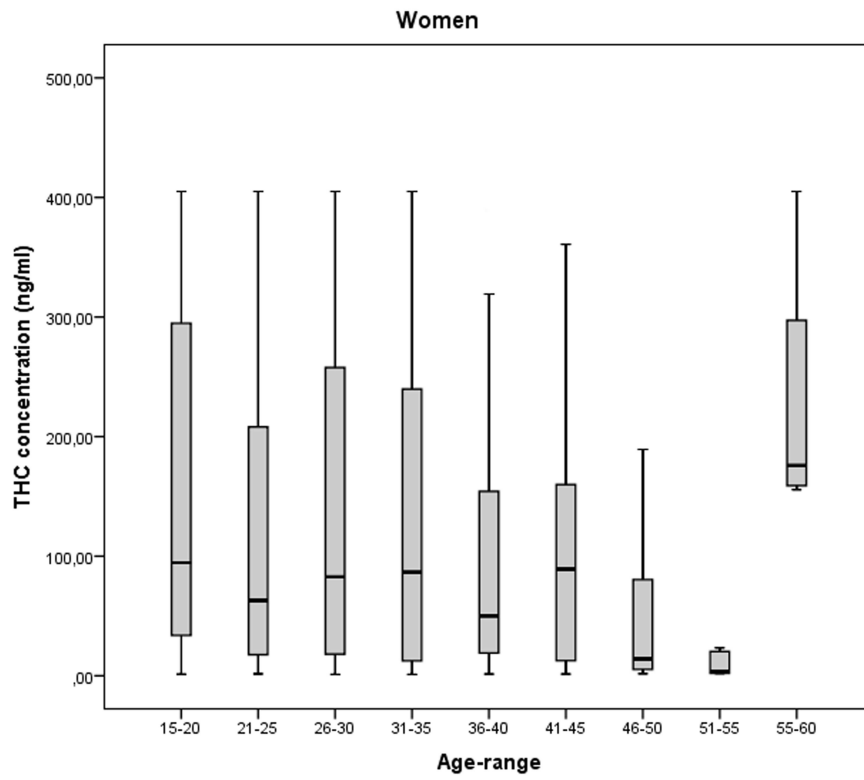
| Deciles | THC concentration (ng/mL) | Positive results for THC alone (%) | Positive results for THC and non-THC substances (%) |
|----------------|--------------------------------------|---|--|
| 1 | 8.0 | 32.5 | 67.5 |
| 2 | 21.4 | 48.2 | 51.8 |
| 3 | 41.8 | 52.3 | 47.7 |
| 4 | 71.0 | 54.0 | 46.0 |
| 5 | 113.8 | 53.6 | 46.4 |
| 6 | 178.3 | 52.9 | 47.1 |
| 7 | 283.2 | 52.5 | 47.5 |
| 8 | >400.0 | 50.6 | 49.4 |
| 9 | >400.0 | 48.1 | 51.9 |
| | | χ^2 (p): 748.2 (<0.0001) | |

χ^2 , chi-squared test; THC, delta-9-tetrahydrocannabinol.

Figure S1

Distribution of medians and interquartile ranges of THC concentration in oral fluid from THC-positive men (a) and women (b) by age. X-axis=5-year age ranges. Y-axis=THC concentration (ng/mL). THC, delta-9-tetrahydrocannabinol

a

b

Footnotes

- (a) Real Decreto Legislativo 6/2015, de 30 de octubre, por el que se aprueba el texto refundido de la Ley sobre Tráfico, Circulación de Vehículos a Motor y Seguridad Vial. [Royal Legislative Decree 339/1990 (30 October) approving the Restated Text of the Law on Traffic, Circulation of Motor Vehicles, and Driving Safety].
<https://www.boe.es/boe/dias/2015/10/31/pdfs/BOE-A-2015-11722.pdf> (accessed 10 December 2018)
- (b) Ley Orgánica 5/2010, de 22 de junio, por la que se modifica la Ley Orgánica 10/1995, de 23 de noviembre, del Código Penal [Institutional Act 5/2010 (22 June) amending Criminal Code Institutional Act 10/1995 (23 November)].
<https://www.boe.es/boe/dias/2010/06/23/pdfs/BOE-A-2010-9953.pdf> (accessed 10 December 2018)

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- 6 Schulze H, Schumacher M, Urmeew R, et al. Driving under the influence of drugs, alcohol and medicines in Europe – findings from the DRUID project [internet]. Lisbon, Portugal: European Monitoring Centre for Drugs and Drug Addiction (EMCDDA), 2012.
http://www.emcdda.europa.eu/system/files/publications/743/TDXA12006ENN_402_402.pdf (accessed 30 June 2018)
- 7 Bohensky MA, Jolley D, Sundararajan V, Evans S, Pilcher DV, Scott I, et al. Data linkage: a powerful research tool with potential problems. *BMC Health Serv Res* 2010;**10**:346. <http://dx.doi.org/10.1186/1472-6963-10-346>