Effects of Cannabis on Driving

DRUG-IMPAIRED DRIVING
LEARNING CENTRE

What is the Drug-Impaired Driving Learning Centre (DIDLC)?

The Drug Impaired Driving Learning Centre (DIDLC) is a fully bilingual, web-based educational resource that was developed by the Traffic Injury Research Foundation, in partnership with State Farm®.

This comprehensive, accessible tool was created to inform the development of an evidence-based drug-impaired driving strategy. It was designed to meet the needs of a wide spectrum of diverse stakeholders who are seeking more information about priority issues.

The objective of the DIDLC is to support the work of governments and road safety partners by sharing current knowledge about research and practice, and increasing awareness about drug-impaired driving. A consolidated base of knowledge is essential to build a common understanding of the drug-impaired driving problem, inform discussion, and achieve progress in reducing it.

The Learning Centre contains several modules that are structured in a question and answer format, similar to other TIRF educational programs. Module topics include:

- magnitude and characteristics of the problem
- effects of drugs on driving
- legislation and penalties
- tools and technologies.

To view more fact sheets, or to get more information about drug-impaired driving, visit http://druggeddriving.tirf.ca

What functional abilities are necessary for safe driving?

Driving is a complex self-paced task that requires many skills and abilities to be completed simultaneously, and it requires that information be processed at a rapid pace while utilizing visual (ex: ability to scan the road for hazards), cognitive (ex: ability to divide attention between multiple concurrent events) and motor skills (ex: ability to perform physical movements such as turning the steering wheel, pressing acceleration and brake pedals). The processes drivers use to operate a vehicle can be divided into three steps: perception, decision and reaction. These three steps are assumed to happen consecutively, and depend on the driver's visual, cognitive and motor abilities. Impairment in any or all of these abilities can lead to unsafe driving.[1]

What are the different types of drugs that can impair driving?

Drugs that can impair driving are categorized according to the seven drug categories, established by the International Drug Evaluation

[1] Dewar et al. 2007

and Classification Program (DECP). These include: cannabis[2], central nervous system (CNS) depressants, central nervous system (CNS) stimulants, hallucinogens, dissociative anesthetics, narcotic analgesics, and inhalants.

There are also New Psychoactive Substances (NPS) that are frequently not included under the international drug control conventions. There are currently over 450 NPS being monitored by the European Union, with over half being reported since 2013.[3] An NPS is a synthetic drug that is designed to mimic the pharmacological effects of existing controlled substances. It is unlikely that synthetic drugs are detected using the common standardized drug test.[4] An NPS is characterized by the following features: psychoactive properties; a level of potential harm comparable to internationally controlled drugs; and newly available, rather than newly invented.[5]

How do researchers measure the impairing effects of drugs on driving abilities?

Laboratory tests. Researchers use laboratory tests that measure cognitive or psychomotor abilities thought to be related to or involved in driving. These tests are typically validated and reliable measures to assess specific cognitive capacities and physical motor coordination.

Cognitive tests evaluate the effects of a drug on these specific capacities: attention (simple and divided), perception (auditory, time and visual), memory (long and short-term), vigilance, logical reasoning, problem-solving and decision-making. Examples of validated tests include the Tower of London task, the Wisconsin Card Sorting Task,

the Time Wall test, and the Object Movement Estimation under Divided Attention (OMEDA).

Psychomotor tests measure the effects of a drug on participant performance during actions such as body sway, motor coordination and reaction time. Examples of specific tests commonly used to evaluate the effects of drugs include Simple Reaction Time and the Critical Tracking task.[6]

Simulator tests. Researchers also employ driving simulators to evaluate how the administration of a drug can affect driving. Driving simulators can vary in terms of the level of immersion, which can range from a simple desktop display to a full car cabin with a 360 degree display. Regardless, all simulators display an interactive virtual roadway (i.e., driving scenario) and the participant is directed to perform specific navigational and driving tasks on the virtual roadway via a steering wheel, accelerator and brake pedal. Drivers are administered a specific drug dose or placebo and instructed to complete a driving scenario during which they must perform a variety of

[2] The term "cannabis" refers to the cannabis plant that contains more than 100 cannabinoids. The primary psychoactive component of cannabis is delta-9-tetrahydrocannabinol, commonly known as THC. THC and its psychoactive metabolite, 11-hydroxy-THC or 11-OH-THC, and primary inactive metabolite, 11-nor-9-carboxy-THC or THC-COOH are frequently measured in biological fluids to document cannabis intake.

[3] New psychoactive substances in Europe: An update from the EU Early Warning System 2015

[4] Patil et al. 2016

[5] New Psychoactive Substances Review: report of the expert panel 2014

[6] Verstraete et al. 2014

actions. Measures typically include: lane weaving behaviours (variability in lateral lane position), speeding behaviours (average speed, speed variability), headway maintenance (the amount of headway distance maintained between the driver's vehicle and the vehicle in front), braking reaction time, and near-crash and collisions.[7]

On-road tests. On-road driving tests involve study participants operating a real vehicle, in the presence of a driving instructor who has a secondary set of vehicle controls, either on a closed track or on a public road. Test cars are usually fitted with devices to measure speed, lane positioning, acceleration/ brake use, and video cameras to record the driver's actions/errors.[8]

What are the limitations of the current research that measures the effects of drugs on driving ability?

Laboratory tests of cognitive and psychomotor capacities often only measure a single skill or ability related to driving performance, and it is well-known that driving ability engages a combination of cognitive, psychomotor and motor functions.[9] Even when a series of tests are used, they are administered independently of each other and many are short and relatively simple, and consequently fail to replicate the complex skills or engage the precise psychomotor and cognitive capacities required for driving.[10]

Driving simulators also have limitations since they can never fully replicate authentic driving. Participants may be less careful, as they are aware that it is a safe and artificial environment. As a result, driver errors and risk-taking behaviours may be exaggerated.[11] Additionally, driving scenarios are often short, involve few elements, engage a limited range of cognitive and psychomotor capacities, and thus do not replicate the complicated conditions that drivers may normally experience.[12]

The central limitation of on-road driving tests is the safety concern associated with placing drug-impaired drivers on the road, though these can be mitigated by using closed course tests and the presence of driving instructors who can take control of the vehicle when necessary.

What is cannabis?

Cannabis is the scientific term for the products of the cannabis plants, including marijuana, sinsemilla and hashish. The main psychoactive component is Δ9-tetrahydrocannabinol (THC). Cannabis is the most commonly used illicit drug.[13] The short-term effects of cannabis use include increased heart rate, distorted perceptions, impaired short-term memory, impaired coordination, relaxation, and feelings of euphoria. In contrast, some users experience anxiety, paranoia and/or panic attacks.

New psychoactive substances (NPS) that have cannabis-like effects are termed synthetic cannabinoids. The synthetic form is abused recreationally, has many street names including "spice". Synthetic cannabinoids are the most popular synthetic substances.[14]

[7] Verstraete et al. 2014
[8] Schulze et al. 2012; Verstraete et al. 2014
[9] Leufkens et al. 2007
[10] Ramaekers et al. 2004
[11] Dassanayake et al. 2011; Wolff et al. 2013
[12] Verstraete et al. 2014
[13] Statistics Canada 2016
[14] UNODC: World Drug Report 2012

Is cannabis frequently detected in drivers?

Aside from alcohol, cannabis is the most frequently detected drug in fatally injured drivers across North America, Europe and Australia.[15] Recently, some studies also examined the prevalence of synthetic cannabinoids in drivers. Although the prevalence of synthetic cannabinoids is not similar to the traditional form of the drug, studies show that synthetic cannabinoids are also found in the general driving population[16] as well as fatally injured drivers.[17] The latest 2013-2014 National Roadside Survey (NRS) showed that cannabis use in the general United States driving population increased by 48% from the previous 2007 NRS. The authors speculated that this increase may be due to changes in state policies for medical and legal recreational cannabis, although it is not certain whether this is the case without individual state data.[18] However, a recent study in Washington State, where cannabis has been legally sold since 2014, showed a significant increase in drivers testing positive for cannabis (11.6% vs. 16.4%) when comparing the percentage from before cannabis was legally sold to after the implementation of this new law.[19] In addition to this, Washington State has seen a twofold increase in fatal crashes involving drivers who are THC-positive (8% in 2013 to 17% in 2014).[20]

Can cannabis impair driving abilities, and if so, how?

Low doses of cannabis produce mild to moderate impairment in cognitive and psychomotor abilities. Studies involving larger doses showed significant cognitive, psychomotor and driving performance. The driving measures that are impaired include variability in speed maintenance, lane weaving, increased variability in headway, and increased reaction times.[21]

Cannabis use has been associated with a significantly increased risk of fatal crash involvement, with an odds ratio ranging from 1.8 to 2.8, in other words, drivers that use cannabis are at an increased risk (anywhere from 1.8 to 2.8 times higher odds) of injury.[22] Furthermore, the odds of drivers being found responsible for a crash increased with rising cannabis concentrations in the blood.[23]

Are the effects of cannabis on driving ability impacted by other factors, such as alcohol, or sleep deprivation?

Alcohol has an additive impairing effect when used in combination with cannabis. This means that the ability to compensate for the impairing effects of low doses of THC is negated when alcohol and THC are used together.[24] Furthermore, both multiple drug use and sleep deprivation increased the impairing effects of cannabis.

[15] Brady & Li, 2014
[16] Ramirez et al. 2016
[17] Yap & Drummer, 2016
[18] Berning et al. 2015
[19] Ramirez et al. 2016
[20] Tefft et al. 2016
[21] Hart et al. 2001; Sexton et al. 2000; Hartman et al. 2016
[22] Li et al. 2013; Asbridge et al. 2012
[23] Drummer et al. 2003; Drummer et al. 2004
[24] Verstraete et al. 2014

Traffic Injury Research Foundation

The mission of the Traffic Injury Research Foundation (TIRF) is to reduce traffic-related deaths and injuries. TIRF is a national, independent, charitable road safety institute. Since its inception in 1964, TIRF has become internationally recognized for its accomplishments in a wide range of subject areas related to identifying the causes of road crashes and developing programs and policies to address them effectively.

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