# CANNABIS AND THE RISK OF ROAD CRASHES

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THC-positive cases (no other drugs or alcohol detected) showed an elevated relative risk compared to drug free drivers suggesting increased crash risk with recent cannabis use. When alcohol or other psychoactive drugs were also present this crash risk increased substantially. Recent use of cannabis therefore appears to be associated with an increased risk of a fatal car crash similar to a BAC of 0.10 g/100 mL.

## INTRODUCTION

The most controversial aspect of the involvement of drugs in accident causation is that of cannabis. Previous reports using responsibility analysis of Australian drivers have relied on coroners records in which forensic laboratories only measured the inactive form of cannabis (carboxy-$\Delta^9$-THC). Following the use of cannabis, this species is present in blood for up to several days and therefore its presence cannot be used to imply recent use of cannabis, and therefore likely impairment. Those studies show an odds ratio of a control driver of close to 1.0, implying no increase in risk for a cannabis user. Since 1998, most Australian forensic laboratories have measured THC in fatal road crashes.

While alcohol over-involvement has been demonstrated by a number of epidemiological studies, there are only a relatively few that have clearly demonstrated the risk of crashes while using cannabis. This presentation reviews the evidence of the involvement of cannabis in road crashes and includes the results of a major Australian study conducted over several years that has examined the over-representation of drugs in fatal road crashes. The authors have used a form of responsibility analysis to provide a measure of involvement of cannabis and other drugs in about 3400 fatal crashes (1).

## METHODOLOGY

The method involves establishing the responsibility or culpability of the driver using strict scoring guidelines in the absence of laboratory data on the presence or absence of drugs. Drivers who were involved in accidents in which significant mitigating factors were identified (other than a drug) were given a score which placed them into a "contributory" group. When a number of mitigating factors were identified, the drivers were placed into the "non-culpable" group. This model has been previously validated for alcohol involvement in fatal crashes.

Drugs that contribute to accident causation would be expected to show an over-representation of drivers in the culpable group compared to the non-culpable group. Thus, the culpability ratio would be expected to be larger than the control drug-free group if drugs are having an adverse effect on driver performance. This was confirmed in the paper by Robertson & Drummer (1). The odds ratio (OR) for alcohol from 0.01 to 0.049 gram/100 mL (%) is the same as the control group, but at higher BACs proportionally higher relative risks are seen. At BACs above 0.15% the OR is 24.

Drivers killed in road traffic crashes were subject to a full toxicological investigation including immunoassay screens for drugs of abuse. Cannabinoids were confirmed for the presence of tetrahydrocannabinol (THC) in blood using GC-MS. All other drugs were confirmed in blood by conventional toxicological procedures.

Responsibility analysis was used to assess the contribution of drugs in traffic accidents involving fatally injured drivers killed in the Australian States of Victoria (1990-1999), Western Australia (1991-93 & 1995/96 & 1997/98&1999), and New South Wales (1990-92, 1995-98 & 1999). The Victorian Institute of Forensic Medicine, VicRoads, Austroads and the NSW Roads and Traffic Authority funded these studies. Coroners records were kindly made available by the respective agency.

Statistical analyses for assessing differences in culpability ratios between groups were calculated by dividing the culpability ratio for a drug group to the drug-free culpability ratio. This odds ratio was analysed statistically using Fisher's Exact test and logistic regression.

## RESULTS

The database of ~3400 cases comprised of ~1400 Victorian, ~1300 NSW and ~700 Western Australian cases. Single vehicle crashes comprised about 50 % of all cases.

Drugs were found in 25 % of all cases. Alcohol over 0.05 % was detected in 29 % of cases. The incidence of cannabis during this period has ranged from 13-19 %. In recent times the prevalence of cannabis use has seemingly increased. In Victoria, the incidence was about 13 % in the early 1990s, however in the period 1998-2000 the incidence of cannabis in over 500 drivers killed in traffic crashes was 15 %. In 1999, the incidence in NSW, Western Australia and Victoria was 19, 17 and 15 %, respectively.

In all cases recorded in our database to end 1999, THC was present in 57 cases in which no other psychoactive drug or alcohol was detected. The median THC concentration was 8 ng/mL with a range from 1 to 228 ng/mL. The approximate incidence of other drugs in THC-positive cases was alcohol (44 %), opiates (13 %), benzodiazepines (13 %) and amphetamines (8%). A further 65 cases contained alcohol and cannabis (as THC).

THC-positive cases (no other drugs or alcohol detected) showed an odds ratio of 3.0 compared to drug free drivers suggesting an increased crash risk (see Table 1). When alcohol was combined with THC the risk increased to 19 ($P<0.05$). This high risk remained when all cases with alcohol or other psychoactive drugs were present. All drivers with positive alcohol concentrations (over 0.01 % and no other drugs) produced an odds ratio of 5.7 ($P<0.05$).

## DISCUSSION

Much is made of earlier studies using some form of culpability analyses and how these have generally shown little or no increase in risk in having a crash with cannabis positive drivers. Analysis of Australian fatalities before 1998 showed that THC was rarely measured and therefore it would not be appropriate to use those studies to define the role of cannabis in road trauma.

Other studies investigating the role of drugs in crash risk have previously been reviewed. Those studies tend to “suggest that marijuana-users are more likely to be responsible for their crashes than

drug-free drivers" (2-5). In contrast, another study found little evidence for any causal role for cannabis, although numbers of drivers were small (6).

**Table 1 Responsibility Analyses in Fatally-Injured Drivers**

| Drug Group | Total | Culpable | Not Culpable | Ratio | Odds Ratio |
|---|---|---|---|---|---|
| Drug negative cases | 1588 | 1209 | 372 | 3.25 | 1.0 |
| Alcohol only (over 0.05%) | 793 | 720 | 39 | 18.5 | 5.7* |
| Psychotropics (no alcohol) | 481 | 391 | 68 | 5.8 | 1.8* |
| Psychoactive drugs + alcohol | 323 | 302 | 13 | 23.2 | 7.1* |
| THC –only[1] | 56 | 49 | 5 | 9.8 | 3.0 |
| THC + alcohol | 65 | 62 | 1 | 62 | 19* |
| Carboxy-THC only[2] | 106 | 68 | 26 | 2.6 | 0.8 |
| Stimulants only | 53 | 43 | 5 | 8.6 | 2.6 |
| Benzodiazepines only | 34 | 27 | 6 | 4.5 | 1.4 |
| Opioids only | 57 | 46 | 11 | 4.2 | 1.3 |

[1] THC detected in blood and no other drugs including alcohol.

[2] Cases positive to carboxy-THC, but not positive to THC in blood

* $P<0.05$ Fishers Exact Test

The data presented shows a strong trend for an increase in risk of crashes for drivers who had recently consumed cannabis, somewhat similar to a BAC of between 0.05 and 0.10 %. It is of interest that drivers positive to cannabis metabolite, but not positive to THC in blood, showed an odds ratio very similar to a drug-free driver. This further confirms that past use of cannabis does not increase accident risk and means that laboratories must measure THC in blood to provide any useful evidence of possible driver impairment.

The most significant increases in crash risk were seen with drivers using any combination of psychoactive drug or a drug combination with alcohol. Noteworthy in this group were drivers using cannabis and alcohol showing an odds ratio of well over 10 ($P<0.05$).

In conclusion, the analysis of some 3400 fatally-injured drivers using responsibility analysis has shown that drivers using cannabis with detectable THC in blood have a three-fold higher risk of

being killed in a crash than drug-free drivers. The risk is further increased when other psychoactive drugs or alcohol have also been used.

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## REFERENCES

1. Robertson MD, Drummer OH. Responsibility analysis: a methodology to study the effects of drugs in driving. Accid Anal Prev 1994;26(2):243-7.

2. Simpson HM. Epidemiology of road accidents involving marijuana. Alcohol, Drugs and Driving 1986;2(3-4):15-30.

3. Simpson HM, Mayhew DR, Warren RA. Epidemiology of road accidents involving young adults: alcohol, drugs and other factors. Drug Alcohol Depend 1982;10(1):35-63.

4. Terhune KW, Ippolito CA, Hendricks DL, Michalovic JG, Bogema SC, Santinga P, et al. The incidence and role of drugs in fatally injured drivers. Washington: US Department of Transportation, National Highway Traffic Safety Administration; 1992, Report No.: Report DOT HS 808 065.

5. Warren RA, Simpson HM, Hilchie J, Cimbura G, Lucas D, Bennett R. Drugs detected in fatally injured drivers in the Province of Ontario. In: Goldberg L, editor. Alcohol, Drugs and Traffic Safety; 1981; Stockholm, Sweden: Almqvist and Wiksell International, Stockholm; 1981. p. 203-217.

6. Williams AF, Peat MA, Crouch DJ, Wells JK, Finkle BS. Drugs in fatally injured young male drivers. Public Health Rep 1985;100(1):19-25.

## BIOGRAPHICAL NOTE

### Olaf H Drummer

Professor Drummer is a forensic pharmacologist and toxicologist with some 25 years experience in measuring drugs in biological fluids and in investigating the effects of drugs including the involvement of drugs in driving. He has published some 200 scientific papers in international journals covering both basic research and medico-legal issues of drugs.

He holds a Ph.D. in Medicine (Pharmacology) at Melbourne University and a Bachelor's Degree in Applied Chemistry from Royal Melbourne Institute of Technology and is a member of a number of professional bodies including the Royal Australian Chemical Institute and the Australian Academy of Forensic Sciences. He is an Executive Officer and Treasurer of The International Association of Forensic Toxicologists.

He has given expert evidence in numerous courts throughout the Country in Inquests, Committals and Criminal trials.

He has recently published a book “The Forensic Pharmacology of Drugs of Abuse”, Arnolds 2001.

He is currently Head of the Scientific Services at the Victorian Institute of Forensic Medicine which includes the forensic toxicology laboratory. He also holds the position of Associate Professor in Forensic Medicine at Monash University.