CANNABIS & DRIVING

International Council on Alcohol, Drugs & Traffic Safety

3: Recent Epidemiological Evidence

What is the prevalence of cannabis use in randomly selected drivers in traffic?

In roadside surveys, THC is typically the most commonly detected recreational drug after alcohol.

The prevalence of Δ^9 tetrahydrocannabinol (THC) positive drivers varies from country to country, depending on the legal status of medical and/or recreational cannabis, the availability of cannabis, prevalence of cannabis use in the general population, traffic laws and their enforcement, and driving culture. A recent systematic review indicates those who use drugs and drive – and in particular, those who use cannabis and drive – are more likely to be younger and male.[1] Findings from several recent roadside surveys in Europe and North America are summarized in Table 1 below.
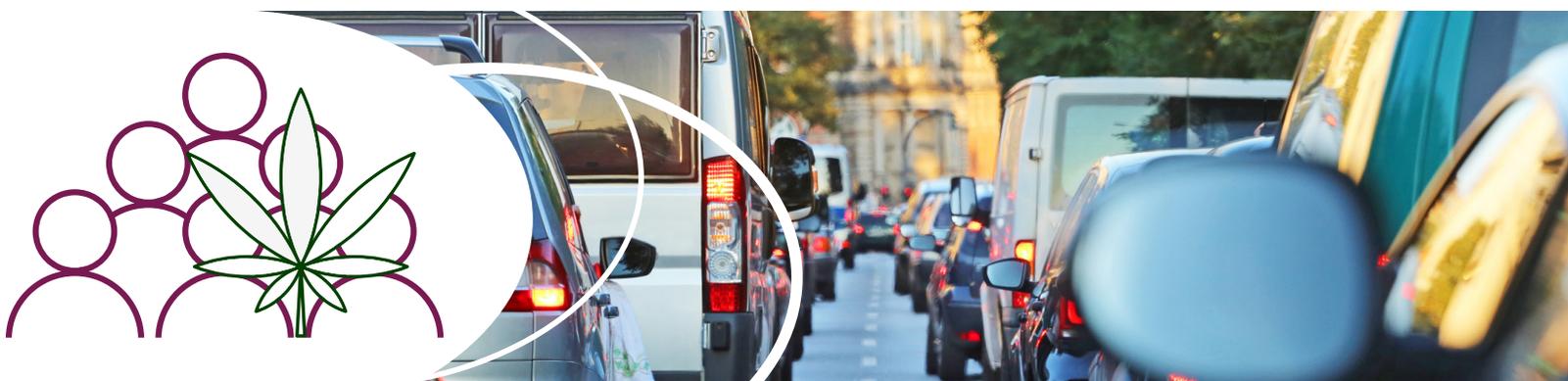
Table 1. Prevalence of cannabis / alcohol use in randomly selected drivers in traffic (recent research).

Country (year)	THC positive	Alcohol positive	Notes
Europe (Past year use of cannabis in adults = 7.4%)[2]			
Norway (2016-17)[3]	1.3%	0.2%	BAC>.02
Spain (2018)[4]	5.1%	4.7%	BAC>.01
Europe (2007-2009;13 countries)[5]	1.3%	3.5%	DRUID project; >50,000 drivers BAC>.01
North America (Past year use of cannabis in US adults = 17.9%[6]; in Canadian adults = 27% (unweighted)[7])			
British Columbia, Canada (2018)[8]	6.0%	4.4%	BAC>0; non-weighted values; evening and nighttime drivers
Ontario, Canada (2017)[9]	8.6%	4.9%	BAC>0; non-weighted values; evening and nighttime drivers
US Roadside Survey (2013/14)[10, 11]	8.9% daytime 12.5% nighttime	1.1% daytime 8.3% nighttime	Nationally representative sample; weighted values
Australia (Past year use of cannabis in Australian adults = 11.6% in 2019)[12]			
Queensland (2006 – 07)[13]	1.7%	Not reported	Oral fluid testing with Cozart® Rapiscan device.

What is the prevalence of cannabis use in crash-involved drivers?

Findings from recent studies of crash-involved drivers from different regions are summarized in Table 2. Variation between these studies is explained by cultural and legal factors that influence how often drivers in different countries use drugs or alcohol and by differences in study design. For example, substances are more commonly detected in seriously injured drivers than in drivers involved in minor crashes and different studies use different detection thresholds for reporting THC and/or alcohol.

The prevalence of cannabis and of alcohol are generally higher in crash-involved drivers than in roadside surveys.

Table 2. Prevalence of cannabis / alcohol in crash-involved drivers (recent research).

Country (year)	THC positive	Alcohol positive	Notes
Europe (Past year use of cannabis in adults = 7.4%)[2]			
Norway (2015-18)[14]	9.9% (THC>1.3ng/mL)	16.3% (BAC>.02)	Fatally injured car/van drivers
EU (2007-2010)[15] Belgium, Denmark, Finland, Italy, Lithuania, the Netherlands	2.7% (THC>1ng/mL)	24.5% (BAC>.01)	Seriously injured drivers (DRUID study)
Italy (2017-2018)[16]	1.5% (THC>2ng/mL)	17.3% (BAC>.05)	Crash-involved drivers
Italy (2012-2015)[17]	3.7% (THC>2ng/mL)	Not reported	Drivers treated in an Emergency Department
North America (Past year use of cannabis in US adults = 17.9%[6]; in Canadian adults = 27% (unweighted)[7])			
Canada (2018-20)[18]	18.8% (THC >0.2 ng/mL) 7.6% (THC>2ng/mL)	15.5% (BAC>.01)	Injured drivers treated in fifteen trauma centres.
Canada (2015-2019)[19]	21.8% (THC greater or equal to 0.01 ng/ml)	31.8% (BAC greater or equal to .01)	Fatally injured drivers of highway vehicles
USA (2019-2020)[20]	20.8-32.7% (THC>1 ng/mL)	21.8-28.3% (BAC >.02)	Injured drivers in five Level 1 Trauma Centers pre/post COVID-19 periods
USA (2011-12)[21]	7.6% (THC>2ng/mL in oral fluid or THC>1ng/mL in blood)	5.0% (BAC>.01)	Mostly minor injuries (Virginia Beach Study)
Australia (Past year use of cannabis in Australian adults = 11.6%)[22]			
Victoria (2013-18)[23]	11.1% (THC>1ng/mL)	15.8% (BAC≥.01)	Injured drivers treated in hospital
Victoria (2006-16)[24]	13.1% (THC>0.01ng/mL)	18.4% (BAC>.05)	Fatal crashes
Queensland (2011-15)[25]	15.5% (THC≥1ng/mL)	31.8% (BAC>.00)	Fatal crashes
*> means greater than; *< means less than			

What is crash risk and how is it measured?

Crash risk is an odds ratio (OR) which measures relative risk of rare events such as drug-impaired driving. It expresses the likelihood that drivers who test positive for cannabis will be involved in a crash compared with drivers who test negative for cannabis. Most epidemiological studies of crash risk associated with cannabis are either case-control designs (which compare cannabis use in crash-involved drivers with that of non-crash-involved drivers), or responsibility (i.e., culpability) analyses which include only crash-involved drivers and compares cannabis use in drivers who were deemed responsible for the crash versus in drivers deemed not to be responsible.

What is the risk of crashing after using cannabis?

Cannabis, when consumed alone, is associated with a modest increase in crash risk at the population level according to most studies which compared the presence versus the absence of cannabis.

The increase in crash risk varies between studies, but the average increase is 30% to 40% in the latest meta-analysis.[26] This means drivers who test positive for cannabis are approximately 1.3-1.4 times more likely to be involved in a crash than drivers who test negative for cannabis. Since this meta-analysis, two high-quality responsibility analyses were completed. A Canadian study of 1,825 injured drivers linked to police reports demonstrated no statistically significant increased risk in THC-positive drivers.[27] An Australian study compared the odds of crash responsibility in 98 drivers who tested positive for THC with 1,837 drivers who tested negative for alcohol and all drugs, and showed a 90% increased risk of responsibility (OR = 1.9).[28]

How does crash risk vary with THC concentration?

Limited data suggest that risk increases for drivers with whole blood THC ≥ 5ng/mL.

Two recent high-quality studies investigated crash risk at different THC concentrations. A Canadian study[27] reported no evidence of increased crash risk responsibility for drivers with THC < 5 ng/mL. The estimated risk of crash responsibility was increased (OR=1.74) in drivers with THC ≥ 5 ng/mL. This was not statistically significant (perhaps due to the small number of drivers with THC > 5 ng/mL) and so may have been due to chance. Fortunately, most drivers do not drive while impaired by cannabis, so epidemiological studies can analyze only a limited range of relatively low THC concentrations.

A large Australian study[28] found a significantly increased responsibility risk (OR=3.2) for drivers with THC ≥ 5ng/mL. For drivers with 1 ng/mL < THC < 5 ng/mL, the estimated risk was increased (OR=1.6) but this result was not statistically significant meaning it may have been due to chance. These responsibility analysis designs used different analytic approaches which may have contributed to their different findings. The Australian study excluded drivers who used more than one substance and compared risk in drivers who used cannabis alone (THC positive, all other substances negative) with the risk in drivers who were negative for all substances. In contrast, the Canadian study included drivers with polysubstance use and compared risk in drivers who used cannabis versus those who did not use cannabis, while statistically adjusting for the presence of other substances.

How does the crash risk associated with cannabis compare with that of alcohol?

The crash risk associated with alcohol is much higher than cannabis.

Large case-control studies with low test refusal rates showed drinking drivers are at high risk of crashing. For example, a large U.S. study[29] showed drivers with BAC>.08 had 6.63 times the likelihood of crashing (OR=6.63) compared to non-drinking drivers. Similarly, large increases in risk in drinking drivers were reported in the recent responsibility analyses from Canada (OR=4.2 for BAC>0; OR=6.0 for BAC>.08)[27] and Australia (OR=16 for BAC>0).[28]

What happens to risk when drivers combine alcohol and cannabis?

Drivers who combine cannabis and alcohol are at a very high risk of crashing.

In the recent Canadian responsibility analysis,[27] drivers who tested positive for both alcohol and cannabis were approximately 7 times more likely to cause a crash than drivers who did not use either substance (OR=7.3 for BAC>0 and 0<THC<2ng/mL; OR = 6.8 for BAC>0 and THC≥2). Similarly, the Australian study[28] found an odds ratio of crash responsibility of 14 (OR = 14) in drivers who combined alcohol and cannabis compared to use of neither substance. These findings are consistent with those observed in experimental studies (see ICADTS Cannabis Recent Experimental Evidence for more information). An American study demonstrated the combined use of even low doses of alcohol (i.e., BAC <.05) and cannabis significantly increased crash risk (i.e., OR=3.2).[30]

What are the major limitations of epidemiological studies?

The four most common study limitations are described below.

Failure to measure recent cannabis use or impairment.

In older studies, cannabis exposure was often based on the presence of THC-COOH. This is an inactive THC metabolite that does not indicate either recent cannabis use or impairment. A number of studies of fatally injured drivers relied on post-mortem THC concentrations that are difficult to interpret because THC undergoes unpredictable post-mortem redistribution-up and down, but most data shows less post-mortem distribution than expected. THC concentrations in post-mortem blood correlate poorly with THC concentrations at time of death. More recent studies have defined cannabis exposure using the presence of THC in blood or oral fluid but the presence of THC in blood or oral fluid does not necessarily indicate acute impairment or intoxication, or even recent use of cannabis. This is partly due to the complex pharmacokinetic profile of cannabis (see ICADTS Cannabis-Impaired Driving Detection & Toxicology for more information). As a general rule, higher concentrations of a drug are more likely to indicate impairment, but the relationship varies greatly from person to person. A low-THC concentration may not be associated with noticeable impairment in frequent, heavy consumers but could be associated with substantial impairment in people who use cannabis occasionally.

Most studies have substantial limitations which make the interpretation of results difficult.

Delays in obtaining blood to measure THC.

Many studies suffer from substantial delays between the time a crash occurs and the collection of a blood sample. THC levels decline rapidly after smoking cannabis, so concentrations measured hours after a crash are substantially lower than at the time of the crash. Conversely, in chronic heavy cannabis consumers, THC can be detected at low levels many hours after using cannabis, so detection of THC at low concentrations does not indicate drivers were high or intoxicated at the time of the crash. In studies of drivers who used cannabis more than 3-4 hours before a crash, the calculated crash risk is biased downwards (i.e., under-estimated) compared with the crash risk in the first 2-3 hours after cannabis use.

High refusal rates in case-control studies.

Most case-control studies have high refusal rates (>15%). This introduces potential selection bias if, as is likely, drivers who refuse to participate have higher rates of drug use. In addition, many case-control studies used different methods to measure cannabis exposure in cases versus in controls (e.g., blood THC in cases and saliva THC in controls). Another common problem is the use of non-comparable controls (e.g., patients visiting hospitals for medical problems) to estimate the prevalence of THC use in the general driving population.

Difficulty assigning responsibility in responsibility analyses.

In a responsibility analysis design, all drivers are involved in a crash. This minimizes differential ascertainment of THC in cases versus controls and eliminates bias due to refusals by using routine THC testing done by police, hospitals, or coroner investigations. Responsibility analyses nonetheless face major challenges in retrospectively determining who was responsible for a crash in a sample of drivers who *failed to avoid crashing*. As a result, *non-responsible* drivers may differ from the general driving population.

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About ICADTS

The International Council on Alcohol, Drugs & Traffic Safety (ICADTS) is an independent not-for-profit body whose only goal is to reduce mortality and morbidity brought about by misuse of alcohol and drugs by operators of vehicles in all modes of transport.

To accomplish this goal, the Council sponsors international and regional conferences to collect, disseminate and share essential information among professionals in the fields of law, medicine, public health, economics, law enforcement, public information and education, human factors and public policy.

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www.icadtsinternational.com

Email: admin@icadtsinternational.com