



**IFSTAR**

French Institute  
of Science and Technology  
for Transport, Development and Networks



**Lyon 1**

University of Lyon

# Drugs and fatal crashes

Jean-Louis Martin

Blandine Gadegbeku

Dan Wu

Vivian Viallon

Bernard Laumon



# Objectives

- Estimation of the risk of being responsible for a fatal crash when driving while impaired by drugs (alcohol, cannabis, amphetamines, cocaine, opiates)
- Estimation of corresponding attributable fractions



# Data

- Codification from Police reports, including photos (vehicles and crash spot), crash maps and injury pattern from hospitals
- For all fatal crashes in France 2011 (N=3622)
- DWI assessment:
  - If possible, breath testing for alcohol, saliva testing for illicit drugs, and measure from blood sample if positive
  - Otherwise, direct measure in blood

Alcohol  $\geq 0.5$  g/l

Cannabis: THC  $\geq 1$  ng/ml

Opiates  $\geq 20$  ng/ml

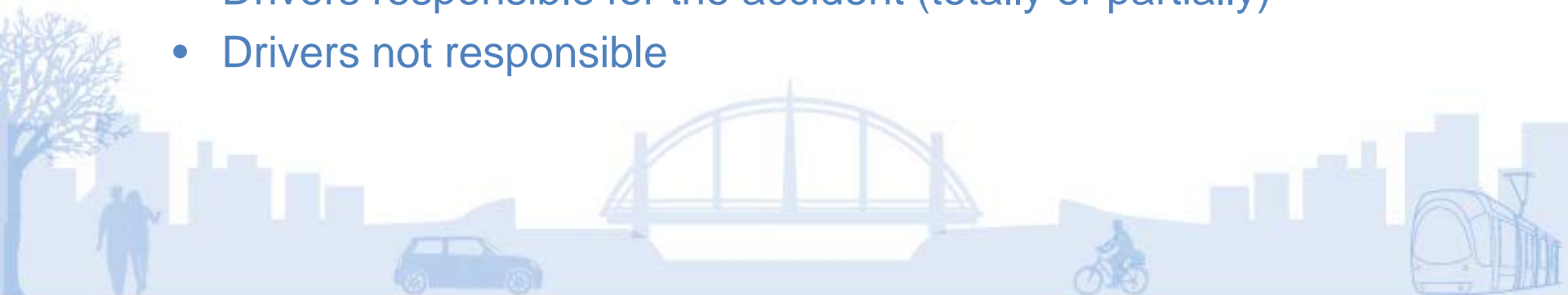
Amphetamines  $\geq 50$  ng/ml

Cocaine  $\geq 50$  ng/ml



# Method: Responsibility analysis

- Responsibility was assessed by experts from in-depth analysis of the total amount of crash information
  - A driver involved in a crash was considered responsible for a crash if he committed a driving fault (lane departure, failure to obey traffic signs, driving against traffic, etc), which did trigger the crash.
- Definition of two groups:
- Drivers responsible for the accident (totally or partially)
  - Drivers not responsible



# Results



# Prevalences and crude Odds-Ratios (OR) of being responsible according to detected drug intoxication

Blood concentration	Total (N=4059)	Responsible (N=2569)	Not responsible (N=1490)	Crude OR [95 % C.I.]
Alcohol $\geq$ 0.5 g/l	788	29.5%	2.1%	19.7 [20.1 – 56.3]
Cannabis: THC $\geq$ 1 ng/ml	325	10.7%	3.4%	3.45 [2.84 – 5.82]
Opiates $\geq$ 20 ng/ml	43	1.3%	0.6%	2.21 [1.06 – 4.61]
Amphetamines $\geq$ 50 ng/ml	10	0.4%	0.1%	5.22 [0.62 – 41.2]
Cocaine $\geq$ 50 ng/ml	12	0.4%	0.1%	6.40 [0.83 – 49.6]



# ORs adjusted for the three significant drugs, and for age, sex, type of vehicle and time of the crash (week or week-end, day time or night time)

Blood concentration	Adjusted OR [95% C.I.]
Alcohol $\geq$ 0.5 g/l	17.8 [12.1-26.1]
Cannabis: THC $\geq$ 1 ng/ml	1.65 [1.16-2.34]
Opiates $\geq$ 20 ng/ml	2.21 [1.02-4.78]



Blood concentration	Adjusted OR [95% C.I.]
Alcohol: Alc < 0.5 g/l	1
0.5 $\leq$ Alc < 0.8	6.40 [2.70 -15.2]
0.8 $\leq$ Alc < 1.2	8.30 [4.52 -15.2]
1.2 $\leq$ Alc < 2	24.4 [11.9 -50.1]
Alc $\geq$ 2	44.4 [18.1 -109.]
Cannabis: THC < 1 ng/ml	1
1 $\leq$ THC < 3	1.35 [0.86 -2.14]
3 $\leq$ THC < 5	3.59 [1.36 -9.48]
THC $\geq$ 5	1.59 [0.85 -2.97]
Opiates $\geq$ 20 ng/ml	2.21 [1.02-4.77]

- No significant (multiplicative) interaction between alcohol and cannabis
- More than half of responsible drivers impaired by cannabis were also impaired by alcohol
- Similar results in Chihuri, 2017, Injury Epidemiology, from a case-control study carried out on 2006-2008 US data (with positive additive interaction)

# Attributable Fraction

Attributable Fraction: it is the proportion of the incidence that would disappear when the incidence in the exposed group is reduced to the level in the unexposed group.

Cannabis	AF [95 % C.I.]
Alcohol $\geq$ 0.5 g/l	27.7% [26.0%-29.4%]
Cannabis: THC $\geq$ 1 ng/ml	4.2% [3.71%-4.75%]
Opiates $\geq$ 20 ng/ml	0.7% [0.5%-1.0%]





# Discussion



# Comparison with a similar study (SAM\*) carried out on 2002-2003 data

Blood concentration	Present Study (N=4059)		Previous Study (N=9972)	
	Responsible (N=2569)	Not responsible (N=1490)	Responsible (N=6766)	Not responsible (N=3006)
Alcohol $\geq$ 0.5 g/l	29.5%	2.1%	29.8%	2.7%
Cannabis: THC $\geq$ 1 ng/ml	10.7%	3.4%	8.8%	2.8%
Opiates $\geq$ 20 ng/ml	1.3%	0.6%	0.8%	0.9%
Amphetamines $\geq$ 50 ng/ml	0.4%	0.1%	0.6%	0.2%
Cocaine $\geq$ 50 ng/ml	0.4%	0.1%	0.3%	0.1%

\* *Laumon, B., Gadegbeku, B., Martin, J.L., Biecheler, M.B., 2005. Cannabis intoxication and fatal road-traffic crashes in France: population based case-control study. BMJ 331, 1371–4*

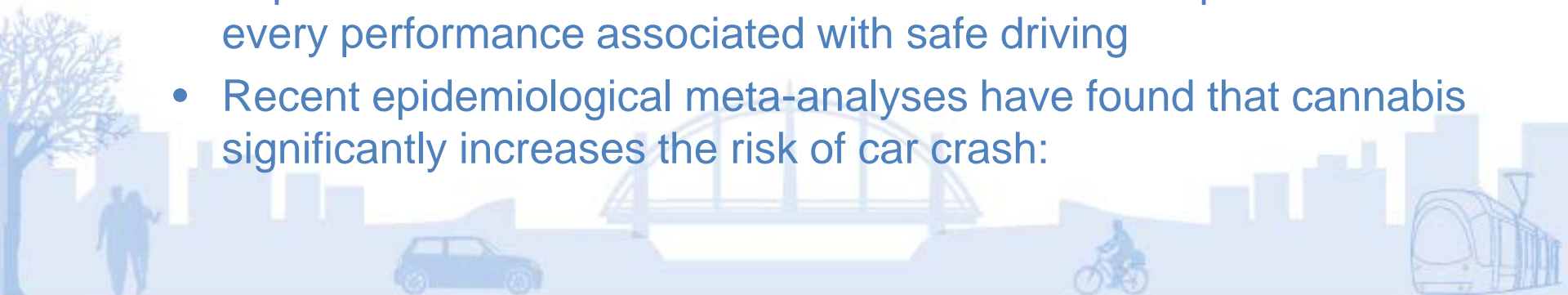
# Comparison with a similar study (SAM\*) carried out on 2002-2003 data

- Similar OR for cannabis: 1.78 vs 1.65
- Lower for Alcohol: 8.51 vs 17.8 (due to a less reliable assessment of responsibility)
- Opiates, amphetamines and cocaine were not significant
- Similar attributable fractions
  - For Alcohol (27.7% vs. 31.5%)
  - For Cannabis (4.2% vs 4.3%)



# Comparison with other results

- **Alcohol: Widely recognized**
  - Well established as one of the most important personal risk factor for serious and fatal injuries, because impairing driving skills and wrongly increasing self confidence (→ speeding)
  - Contributing to approximately one third of all deaths from traffic crashes (Stübig 2012, Zeckey 2011, Brady 2014)
- **Cannabis: More controversial**
  - the effects of cannabis vary more between individuals than they do with alcohol because of tolerance, differences in smoking technique, and different absorptions of THC
  - Experimental studies have shown that cannabis impairs almost every performance associated with safe driving
  - Recent epidemiological meta-analyses have found that cannabis significantly increases the risk of car crash:



# OR estimates from systematic reviews for cannabis

- Li, Ep Reviews, 2011
  - Global estimation (9) OR=2.66 (2.07-3.41)
- Asbridge, BMJ, 2012
  - Responsibility analysis (6): OR=1.65 (1.11-2.46)
  - Case-control studies (3) OR=2.79 (1.23-6.33)
- Elvik, Acc Anal Prev, 2013
  - For fatal crashes (10) OR=1.31 (0.91-1.88)
  - For injury crashes (15) OR=1.26 (0.99-1.60)
  - For PDO crashes (17) OR=1.48 (1.28-1.72)



# Limits

- No information on medication use
- Results based on 2 hypotheses:
  - 1) The crash would not occur in the absence of the error/fault from which the driver was assessed as responsible by the expert
  - 2) non-responsible drivers represent a random sample of the general driving population that was "selected" to crash by circumstances beyond their control and therefore have the same risk factor profile as other drivers on the road at the same time

Almost always the case

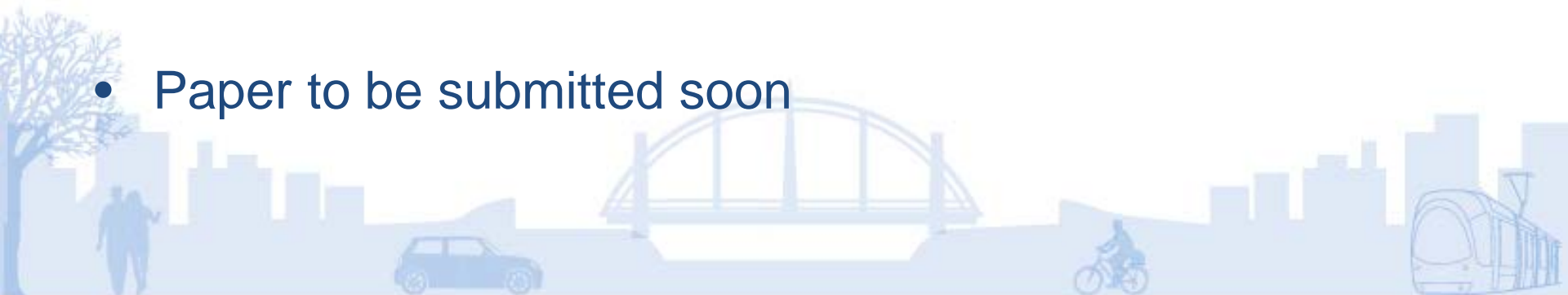
Adjustment for confounding factors was used to mitigate the possible bias

# Conclusion

- DWI by alcohol associated with 28% fatal crashes
- Driving while impaired by cannabis (THC) associated with 4% of fatal crashes
- Opiates are significantly associated to responsibility in fatal crashes, but this estimation needs to be confirmed in further work
- Amphetamines and cocaine have low prevalence, corresponding risks cannot be estimated
- → Although a law required the systematic testing of illicit drugs since 2002 (for fatal crashes), and while the number of fatal crashes has dramatically decreased (6500 => 3600), the proportion of fatal crashes attributable to driving under the influence of alcohol or cannabis has remained stable

# Research framework

- VOIESUR project, with 4 partners
  - LAB GIE PSA-Renault,
  - CEESAR,
  - CEREMA,
  - IFSTTAR
- Grants from ANR (National Agency for Research) and from DSCR (National delegation for traffic safety)
- Deliverables (in French) on website <http://voiesur.esy.es/>
- Paper to be submitted soon





# Thank you for your attention

[Jean-louis.martin@ifsttar.fr](mailto:Jean-louis.martin@ifsttar.fr)

Umrestte (Joined research unit for epidemiology and surveillance for transport, environment and occupational)

TS2 (Transport, Health, Safety department)

Ifsttar

