

ROLE OF CANNABIS IN ROAD CRASHES

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1.1 A brief statement of the issue

Although there is some evidence to indicate that many drugs other than alcohol impair driving, relatively little is known about the precise contribution that they might make to road crashes. Cannabis is a drug of particular concern in this context and its use while driving may have a potential impact on road safety (Austroads Working Group on Drugs and Driving 2000).

1.2 An assessment of the road safety issue

Cannabis is being used by a growing proportion of the population, particularly younger people, making it the most widely used illegal drug in the world (Teixira et al. 2004). Cannabis is the most commonly used recreational illicit drug in Australia with a reported 30% of Australians over 14 years having used cannabis at least once and 18% having used it recently (Adhikari and Summerill 2000). Likewise, in New Zealand, the 1998 National Drugs Survey found that cannabis is a popular recreational drug used by 43% of males and 27% of females aged 18 to 24 years in the last 12 months (New Zealand Ministry of Health 2001). As the number of people using cannabis increases, so too does the number of people who drive following cannabis ingestion (O'Kane et al. 2002). Given its widespread use and its possible effects on driving performance, there are growing concerns about the road safety implications arising from the use of cannabis.

There are three fundamental questions relating to cannabis and crash risk:

- how frequently do people drive under the influence of cannabis?
- what is the relationship between cannabis, driving performance and crash risk?
- what is being done to develop effective devices to detect cannabis in drivers?

1.3 Review of the research

1.3.1 What is being measured?

Cannabis can be detected primarily through blood or urine analysis. Research studies using the results of these analyses, however, need to specify whether testing has been for:

- tetrahydrocannabinol (THC)-acid, an inert metabolite which may be present more than 30 days after the last use of the drug, long after any psychological effect or possible impairment has disappeared; or
 - the psychoactive component of cannabis, delta-9-THC, the presence of which indicates that the subject has recently ingested cannabis and is to some extent influenced by its consumption.
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1.3.2 *The extent of cannabis use in drivers*

Although a number of studies have established that some proportion of drivers drive while impaired by cannabis, the methods for selecting drivers and the criteria for cannabis use vary considerably:

- In assessments of drivers suspected to be under the influence of either alcohol or some other substance, THC has been found to be present in 3% of drivers in Finland, 17% in Denmark, 26% in Norway and 57% in Switzerland (Augsberger and Rivier 1997, Lillsunde et al. 1996, Maes et al. 1999).
- In the US, 47% of drivers arrested for driving while impaired, as judged by roadside police, tested positive for THC (Poklis et al. 1987).
- In a survey of over 800 households in Western Australia, 6% of drivers reported having driven while affected by cannabis in the previous 12 months, with an additional 4% reporting driving after consuming cannabis and alcohol (McLeod et al. 1998).
- In Victoria, 96% of 100 drivers apprehended for suspected drug impaired driving tested positive for drugs, with 43% of these being THC positive (Gerostamoulos et al. 2002).
- In Sydney, a survey found that 74% of regular drug users reported driving a vehicle following cannabis ingestion, with 57% having done so in the preceding 12 months (Darke et al. 2004);
- Most recently, Victoria Police reported that their targeted testing program conducted between December 2004 and May 2006 resulted in 1 in 46 drivers tested returning positive results for either cannabis or methamphetamines or both (Victoria Police media release, 2006).

Despite the different implications of delta-9-THC and THC-acid, the studies cited above generally failed to specify which measures of cannabis use were being employed. Only the Victorian study (Gerostamoulos et al. 2002) specified that measures were based on delta-9-THC.

1.3.3 *The effect of cannabis on driving performance*

Studies have examined the effect of cannabis on both simulated driving (Sexton et al. 2000, Smiley et al. 1981 and Stein 1987) and on-road driving (Robbe 1994, Smiley 1986). These studies generally demonstrate that cannabis impairs driving performance to some extent, particularly on measures such as lateral placement (or weaving) and reaction time, and that higher doses of cannabis affect driving performance significantly more than lower doses.

It has been noted that most drivers under the influence of cannabis drive more slowly, focus attention more closely, leave larger headways and tend not to take risks (Henderson 1994). Whether this is due to deliberate compensation or to the effects of the drug itself, these changes may have some protective benefits. However researchers argue that any behaviour compensation will be inadequate when the driver encounters unexpected events or is placed in a situation requiring increased mental load, a rapid adaptive response or continuous attention (Robbe 1994, Smiley 1986). A review of the effect of drugs and alcohol on driving (Ogden and Moskowitz 2004) reports that cannabis-impaired drivers hit more obstacles, fail to notice road signs, and exhibit delayed braking and accelerating responses, when driving a simulator. Similarly, closed on-road studies have shown that drivers are five times more likely to hit traffic cones following ingestion of high doses of cannabis compared to driving when unaffected by the drug.

In summary, cannabis usage has been consistently associated with driving impairments, in a dose-related manner (Alvarez et al. 1997; Ramaekers et al. 2004) particularly in relation to lateral placement and performance in an emergency situation. Cannabis has at least the potential to increase crash risk.

1.3.4 Does cannabis increase crash risk?

In an attempt to address this issue, studies have examined the extent to which cannabinoids are present in the blood of drivers killed or injured in crashes. For example, cannabinoids (in the form of either THC or THC-acid) were found in 7% of drivers killed in the US and in 2% of drivers killed in Spain (Ramaeckers et al. 2004). These studies, however, have suffered from a failure to make the distinction between the presence of the active component of THC and the inactive metabolite, THC-acid (Alvarez et al. 1997, O’Kane et al. 2002).

In the early 1990s in Australia, Drummer (1994) found alcohol in 27% of fatally injured drivers and cannabinoids in 11% of this group. The author acknowledged that, as with other studies, the majority of cannabis cases tested positive for THC-acid, with only a small proportion testing positive for the THC active component. More recently, Drummer (1999) reported an increase in the prevalence of drugs in drivers killed and attributed this to higher detection rates for cannabis use. The most prevalent drug (other than alcohol) was cannabis, ranging from 12% in Victoria to 17% in Western Australia (with at least some of this variation possibly being due to different measurement protocols). Again, however, the author acknowledged that all cases had the inactive metabolite present.

In a later study published in 2003, Drummer and colleagues (2003a) investigated the incidence of alcohol and drugs amongst 3,398 fatally injured drivers from Victoria, New South Wales and Western Australia for the period 1990 -1999. Their sample contained 85% of all fatalities for these States during this timeframe. They reported that 8.5% of the sample tested positive for the active THC.

In New Zealand, Poulsen et al. (1998) examined levels of the THC active component of 1.0 ng/ml and above in drivers killed in road crashes over a two-year period and found that 12% of drivers tested positive at and beyond this level, a result broadly comparable to the Australian findings.

The relationship between cannabis and non-fatal injuries has received little attention. However, the limited available injury crash data show similar proportions of cannabis use among injured drivers. An early study by Bailey (1987) found 20% of drivers admitted to a trauma unit in New Zealand had been drinking and 7% had used cannabis. In a later study of injured car occupants in the US, Waller et al. (1997) found alcohol in 21% of the patients, cannabis in 14%, cocaine in 1% and opiates in 1%. It was also noted that some patients tested positive for more than one illicit drug and/or for alcohol and other drugs.

However, any measurement of the incidence of cannabis presence amongst road victims does not in itself constitute evidence for causality.

To date, the most feasible approach to determining causality is provided by ‘culpability analyses’. This approach relies upon the following basic steps:

- determining which drivers in crashes tested positive for the presence of THC and which drivers were shown to be cannabis-free
- determining which drivers in crashes were primarily responsible for the crash, based on police or other evidence
- determining separately for the THC-positive and the cannabis-free sub-groups, the proportion of drivers responsible for the crash

- if the proportion of 'responsible' THC-positive drivers is higher than the proportion of 'responsible' cannabis-free drivers then, by inference, cannabis has a causal role in road crashes. Conversely, if the proportion of 'responsible' THC-positive drivers is lower than the proportion of 'responsible' cannabis-free drivers, then cannabis has a protective role in road crashes.

Culpability analysis requires careful control of all appropriate factors if its conclusions are to be valid. It may well be that THC-positive and THC-free drivers may also differ across other variables - for example, gender, age, risk-taking - and it may be that these variables produce the differences in culpability, rather than cannabis.

Most culpability studies suggest that drivers who use cannabis alone have around the same culpability rate as drug-free drivers (Bailey 1987, Hunter et al. 1998, Ramaeckers et al. 2004). Longo et al. (2000a) also noted that the evidence suggested a biphasic effect of THC on crash culpability, with low concentrations decreasing crash risk and high concentrations increasing crash risk. However, as none of the differences in culpability across the different THC concentrations were significant, the possibility of cannabis being protective in low concentrations was described as 'an intriguing possibility only'.

Because many of the culpability analyses have relied upon the presence of the inert THC-acid, rather than the active THC, it has been suggested that there has been a consequent under-estimation of culpability amongst drivers with an active THC presence. Other methodological flaws in these studies include the length of time before the blood was tested for THC and the method of storage of this blood, both of which may have led to decreased levels of active THC (O'Kane et al. 2002).

The possibility of there being a positive association between recent cannabis use and increased crash risk, has been strengthened by research conducted by Drummer et al. (2003b). Blood analyses of 3398 fatally-injured Australian drivers showed that, relative to drug-free drivers, those with positive active THC readings had close to three times the odds of being culpable and the difference was statistically significant. Further, the greater the dosage, the higher the risk – drivers with active THC measurement of 5 ng/mL or above had 6.6 times the odds of being culpable (also statistically significant). Other evidence supports this finding, suggesting that drivers who tested positive for the active THC, especially those with higher doses, are three to seven times as likely to be judged responsible for the crash (Alvarez et al. 1997).

Given that cannabis is often ingested with alcohol being present, and bearing in mind the finding that a substantial number of those who take cannabis with alcohol drive (Longo et al. 2000b, Poulsen et al. 1998), the combined effect of the two drugs on driving has been examined.

Longo et al. (2000b), for example, note that culpability is high for drugs in combination with alcohol, particularly cannabis and benzodiazepines. They found that drivers who tested positive for alcohol in combination with THC were judged culpable in 86% of cases. This proportion did not differ significantly from drivers who only tested positive for alcohol (90%), which suggests the possibility that there was no increase in culpability beyond that produced by alcohol. Since the number of drivers who tested positive for alcohol and THC was small, these results should be interpreted with caution.

Drummer et al. (2003b) found that, for fatally-injured drivers in Australia, alcohol combined with THC produced a statistically significant increase in the odds of being found culpable, relative to drivers with a positive alcohol reading but otherwise drug-free – in other words, THC has increased the culpability rate over alcohol alone. Neither Drummer nor Longo reported the exact dose of each drug in the combinations where they were above the limit. Thus it is not clear how the results of the two studies should be compared.

In summary, there is emerging evidence that cannabis (particularly at high dosage) may cause crashes. When cannabis is combined with illegal doses of alcohol, there is a high overall crash risk.

The need to unravel any association between cannabis and heightened crash involvement is illustrated by a recent New Zealand study. Blows et al. (2005) found that self-reported acute marijuana use (use in the past 3 hours) was significantly associated with car crash injury after controlling for a range of possible confounders: when further adjustments were made to allow for risky driver behaviours at the time of crash (blood-alcohol concentration, seat belt use, travel speed and driver sleepiness), the association with acute marijuana use was no longer significant. However after making the same complete set of adjustments, there remained a strong and significant association between crash injury and habitual marijuana use – with the authors noting the possibility of other confounders and risky behaviours that needed to be considered. They also put a perspective on this issue by reporting that the prevalence of self-reported acute marijuana use in the study's driving population was less than 1%.

1.3.5 Detecting drug-impaired drivers

If a relationship between cannabis use and crash risk is supported, then effective measures to detect impaired drivers will be required. Several European countries, such as Belgium, Germany and Sweden, have laws that permit the screening of suspected drug-drivers (Samyn et al. 2002). As of 1 December 2000, an amendment to the Road Safety Act in Victoria empowered police to compel drivers suspected of driving under the influence of drugs to provide a blood sample. There are also similar provisions made in the laws of most of the other States in Australia (Gerostamoulos et al. 2002). In December 2003 the Victorian Government strengthened its attack on drug drivers with legislation that allowed for roadside saliva-based testing for two illicit drug types, cannabis and methamphetamines. If positive roadside readings are given, oral fluid samples are then collected and sent for evidentiary standard laboratory analyses.

Since then, other Australian jurisdictions (New South Wales, South Australia, Tasmania and Western Australia) now have or soon will have legislation to allow roadside drug testing under various circumstances, with these testing programs being at various stages of development. For example, in Western Australia in 2003, an expert working group of the Road Safety Council prepared a report about drug driving. Recommendations arising from that review were presented to Government, resulting in approval to draft legislation and other strategies to address drug impaired driving. WA has subsequently moved to introduce new legislation to counter drug driving. In November 2005 a Road Traffic Amendment (Drug Impaired Driving) Bill 2005 was introduced into Parliament, which had a primary focus on the identification and prosecution of drug-impaired drivers. In early 2006, Government also approved the introduction of random roadside drug testing using oral fluid (saliva). Legislation to cover both drug impaired driving and saliva testing for the presence of specified drugs is being progressed.

The two main approaches that are currently being used worldwide to detect drug-impaired drivers rely on either analysis of body samples or performance on standardized tests. Looking at the total range of performance-affecting drugs, both approaches currently show some deficits in sensitivity which need to be resolved if they are to be fully useful.

Measuring cannabis in bodily samples

Research is underway to develop a validated measure of drug use in bodily specimens such as blood, urine, sweat, saliva and hair. Complications to this approach include:

- practicality of taking blood samples at the roadside, including the time required to obtain a sample

- difficulty in detecting recent use and, therefore, likely impairment. Screening tests that are designed to detect cannabis in hair, urine and sweat samples often fail to distinguish between delta-9-THC, the principal active compound in cannabis, and its major metabolite, THC-acid, which is not psychoactive
- failure to establish the dosage of cannabis. The concentration of THC in the blood may begin to fall even while cannabis is still being consumed, to be stored in other tissues of the body. Unlike alcohol, the reduction of blood THC levels does not mean overall elimination of the drug
- there is still much that remains unknown about the relationship between bodily samples of a drug, the dosage required to reach those levels and subsequent impairment of performance.

Saliva-based measures of drug use are the most actively researched option and are generally preferred by police forces and experts worldwide. There are two saliva-based devices, the Rapiscan and Drugwipe, which are currently in use in Europe. While earlier evaluations of both devices returned unacceptably high rates of false negatives and false positives (Lenné et al. 2000, Mura et al. 2000, Samyn and van Haeren 2000), these types of device now have a more acceptable accuracy if used as a precursor for a bodily fluid analysis, as in Victoria.

Measuring drug impairment using performance testing

An alternative to screening for drug levels in bodily samples is to test performance in the field to establish driving impairment. One such test, the Standardised Field Sobriety Test (SFST), was developed by the National Highway Traffic Safety Administration (NHTSA) in the US to identify alcohol-impaired drivers (Stuster and Burns 1998). The SFST has since been expanded to form the Drug Recognition Expert (DRE) Program, a 12-step process that encompasses a greater number and range of tests. It aims to enable the police to determine whether or not a driver is impaired by drugs other than alcohol, and then to determine the type of drug causing the observable impairment. While evaluations of the program suggest that some improvements could be made to the accuracy of drug discrimination (Heishman et al. 1998), it has been hailed as a great success in the US.

In Victoria, changes to the drugs and driving legislation became effective in December 2000, as recommended by the Victorian Parliamentary Road Safety Committee (1996). The SFST is currently being used for detecting drug-related impairment in Victoria and police are now empowered to order the provision of bodily fluid samples from suspected impaired drivers. A recent study has shown that cannabis consumption results in impaired performance on SFSTs, with higher doses of THC resulting in a greater likelihood of being classified as impaired (Papafotiou et al. 2004).

1.4 Political, social and other factors

Under most circumstances, the possession and use of cannabis in Australasia is illegal. One might expect little opposition to road safety campaigns aimed at restricting the use of driving while influenced by an illicit substance.

However, the situation is more complex. On one hand, there is a 'War Against Drugs' lobby which would welcome the introduction of penalties for those detected driving while positive for THC, as part of a wider drug enforcement strategy. On the other hand, there is a strong pro-cannabis lobby which claims that the drug, when used within reasonable limits, poses less risk than many other approved drugs, especially alcohol.

Consequently any campaign targeting cannabis as a road safety risk is likely to be very closely scrutinised.

1.5 Conclusions: Is cannabis a major road safety concern?

The evidence suggests that high doses of cannabis increase crash risk, with possible additional risk posed by cannabis in combination with alcohol. As mentioned earlier, field screening procedures are now able to be used in Victoria, followed by evidential bodily fluid testing if they are positive. Further, there is the need for an improved understanding of the relationship between the cannabis dosage, recorded levels of cannabis in blood or other specimens, the associated impairments in driving skills and the impact on crash risk.

Given the limitations of the available research, it is problematic whether cannabis can be identified as an immediate road safety priority. It is considered essential, however, that research in this area continues. For example, the Austroads Working Group on Drugs and Driving has recommended that a watching brief be maintained in regard to Australasian and international development of understanding of the effect of drugs, particularly cannabis, on driver impairment, crash risk and responsibility.

In the meantime, it remains that police in Australasian jurisdictions are empowered to take action against impaired drivers – whether that impairment is attributable to alcohol, cannabis or to other factors.

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