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Drugs and Driving: A Compendium of Research Studies

Drugs and Driving: A Compendium of Research Studies

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*The views expressed herein are solely those
of the author and do not necessarily reflect those
of the Department of Justice Canada or the Government of Canada.*



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Introduction

Impaired driving involving illicit drugs and/or legal drugs that are abused causes needless injuries and deaths on Canadian roads each year. The Department of Justice Canada report titled *Strengthening Drug-Impaired Driving Investigations* points out that,

Drug users are disproportionately involved in fatal accidents. A study by the *Société de l'assurance du Québec* determined that more than 30% of fatal accidents in the province involved drugs or a combination of drugs and alcohol.^[1]

A Traffic Injury Research Foundation poll in 2002 found that close to 20% of Canadian drivers had driven within two hours of taking a potentially impairing drug (over-the-counter, prescription or illegal). The Ontario Student Drug Use Survey in 2003 found that close to 20% of high school drivers in the province reported driving within one hour of using cannabis at least one in the preceding year.²

It is clear that drug-impaired driving is a serious, wide-spread problem that requires effective responses. There is a broad spectrum of options, from strictly preventative to strictly punitive approaches. As seen in relation to alcohol-impaired driving, it is likely that a combination of both preventative and punitive responses provides the best results.³ Nevertheless, this annotated bibliography focuses on studies pertaining to identification and to prosecution of drug-impaired driving. Moreover it concentrates on studies about drug-impaired, rather than alcohol-impaired, driving.

As described in the section that follows, there have been a substantial number of studies relating to drug-impaired driving worldwide. However, there has been a paucity of research that brings together data from these various sources. Assessment of the merits of proposed legislative changes in the future and identification of alternative options will require up-to-date knowledge of current literature pertaining to drug-impaired driving.

This annotated bibliography attempts to meet these needs. Its objective is to provide a listing of drug-impaired driving research published in English, since 1999.⁴ Qualitative and quantitative research, relevant surveys and other materials pertaining to drug-impaired driving are included among its listings.

¹ See Gouvernement du Québec, Société de l'assurance automobile web site, *Le rôle de l'alcool et des autres drogues dans les accidents mortels de la route au Québec : Résultats finaux*, http://www.saaq.gouv.qc.ca/publications/dossiers_etudes/droque_fr.pdf (accessed April 1, 2006).

² Government of Canada, Department of Justice Canada, News Room Backgrounder website, *Strengthening Drug-Impaired Driving Investigations*, accessed April 1, 2006 from http://www.justice.gc.ca/en/news/nr/2004/doc_31280.html (citing the report, *The Road Safety Monitor 2002: Drugs and Driving* on the Traffic Injury Research Foundation website http://www.trafficinjuryresearch.com/publications/PDF_publications/RSM_02_Drugs_and_Driving.pdf).

³ The non-profit organization of Mothers Against Drunk Driving (MADD), for example, has taken on dual roles. It has been instrumental in using public education and advertising campaigns to awaken the Canadian population to the dangers of drinking alcohol and driving. This organization has also seen successes in lobbying for stronger laws to sanction alcohol-impaired driving.

⁴ Alcohol-impaired driving is not the focus of this annotated bibliography, although alcohol may also be considered a drug.

This annotated bibliography was researched and written by the Traffic Injury Research Foundation (TIRF), and Sherilyn A. Palmer from the Department of Justice Canada. TIRF is an independent charitable institute, which engages in research relating to the causes of road crashes on an ongoing basis. TIRF also continues to develop and promote effective preventative programs and policies, with a focus on safety on Canadian roads.⁵

In terms of structure, this bibliography organizes listings according to the country in which the drug-impaired population was studied (rather than the country in which the research was analyzed, published or presented). Those studies involving multiple countries and more than one continent are listed under the rubric of "International," while studies involving several European countries are listed under the rubric of "Europe." These two broad categories are followed by alphabetically ordered individual countries in which single-country studies have been conducted.⁶ Under these rubrics, studies included in this annotated bibliography are listed alphabetically according to the last name of the first author.

Rather than adopting a traditional format, a point-form approach is used. Citations for the various studies and succinct summaries of their descriptions, data and research findings are given. This approach facilitates studies and their contents to be found quickly and easily. It also provides insights into the countries in which studies of drug-impaired driving have been conducted and the issues that have been researched.

It is hoped that this annotated bibliography will provide criminal justice professionals, researchers, policy makers, legislators and the general public with useful information about research relating to drug-impaired driving in Canada and throughout the world.

⁵ See TIRF website: <http://www.trafficinjuryresearch.com> (accessed March 27, 2006).

⁶ See Contents page.



Legislative Background

Section 253 of the *Criminal Code of Canada* includes two separate and distinct offences for impaired driving. Under Paragraph 253(a) of the *Criminal Code*, it is an offence to operate a motor vehicle, vessel, aircraft or railway equipment while one's ability is impaired by alcohol or a drug. (The combination of a drug and alcohol is also included, even when each alone would not constitute impairment.) Secondly, under Paragraph 253(b) of the *Criminal Code* it is an offence to operate a motor vehicle, vessel, aircraft or railway equipment with a blood alcohol concentration that exceeds 80 milligrams of alcohol in 100 millilitres of blood.⁷ The failure of the *Criminal Code* to set a "legal limit" for any drug - other than for alcohol - raises substantial problems for identification and prosecution of drug-impaired driving in Canada.

The lack of clear and effective legislative responses to drug-impaired driving has been a longstanding concern. In 1999, for example, a Department of Justice Canada report pointed out that,

The House of Commons Standing Committee on Justice and Human Rights reviewed the impaired driving provision of the *Criminal Code* and heard from police and scientific witnesses that drug-impaired driving is a serious [but preventable] problem on Canadian roads. In its report, *Toward Eliminating Impaired Driving*, the Standing Committee recommended that federal/provincial/territorial officials consider ways to improve the *Criminal Code's* provisions relating to investigation of drug-impaired driving.⁸

At the federal level, in the past few years several legislative reforms have been introduced to Parliament to respond to drug-impaired driving. The Parliamentary website provides summaries of these bills and the reasons they have not become law.

The House of Commons Special Committee on the Non-medical Use of Drugs (Bill C-38) published the most recent parliamentary report involving

⁷ A Department of Justice Canada report titled, Drug-Impaired Driving Consultation Document also points out that, "Sections 254, 256 and 258 of the *Criminal Code* set out extensive procedures that permit a peace officer to gather evidence of alcohol-impaired driving and produce this evidence before the court, typically to prove the paragraph 253(b) offence. An officer may demand a sample of breath into an 'approved screening device' when the officer has reasonable suspicion that there is any alcohol in the driver's body. With reasonable grounds to believe that a driver has committed a section 253 offence in the previous three hours, the officer may demand a sample of breath into an 'approved instrument'. If the driver is unable to provide a sample of breath into an approved instrument, the officer may demand a blood sample. If a blood sample is taken for alcohol analysis, it may also be analyzed for the presence of a drug. As recommended by the Standing Committee, Parliament amended section 256 of the *Criminal Code* in 2000, so that an officer may apply for a warrant to obtain a blood sample from an unconscious driver who is reasonably believed to have committed, in the previous four hours, a section 253 drug-impaired driving offence involving a collision resulting in injury or death. Prior to the amendment, the warrant application could only have been made in relation to alcohol. Government of Canada, Department of Justice Canada, *Drug-Impaired Driving: Consultation Document, Background Information and Legislative Proposals to Enhance Criminal Code Drug-Impaired Driving Investigations*, October, 2003, p. 3-4.

⁸ Ibid, p. 3.

drug-impaired driving in the fall of 2003.⁹ It briefly called Parliament to develop a strategy to address the issue of drug-impaired driving following a review of Bill C-17. On 26 April 2004, Bill C-32¹⁰ was introduced in the House of Commons and later referred to Committee for study before second reading. Substantially similar to ...[the more recent] Bill C-16, Bill C-32 would have amended the *Criminal Code* to deal with drug impaired driving, but died on the *Order Paper* in May 2004 when an election [of June 28, 2004] was called.¹¹

Subsequently Bill C-16¹² and Bill C-17¹³ also died on the *Order Paper* at dissolution of Parliament when the federal election of January 23, 2006, was called.

On November 21, 2006, the Government of Canada tabled the current Bill C-32 in the House of Commons. Bill C-32 would make Canada's streets safer by cracking down on drug-impaired driving. The proposed legislation will get tough on drug impaired driving by:

1. physical sobriety tests at the roadside based on suspicion of a drug in the body,
2. Drug Recognition Evaluations at the station based on reasonable belief that the driver committed a drug-impaired driving offence, and
3. a bodily substance sample to test for the presence of a drug.

Refusal of a demand would be an offence carrying the same penalties as those that exist for impaired driving. This structure for 253(a) impaired investigations parallels that which already exists for 253(b) alcohol concentration investigations.

As these legislative reforms have not yet been adopted, the above-mentioned issues relating to identification, evidence gathering, and prosecution of drug-impaired driving offences remain unresolved. In this context, the present annotated bibliography is meant to provide useful sources, data and information pertaining to drug-impaired driving from studies conducted in Canada and abroad.

⁹ Footnote #2, Government of Canada, Library of Parliament website (accessed April 1, 2006), www.parl.gc.ca/38/1/parlbus/chambus/house/bills/summaries/c16-3.htm citing "*Report 1*, Bill C-38, An Act to Amend the Contraventions Act and the Controlled Drugs and Substances Act."

¹⁰ Government of Canada, Library of Parliament website (accessed April 1, 2006), <http://www.parl.gc.ca/38/1/parlbus/chambus/house/bills/summaries/c16-3.htm>.

¹¹ Government of Canada, Library of Parliament website, Bill C-32: An Act to Amend the *Criminal Code* (Drugs and Impaired Driving) and to make related and consequential amendments to other acts, <http://www.parl.gc.ca/38/1/parlbus/chambus/house/bills/summaries/c16-e.htm> (accessed April 2, 2006). See <http://www.parl.gc.ca/LEGISINFO/index.asp?Lang=E&query=4184&Session=12&List=toc>.

¹² Government of Canada, Library of Parliament website, Bill C-16: An Act to amend the *Criminal Code* (impaired driving) and to make consequential amendments to other Acts, accessed April 2, 2006,

<http://www.parl.gc.ca/LEGISINFO/index.asp?Lang=E&query=4292&Session=13&List=toc>.

¹³ Government of Canada, Library of Parliament website, Bill C-17: An Act to Amend Contraventions Act and the Controlled Drugs and Substances Act and to make consequential amendments to other acts, accessed April 2, 2006, from <http://www.parl.gc.ca/LEGISINFO/index.asp?Lang=E&query=4293&Session=13&List=toc>.



Annotated Sources

International

1. **Bates, M. N., and Blakely, T. A. (1999).** Role of cannabis in motor vehicle crashes. *Epidemiology Review* 21: 222-232.

Overview

Review article of the role of cannabis in motor vehicle collisions

Type of study, population(s) and proportion tested

Review of 5 existing studies examining the risks associated with cannabis in motor vehicle collisions

Re-analysis of data was presented for most studies reviewed

Culpability analysis

Drugs examined

Cannabinoids

Some studies also examined cannabis in combination with alcohol

Method of testing and medium used

Various methods were used in different studies

Other dependent variables

Findings (including statistical methods)

3 studies show reduced risk of culpability for fatal crash involvement -- weighted OR of .59, $p=.05$

2 injury studies -- one shows increased risk, one shows decreased risk

Risk of alcohol/cannabis combination higher than alcohol alone but not significantly so (small number of cases)

Comments

Author identifies several limitations of culpability studies

Drivers who have used cannabis modify their driving behaviour to compensate for perceived impairment by driving slower, taking fewer risks, and leaving more headway

Not possible to exclude possibility that cannabis alone or in combination leads to increased risk of crash in less serious crashes

- 2. Gemmell, C., Moran, R., Crowley, J., and Courtney, R. (1999).** *Literature Review on the Relation between Drug Use, Impaired Driving and Traffic Accidents.* CT.97.EP.14. Lisbon, Portugal: European Monitoring Centre for Drugs and Drug Addiction.

Overview

This report summarizes the general findings of drugged driving, with respect to a variety of drugs, and discusses some of the problems associated with epidemiological and experimental studies in this area

Type of study, population(s) and proportion tested

Literature review

Drugs examined (threshold values for detection)

Alcohol
Methadone
Cannabis
Benzodiazepines
Antihistamines
Antidepressants
Amphetamines
Ecstasy and other synthetic drugs

Findings (including statistical methods)

Epidemiological studies:

Unclear whether accidents occur as a direct result of the drug in question
Often no comparison group
Drugs often mixed with alcohol
Presence of drugs does not necessarily imply impairment

Simulation techniques:

Introduces artificiality and ethical issues, with respect to giving high doses of drugs to subjects

Alcohol: no drug found as frequently as alcohol

Methadone: not found often and studies do not suggest sufficient impairment

Cannabis: one of the most prevalent drugs, though often found mixed with alcohol, which is more likely to result in an increased risk of accident

Benzodiazepines: most frequently detected licit drug which can double the risk of accident, especially in older (over 65) drivers and when mixed with alcohol



Antihistamines: seldom suggested as causal in accidents

Antidepressants: effects of severe depression may have greater impact on driving

Amphetamines: insufficient evidence, largely due to lack of controlled studies, but, in high doses, it is likely to increase driving impairment

Ecstasy and other synthetic drugs: more research is required, but they are likely to be a danger to driving

3. **Kelly, E., Darke, S., and Ross, J.** (2004). A review of drug use and driving: epidemiology, impairment, risk factors and risk perceptions. *Drug and Alcohol Review* 23: 319-344.

Overview

Review of drug use and driving literature

Type of study, population(s) and proportion tested

Review

Drugs examined (threshold values for detection)

Cannabis

Method of testing and medium used

Other dependent variables

Findings (including statistical methods)

Drug driving prevalence approximately 4% in past 12 months

Up to 25% of crash-involved drivers positive for drugs

Cannabis is the most common, followed by benzodiazepines, cocaine, amphetamines, opioids -- polydrug use common, as is overlap with alcohol

Cannabis and benzodiazepines increase risk

Unclear as to whether there exists an association between drug use problems and drug driving

Less concern about impaired driving among drug drivers and drink drivers -- perception is that drugs do not significantly impair driving performance

Risk perceptions vary according to drug type -- cannabis seen as producing less impairment than others, including alcohol

Research and interventions should focus on high-risk groups

4. **Ramaekers, J. G., Berghaus, G., van Laar, M., and Drummer, O. H. (2004).** Dose related risk of motor vehicle crashes after cannabis use. *Drug and Alcohol Dependence* 73: 109-119.

Overview

Studies of cannabis prevalence and relative risk to driving are reviewed.
Both epidemiological and experimental studies are discussed

Type of study, population(s) and proportion tested

Literature review

Drugs examined (threshold values for detection)

Cannabis
Alcohol

Findings (including statistical methods)

Epidemiological studies:

Prevalence of THC between 4 and 14% in injured or fatally injured drivers
In the absence of control groups, role of THC in collisions cannot be determined

Culpability studies:

Cannabis in combination with alcohol have shown significant increases in culpability rates

Looking specifically at THC presence, crash culpability increases with increased doses of THC (OR of 2.7 compared to drug-free drivers)

Case-control studies:

OR for accident or injury, for those with THC present or having used cannabis within so many hours of driving, ranged from 2.3-2.9
When in combination with alcohol, OR ranged from 4.6-80.5

Experimental studies:

In interactive simulators (dose up to 200 µg), THC has been found to increase lateral position variability, headway variability, and speed variability and cause subjects to ignore navigational information, hit roadway obstacles, and react more slowly to secondary demands

In actual driving situations, (THC dose of 8.4 mg) concentration, care while driving, and judgement were significantly affected



When cannabis combined with alcohol, more severe performance impairments were found

5. **Thomas, R. E. (1998).** Benzodiazepam use and motor vehicle accidents -- systematic review of reported association. *Canadian Family Physician* 44: 799-808.

Overview

Review of relationship between benzodiazepine use and motor vehicle collisions

Type of study, population(s) and proportion tested

Review of case-control, police or emergency studies and experimental driving studies of the effects of benzodiazepines

Drugs examined (threshold values for detection)

Benzodiazepines

Method of testing and medium used

Other dependent variables

Examines impaired driving, crashes, mortality, medical cases, hospitalization

Findings (including statistical methods)

OR for mortality and emergency medical treatment range 1.45 to 2.4

In police and emergency ward studies, benzodiazepines a factor in 1% to 56% of crashes (usually 5 to 10%)

In cases where BAC was below legal limit, benzodiazepines were found in 43 to 65% of cases

In one controlled study, 5% of drivers and 2% of controls in crashes had benzodiazepines present

Benzodiazepines double risk of motor vehicle collision

For driver >65 years of age, risk is higher when taking longer acting and larger quantities of benzodiazepines

6. **Ward, N. J., and Dye, L. (1999).** *Cannabis and Driving: A Literature Review and Commentary*. Road Safety Research Report, No. 12. London: Department for Transport, Local Government and the Regions.

Overview

Literature review on cannabis and driving

Type of study, population(s) and proportion tested

Literature review and commentary

Drugs examined (threshold values for detection)

Cannabis

Method of testing and medium used

Other dependent variables

Findings (including statistical methods)

Cannabis was considered to cause clear impairment on laboratory tasks such as tracking and attention

Impairment was not as pronounced on real driving or simulator tasks

Compensatory effort could be invoked to offset the impairing effects

4-12% of fatalities test positive for cannabis -- most cases confounded by alcohol

Baseline data for non-crash cases absent

Authors suggest that the equivalent of legal alcohol limit (80 mg/100 ml) for cannabis is 11 ng/ml THC

Study notes that the research has been piecemeal with numerous problems and gaps. No firm conclusions could be drawn



Europe

7. **Christopherson, A. S. (2002).** The role of medicines in traffic accidents in the European countries. In D. R. Mayhew and C. Dussault (Eds.), *Proceedings of the 16th International Conference on Alcohol, Drugs and Traffic Safety*. Quebec: Société de l'Assurance Automobile du Québec.

Overview

This review focuses on medicinal drug use in Europe in both accidents involved and apprehended drivers

Type of study, population(s) and proportion tested

Literature review

Drugs examined (threshold values for detection)

Benzodiazepines
Opiates
Barbiturates
Cannabis
Amphetamines
Muscle relaxants
Antihistamines

Findings (including statistical methods)

Accident involved drivers:

Benzodiazepines seem to have the most negative effect
Prevalence of benzodiazepines appears to be higher in these drivers (7-14%), though prevalence in general population not well known
Benzodiazepines most frequently detected drug after alcohol
OR's for traffic accidents within four weeks after the first prescription for benzodiazepines ranged from 2.5-3.9

Apprehended drivers:

One or more benzodiazepines were found in 50% of cases in 2001
Doses normally above recommended therapeutic dose and often combined with illegal or other psychoactive drugs
Flunitrazepam and diazepam most frequently detected (30 and 25%, respectively)
Majority of drivers apprehended are young men (20 – 35 years old)

Recommendations:

Need for:

Epidemiological surveys on accident drivers
Larger roadside drug screening studies
Standardization of study protocols (cut-off levels, screening procedures, etc.)

8. **de Gier, J. J. (1998).** *Road Traffic and Illicit Drugs*. European Commission, Cooperation Group to Combat Drug Abuse and Illicit Trafficking of Drugs. Strasbourg, France: Pompidou Group.

9. [Also: **de Geir, J. J. (2000).** Review of European investigations of illicit drug prevalence in road traffic. In *Proceedings of the 15th International Conference on Alcohol, Drugs and Traffic Safety*. May 22-26, 2000. Stockholm, Sweden. International Council on Alcohol, Drugs & Traffic Safety.]

Overview

Four large epidemiological studies on the prevalence of drugs, from Italy, Germany, Belgium, and Norway, are reviewed

Type of study, population(s) and proportion tested

Literature review

Drugs examined (threshold values for detection)

- Benzodiazepines
- Opiates
- Cannabis
- Amphetamines
- Cocaine
- Barbiturates
- Tricyclic antidepressants
- Alcohol

Findings (including statistical methods)

Prevalence of drugs and road traffic

	General Population	DUI Suspected	Collision Involved
Cannabis	0.6%	26%	5.5-6%
Opiates	0.7%	8%	3.5-7.5%
Amphetamines	0.08%	21%	2.7-3.0%
Cocaine	0.01%	0.04%	0.5-0.7%
Benzodiazepines	3.6%	31%	8.5%
Barbiturates	0.5%	not detected	1.3-3.4%
Tricyclic			
Antidepressants	Not detected	Not detected	1.5%
Drugs & Alcohol*	30%	25%	17.5-27%
Multiple Drug Use*	95%	not presented	17.5-20%

*drug positive cases

Benzodiazepines are generally higher than illicit drugs

Comparisons between studies difficult because of different methodologies, etc.



Australia

10. **Drummer, O. H.** (1995). Drugs and accident risk in fatally injured drivers. *Proceedings of the 17th International Conference on Alcohol, Drugs and Traffic Safety* (T'95). Australia.

Overview

Study of fatally injured drivers in Australia

Type of study, population(s) and proportion tested

1,052 fatally injured drivers in Australia
Time period of January 1990 to December 1993

Drugs examined (threshold values for detection)

Benzodiazepines
Other prescription drugs
Drugs of abuse (including alcohol)

Method of testing and medium used

Blood samples
Those with drugs compared to those drug-free to obtain ORs

Other dependent variables

Findings (including statistical methods)

Drugs in 22% of cases (13% with drugs only and 9% in combination with alcohol)

Alcohol in 36% of cases

Illegal drugs in 13% of cases

Most common were cannabis (11%), and stimulants, benzodiazepines, and opiates (3% each)

Only OR that was significant was for alcohol (OR=7.6)

Those with higher than therapeutic concentrations or multiple drugs had more responsible cases

Comments

Selection of cases not specified

11. **Drummer, O. H., Gerostamoulos, J. Batziris, H., Chu, M., Caplehorn, J., Robertson, M. D., and Swann, P. (2004).** The involvement of drugs in drivers of motor vehicles killed in Australian road traffic crashes. *Accident Analysis and Prevention* 36: 239-248.

Overview

Culpability analysis of fatally injured drivers in Australia

Type of study, population(s) and proportion tested

Drivers killed in motor vehicle crashes in 3 Australian states (VIC., NSW, and WA) (n=3398)
Only on-road crashes included:

Data from Coroner's offices/Offices of Forensic Medicine, etc.
Cases not included if death was more than 4 hours from crash and if blood sample was not collected within 4 hours of the crash
Time period from 1990 to 1999

Drugs examined

Benzodiazepines
Opiates
Amphetamines
Cannabinoids (THC or carboxy-THC)
Other psychoactive
Non-psychoactive
Alcohol

Method of testing and medium used

Blood sample which was subjected to a full toxicological investigation

Other dependent variables

Responsibility analysis used to determine culpability – involved using the following information:

Condition of the road
Condition of the vehicle
Driving conditions
Type of crash
Witnesses' observations
Road law obedience
Difficulty of task
Level of fatigue

Findings (including statistical methods)

Presence of alcohol - 29%; any type of drug - 27%; cannabinoids – 14%; opioids – 5%; stimulants – 4%; and benzodiazepines – 4%



Of the 1,694 drug-or alcohol-positive drivers, 88% were responsible for the crash (compared to 71% for those not positive)

Odds ratios for alcohol were from 1.2 (BAC <.05%) to 25 (BAC >.20%) and ORs for BAC's above .10% all significant

Detection of any type of drug was significantly associated with culpability (OR=1.7)

Largest ORs associated with THC (6.6), stimulants (OR=2.3), and other psychoactive (OR=3.8)

OR for THC positive and BAC \geq .05% was 2.9 times that for drivers with BAC \geq .05% alone

Comments

65% of opiate-positive drivers were using other drugs; therefore, the exclusion of drivers who had taken other drugs reduced power of testing for an association between opiates and culpability

12. **Gerostamoulos, J., McCaffrey, P., Drummer, O. H., Potter, J., Fitzgerald, M., and Odell, M. (2002).** Drug prevalence in road trauma victims in Victoria. In D.R. Mayhew and C. Dussault (Eds.), *Proceedings of the 16th International Conference on Alcohol, Drugs and Traffic Safety*. Quebec: Société de l'Assurance Automobile du Québec.

Overview

Report on persons injured in collisions in Victoria, Australia

Type of study, population(s) and proportion tested

N=358 (proportion tested not reported)

Drugs examined (threshold values for detection)

Cocaine
Cannabinoids
Opiates
Benzodiazepines
Amphetamines

Method of testing and medium used

Blood samples
Enzyme immunosorbent assay confirmed by chromatographic techniques

Other dependent variables

Findings (including statistical methods)

Cocaine	2%
Cannabinoids	36%
Opiates	10%
Benzodiazepines	14%
Amphetamines	12%

Comments

Few details provided

Not sure if sample consists of drivers or anyone reporting to hospital who was injured in a motor vehicle collision

- 13. Longo, M. C., Hunter, C. E., Lokan, R. J., White, J. M., and White, M. A. (2000).** The prevalence of alcohol, cannabinoids, benzodiazepines and stimulants amongst injured drivers and their role in driver culpability. Part I: The prevalence of drug use in drivers, and characteristics of the drug-positive group. *Accident Analysis and Prevention* 32(5): 613-622.

Overview

Study of injured drivers in South Australia

Type of study, population(s) and proportion tested

2,500 injured drivers involved in a non-fatal road crash and survive for more than 30 days in South Australia

Time period of April to August 1995 and December to August 1996

Drugs examined (threshold values for detection)

Cannabinoids (40 ng/ml)
Benzodiazepines (5 ng/ml)
Stimulants (50 ng/ml)
Alcohol

Method of testing and medium used

Blood sample
Crash details obtained from police records

Other dependent variables

Findings (including statistical methods)

23% tested positive for at least one drug including alcohol, 10% excluding alcohol



Alcohol and cannabinoids most common

12% with positive BAC, 10% over legal (0.05%)

Cannabinoids in 11% of drivers

Drivers tended to be younger males

Drivers in single-vehicle collisions significantly more likely to test positive for drugs than those in multiple-vehicle collisions

14. Parliamentary Travelsafe Committee (1999). *Drug Driving in Queensland.* Legislative Assembly of Queensland.

Overview

This review summarizes general findings about drug use among drivers in Queensland

Type of study, population(s) and proportion tested

Literature review

Drugs examined (threshold values for detection)

Cannabis
Narcotics
Opiates
Antidepressants
Stimulants
Alcohol

Findings (including statistical methods)

Threat to road safety posed by drug driving is significantly less than that for drink driving

Most frequently detected drugs in fatally injured drivers include:

Cannabis
Narcotic analgesics
Opiates
Antidepressants
Stimulants

Drugs commonly found with alcohol and other drugs

Relationship between drug use, impairment of driving, and crash risk is not fully understood

Increased crash risk for drugs in combination with alcohol

Increased crash risk associated with benzodiazepine use as well as cannabis and stimulant use

The young and elderly are at-risk groups with the young more likely to use illegal and prescribed drugs for recreational purposes and the elderly more likely to use prescription drugs

Commercial drivers were highlighted in this review as a group that is more likely to use illegal and prescribed drugs more than any other road user group

Commercial drivers of particular concern with respect to their use of psychostimulant drugs to maintain alertness

15. Potter, J. (2000). *Drugs and Driving in Australia*. Sydney: Austroads.

Overview

This review summarizes findings from Australian studies on the prevalence of drugs and the relative risks associated with drugged driving

Type of study, population(s) and proportion tested

Literature review

Drugs examined (threshold values for detection)

Licit drugs
Illicit drugs
Alcohol

Findings (including statistical methods)

Simply detecting drugs in various populations of drivers cannot allow for causation to be inferred

Many drugs, when detected, are detected in combination with alcohol
The relationship between drug concentration in the body and the risk of that driver crashing are not well understood

Cannabis, when detected alone, does not seem to significantly increase the risk of crash; however, when Delta-9-THC is found alone in high concentrations, elevated risk is observed (though number of cases is small)

Mediating factors of drug effects are illness, fatigue, and mood

Legislation dealing with drugs and driving should deal with the impairment of the driver and not on dose of drug

Roadside screening devices can be a valuable tool for assessing drugged drivers and the prevalence of certain drugs



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16. **Swann, P. (2000).** The real risk of being killed when driving whilst impaired by cannabis. In *Proceedings of the 15th International Conference on Alcohol, Drugs and Traffic Safety*. May 22-26, 2000. Stockholm, Sweden. International Council on Alcohol, Drugs & Traffic Safety.

Overview

Australian studies, from 1995 to 1998, dealing specifically with cannabis prevalence among drivers are discussed. Emphasis is placed on drivers where the only drug detected was the impairing constituent Delta-9-THC

Type of study, population(s) and proportion tested

Literature review

Drugs examined (threshold values for detection)

Cannabis
Psychotropic drugs
Delta-9-THC

Findings (including statistical methods)

Percent driving after using marijuana ranged from 7-22% in injured drivers and 8-37% in fatalities

Illicit drugs 15 times more common in impaired, injured, and fatally injured drivers than in general population

OR for psychotropic drugs was 3.8, drugs and alcohol, 9.2, and, specifically, Delta-9-THC, 6.4

Though small numbers were involved for those containing only the cannabis constituent Delta-9-THC, 24 of the 25 fatally injured drivers were deemed culpable

It is suggested that the concentration of 11 ng/ml of THC affects all performance areas, and doses found in fatally injured drivers who had only THC in their system ranged from 38 ng/ml in 1995-1996 to 24 ng/ml in 1997-1998

Authors suggest that cannabis alone, in high doses, poses a relatively high risk to driving

Austria

17. **Risser, D., Stichenwirth, M., Klupp, N., Schneider, B., Stimpfl, T., Vycudilik, W., and Bauer, G.** (1998). *Journal of Forensic Sciences*, 43(4): 817-820.

Overview

Study of drivers suspected of driving under the influence of drugs in Vienna, Austria

Population(s) and proportion tested (including type of study)

N=205

Stopped for reasons such as reckless driving, unsafe driving, driving at high speeds, etc.
Time period of 1993 to 1996

Drugs examined (threshold values for detection)

Cannabis
Benzodiazepines
Morphine
Cocaine
Methadone
Amphetamines
Barbiturates
Alcohol
Methaqualone

Method of testing and medium used

Urine samples
Data obtained from police files and toxicology reports

Other dependent variables

None

Findings (including statistical methods)

66% with cannabis, 44% morphine, 23% cocaine, 14% methadone

Cannabis positive cases rose from 47% in 1993 to 72% in 1996, whereas morphine positive cases decreased (58% to 37%)

More than one drug detected in 48% of cases



Belgium

18. **Schepens, P. J., Pauwels, A., Van Damme, P., Musuku, A., Beaucourt, L., and Selala, M. I. (1998).** Drugs of abuse in weekend drivers involved in car crashes in Belgium. *Annals of Emergency Medicine* 31(5): 633-637.

Overview

Study of injured drivers in Belgium

Type of study, population(s) and proportion tested

211 drivers injured in weekend car crashes in Belgium
Time period of July 1, 1994 to June 30, 1995
Sampling times from Friday 8 pm to Monday 8 am

Drugs examined (threshold values for detection)

Amphetamines (300 ng/ml)
Cannabis (50 ng/ml)
Cocaine (300 ng/ml)
Methadone (300 ng/ml)
Opiates (300 ng/ml)
Propoxyphene (300 ng/ml)
Sedatives (barbiturates (200 ng/ml) and benzodiazepines (200 ng/ml))

Method of testing and medium used

Blood sample for alcohol
Urine samples for drugs

Other dependent variables

Findings (including statistical methods)

Almost 50% positive for drugs or alcohol, 7% positive for drugs alone
RR for those drivers involved in weekend crashes being hospitalized with a positive BAC was 1.66

Comments

Drug use was broken down by number of drivers
The numbers were small (1 – 6) and, therefore, % for each drug was not given in the paper

Canada

19. **Adlaf, E. M., Mann, R. E. and Paglia, A. (2003).** Drinking, cannabis use and driving among Ontario students. *Canadian Medical Association Journal* 168: 565-566.

Overview

Self-report survey of drug use and driving among Ontario students

Type of study, population(s) and proportion tested

1. 1,846 students in grades 7 to 13 in Ontario
2. 1,119 students in grades 10 to 13 with a driver's licence
3. 508 students in grades 10 to 13 with a driver's licence

Drugs examined (threshold values for detection)

Cannabis
Alcohol

Method of testing and medium used

Ontario Students Drug Use Survey -- self-report survey

1. How often in the past 12 months have you ridden in a vehicle with a drinking driver?
2. How often in the past 12 months have you driven within one hour of having two or more drinks?
3. How often in the past 12 months have you driven within an hour of using marijuana?

Other dependent variables

Findings (including statistical methods)

1. 31.9% -- increased with grade (17.5% in grade 7; 43.4% in grade 13)
2. 15.1% -- 20% male 8.9% female
-- higher among those in grades 12 and 13
3. 19.7% drove after using marijuana -- 24.5% among males; 13.7% females

20. **Beirness, D. J., Simpson, H. M. and Desmond, K. (2003).** *The Road Safety Monitor 2002. Drugs and Driving.* Ottawa: Traffic Injury Research Foundation.



Overview

Telephone survey of drug use and driving among population of Canadian drivers

Type of study, population(s) and proportion tested

N=1,214 Canadian drivers age 16+
Random telephone survey

Drugs examined (threshold values for detection)

Prescription drugs
Cannabis
Over-the-counter drugs
Illegal drugs

Method of testing and medium used

Self-reported use and driving

Other dependent variables

Driving after drinking

Findings (including statistical methods)

17.7% reported driving after using potentially impairing drugs past 12 months

2.3% prescription drugs

15.9% OTC drugs

1.5% cannabis

0.9% other illegal drugs

Males under 30 most likely to drive after drug use

One-third of those reporting driving after cannabis also reported driving after drinking

- 21. Beirness, D. J., Simpson, H. M., and Desmond, K. (2004).** *The Road Safety Monitor 2004. Drinking and Driving.* Ottawa: Traffic Injury Research Foundation.

Overview

Telephone survey of drug use and driving among population of Canadian drivers

Type of study, population(s) and proportion tested

N=1,214 Canadian drivers age 16+
Random telephone survey

Drugs examined (threshold values for detection)

Cannabis
Alcohol

Method of testing and medium used

Self-report

Other dependent variables

Findings (including statistical methods)

2.1% reported driving after using cannabis
Increase from 1.5% two years ago

44% also reported driving after drinking

Most common among males < 30 years of age

- 22. Boase, P., Dawson, N., and Mann, R. (2004).** Cannabis and road safety in Canada: Summary of information on cannabis found in drivers & recent legislative developments. In J. Oliver, P. Williams and A. Clayton (Eds.), *Proceedings of the 17th International Conference on Alcohol, Drugs and Traffic Safety* (CD). Glasgow: Scottish Executive.

Overview

Review of cannabis use and driving in Canada

Type of study, population(s) and proportion tested

Various
Review of survey literature

Drugs examined (threshold values for detection)

Cannabinoids

Method of testing and medium used

Self-reported cannabis use
Self-reported driving after cannabis use

Other dependent variables



Findings (including statistical methods)

Prevalence of use has increased

Prevalence of driving after cannabis use currently 1.9% to 2.1%

Higher among students and appears to be increasing

23. **Bramness, J. G., Skurtveit, S., and Mørland, J. (2002).** Clinical impairment of benzodiazepines – Relation between benzodiazepine concentration and impairment in apprehended drivers. In D. R. Mayhew and C. Dussault (Eds.), *Proceedings of the 16th International Conference on Alcohol, Drugs and Traffic Safety*. Quebec: Société de l'Assurance Automobile du Québec.

Overview

Assessment of clinical impairment of benzodiazepine positive drivers in Norway

Type of study, population(s) and proportion tested

Drivers, suspected of driving under the influence between 1987 and 1998, positive for only one benzodiazepine (n=818)

Comparison group of drivers positive only for alcohol in 1987 (n=10,759)

Drugs examined (threshold values for detection)

Benzodiazepines

Method of testing and medium used

Blood samples

Clinical Test for Drunkenness (CTD)

Other dependent variables

Findings (including statistical methods)

Within the benzodiazepine group, 81% were “impaired”

“Impaired” drivers had significantly higher concentrations of diazepam and oxazepam

Within the alcohol group, 91% were “impaired”

OR for being determined “impaired” significantly rose as dose increased from therapeutic to mildly elevated (1.6), to moderately elevated (3.7), to highly elevated (4.1)

Same trend is true for alcohol group, though a greater OR was found for the highly elevated dose (10.5)

24. Centre for Addiction and Mental Health. (2003). Cannabis Use and Driving Among Ontario Adults. Population Studies eBulletin, No. 20, May/June 2003.

Overview

Telephone survey of Ontario residents about cannabis use and driving after using cannabis

Type of study, population(s) and proportion tested

Results from 2002 CAMH Monitor and 86/97 Ontario Drug Monitor
Both are telephone surveys

Drugs examined (threshold values for detection)

Self-reported cannabis use and driving after cannabis use

Method of testing and medium used

Other dependent variables

Findings (including statistical methods)

Cannabis use: 11.4% (10.0 - 13.0) at least once in previous 12 months
Males 15.1% Females 7.9%
18 - 34 22% >55 3%

Among drivers 2.9% (2.1 - 4.0) drove within 1 hour of cannabis use in the past 12 months
Males 4.7% Females 1.0%

Increase from 1.9% in 96/97

25. Chipman, M. L., Macdonald, S., and Mann, R. E. (2003). Being "at fault" in traffic crashes: does alcohol, cannabis, cocaine, or polydrug abuse make a difference? *Injury Prevention* 9:343-348.

Overview

Historical cohort study of crash rates among drug users in treatment

Type of study, population(s) and proportion tested

Subjects beginning treatment at CAMH in Toronto for alcohol, cannabis, of cocaine abuse in 1994
n=590 (411 drivers)
Control: 518 matched drivers



Drugs examined (threshold values for detection)

Cocaine
Cannabinoids
Alcohol
Combinations thereof

Method of testing and medium used

Secondary data analysis; no drug testing involved

Other dependent variables

Crashes per 100 person-years at risk
Traffic convictions per 100 person-years at risk

Findings (including statistical methods)

Poisson regress to control for variations in time at risk, age, sex

Adjusted RR: higher pre-treatment than post-treatment
No difference between treatment and control post treatment
Higher for at-fault crashes

Comments

Implication is that among the treatment group high pre-treatment crash levels are a consequence of driving under the influence of drugs but there is no evidence that this is so

26. **Dussault, C., Lemire, A. M., Bouchard, J., and Brault, M. (2000).** *Drug use among Quebec drivers: The 1999 roadside survey. In Proceedings of the 15th International Conference on Alcohol, Drugs & Traffic Safety.* May 22-26, 2000. Stockholm, Sweden: International Council on Alcohol, Drugs & Traffic Safety.

Overview

Report on the 1999 roadside alcohol and drug survey in Quebec

Type of study, population(s) and proportion tested

Random roadside survey in Quebec
N=5,509 day and night, month of August
95.9% provided a breath sample for alcohol
41.4% provided a urine sample; of those who refused, 70.1% provided saliva
overall, 82.5% provided either urine or saliva for drug analysis

Drugs examined (threshold values for detection)

Cocaine (300 ng/100ml)
Cannabinoids (25/ng/100ml)
Alcohol (20mg/100ml)

Benzodiazepines (50ng/100ml)
Opiates (100 ng/100ml)
Barbiturates (200 ng/100ml)
Amphetamines (300ng/100ml)
PCP (25 ng/100ml)

Method of testing and medium used

Breath for alcohol
Urine and/or saliva for drugs
Positive urine screen for drugs confirmed by GC/MS

Other dependent variables

Age, sex

Findings (including statistical methods)

Alcohol:
0.8% > 80 mg% (24 hours)
1.8% > 80 mg% (Wed to Sat 9 pm to 3 am)
(1,981 result was 5.9%)

Urine tests:
Cannabis 5.22% (declines with age)
Benzodiazepines 3.66% (increases with age)
Cocaine 1.09%
Opiates 1.08%
Barbiturates 0.35%
Amphetamines 0.07%
PCP 0.03%

Large variation according to age, sex and time of day
Illicit drug use greater among men than women
Prescription drugs more common among women than men

Comments

This is part of a larger case-control study in Quebec. This is the first year of the roadside survey results. Data collection will continue in the following year. The roadside data (controls) will be compared with results from fatally injured drivers (cases)

- 27. Dussault, C., Brault, M., Bouchard, J., and Lemire, A. M. (2002).** The Contribution of Alcohol and Other Drugs Among Fatally Injured Drivers in Quebec: Some Preliminary Results. In D.R. Mayhew and C. Dussault (Eds.), *Proceedings of the 16th International Conference on Alcohol, Drugs and Traffic Safety*. Quebec: Société de l'Assurance Automobile du Québec.



Overview

This is a case-control study comparing drug and alcohol use among fatally injured drivers (cases) with that among a random sample of drivers on the road (controls)

Type of study, population(s) and proportion tested

Case-control study in the province of Quebec. Alcohol testing >95%; urine (for drugs) 41%

Drugs examined (threshold values for detection)

Thresholds (urine, blood) ng/100ml
Cocaine (300, 100)
Cannabinoids (25, 40)
Benzodiazepines (50, 25)
Opiates (100, 50)
Barbiturates (200, 200)
Amphetamines (300, 200)
PCP (25, 10)
All positive screens confirmed by GC/MS

Method of testing and medium used

Roadside - urine (breath for alcohol)
Fatalities - blood/serum

Other dependent variables

Only included cases and controls for which both biological samples were obtained (i.e., breath & urine for controls; blood & urine for cases)
Matched for 354 cases

Findings (including statistical methods)

Based on urine	Case/Control OR	Responsibility Analysis OR
Drug		
Alcohol 51-80	3.7 (1.6 - 8.3)	1.6 (0.2 - 1.5)
>80	39.2 (25.5 - 60.2)	8.1 (1.0 - 34.8)
Cannabis	2.2 (1.5 - 3.4)	1.2 (0.4 - 3.9)
(with alcohol > 80)	80.5 (28.2 - 230.2)	2.5 (0.3 - 20.2)
Cocaine	4.9 (1.4 - 17.4)	
Benzodiazepines	2.5 (1.4 - 4.3)	3.6 (0.5 - 28.2)

	Cases (%)	Controls (%)
Alcohol	35	5.1
Cannabis	19.5	6.7
Cocaine	6.8	1.1
Benzodiazepines	8.5	3.6
Opiates	1.4	1.2
Amphetamines	0.8	0.1
Barbiturates	0.3	0.5
PCP	1.1	0.03

Alcohol found in > 40% of drug cases; drugs found in 35% of alcohol cases

Comments

Testing rate 41.1% for urine in controls

Case results based on urine -- indicative of use but not impairment

- 28. Hemmelgarn, B., Suissa, S., Huang, A., Boivin, J., and Pinard, G. (1997).**
Benzodiazepine use and the risk of motor vehicle crash in the elderly. *Journal of the American Medical Association* 278(1): 27-31.

Overview

Case-control study of benzodiazepine and crashes in Quebec

Type of study, population(s) and proportion tested

67-to 84-year-old drivers who were involved in a crash where at least one person was injured (5,579 cases)

Controls were random sample selected from the cohort (18,490 controls)

Cohort time was June 1, 1990 to May 31, 1993

Drugs examined

Benzodiazepines

Long elimination (> 24 hours)

Short-elimination (\leq 24 hours)

Method of testing and medium used

Prescription drug use was identified from computerized files from the Regie de l'assurance maladie du Quebec (agency responsible for administering health care services for the province)

Other dependent variables

Sex, age, region, and history of crashes (two years before entry into cohort)

Findings (including statistical methods)

Current use of benzodiazepines, irrespective of duration of use, was 7% for cases and 5% for controls

Increased risk of traffic crash associated with current use of long half-life benzodiazepines (RR=1.28)

Within first 7 days of initiating treatment, RR=1.45

Continued use lasting from 61 to 365 days, RR=1.26



29. **Jeffery, W. K., Hindmarsh, K. W. and Mullen, P. W. (1996).** The involvement of drugs in driving in Canada: An update to 1994. *Canadian Society of Forensic Sciences Journal* 29:93-98.

Overview

Presents the toxicological results of cases submitted to Forensic Laboratories in Canada

Type of study, population(s) and proportion tested

All cases -- impaired driving and fatally injured drivers -- submitted to forensic laboratories in Canada for drug testing through November 1994

N=1,158 cases

n=767 impaired drivers

n=391 fatalities (presumably drivers)

Drugs examined (threshold values for detection)

Cannabinoids

Alcohol

Benzodiazepines

Stimulants

Opiates

Others

Method of testing and medium used

Not stated

Other dependent variables

Findings (including statistical methods)

	<u>Impaired drivers</u>	<u>Fatalities</u>
Alcohol <100 mg/dL	32%	18%
≥100 mg/dL	19%	30%
zero	49%	52%
Benzodiazepines	66.0%	21.4%
Cannabis	40.2%	62.1%
Stimulants	21.8%	14.5%
Opiates	18.8%	8.2%
Barbiturates	15.5%	3.1%

Alcohol was present in the majority of cannabis positive cases

Comments

Selection of the sample is unknown -- presumably there had to be a suspicion of drug and/or alcohol use for case to be submitted

Test for drugs not usual when BAC ≥100 mg/dL

Cases testing negative for drugs not reported

- 30. Mann, R. E., Brands, B., Macdonald, S., and Stoduto, G. (2003).** *Impacts of cannabis on driving: An analysis of current evidence with an emphasis on Canadian data.* Report TP 14179E. Ottawa: Transport Canada.

Overview

Review of cannabis use and driving

Type of study, population(s) and proportion tested

Literature review

Drugs examined (threshold values for detection)

Cannabis

Method of testing and medium used

Six areas considered in report:

1. Experimental research on effects of cannabis
2. Prevalence of cannabis use
3. Prevalence of driving under the influence of cannabis
4. Epidemiological studies on collision risk
5. Methods for assessing cannabis in drivers
6. Legal initiatives

Other dependent variables

Findings (including statistical methods)

1. Moderate to high dose considered to impair performance
2. Most widely used psychoactive drug in Canada -- 33% lifetime, 7.3% past year
3. Use by drivers 1.5% to 1.9% -- among young drivers 19.3%
4. Most common drug found among fatal and injured drivers 13.9% to 19.5%
Difficult to determine collision risk -- data and methodological problems
5. Blood test is the gold standard for determining cannabis level. Saliva, sweat and behavioural measures show promise
6. Currently driving impaired by alcohol or drug is an offence.

- 31. Mercer, G. W., and Jeffery, W. K. (1995).** Alcohol, drugs, and impairment in fatal traffic accidents in British Columbia. *Accident Analysis and Prevention* 27(3): 335-343.



Overview

Study of fatally injured drivers in British Columbia

Type of study, population(s) and proportion tested

227 fatally injured drivers who died within 24 hours of a traffic accident in British Columbia
Time period of October 1, 1990 to September 31, 1991

Drugs examined

Alcohol
Specific list of drugs not given
Reported cannabinoids, cocaine, and CNS depressants

Method of testing and medium used

Blood sample

Other dependent variables

Number of vehicles
Time of day
Day of week
Age

Findings (including statistical methods)

48% positive for alcohol, 37% alcohol only

13% positive for cannabinoids

4% positive for cocaine (all male)

5% positive for CNS depressant diazepam

11% tested positive for both alcohol and drugs, 9% drugs only

Those positive for drugs and/or alcohol tended to be younger

Those positive for drugs and/or alcohol tended to be in collisions involving one vehicle

Those positive for drugs and/or alcohol tended to be in collisions at night and on weekends

Comments

Selection criteria for drivers tested not clear

- 32. Neutel, C. I. (1995).** Risk of traffic accident injury after a prescription for a benzodiazepine. *Annals of Epidemiology* 5:239-244.

Overview

Case control study of benzodiazepine use and crash involvement

Population(s) and proportion tested (including type of study)

147,726 who received anxiolytics and 97,862 controls in Saskatchewan monitored for two months after the index prescription was filled for traffic accidents
Time period was 1979 to 1986

Drugs examined (threshold values for detection)

Benzodiazepines
Other drug histories (such as narcotics, alcohol, etc.)

Method of testing and medium used

Data obtained from the Health Insurance Registration File, Prescription Drug Plan, and Hospital Inpatient Data Base

Other dependent variables

Age, sex, year of prescription, concomitant use of other drugs, alcohol abuse, social welfare recipient

Findings (including statistical methods)

Those using hypnotics had a 3.9 increased risk of accidental injury compared to controls

Those using anxiolytics had a 2.5 increased risk of accidental injury compared to controls

Using a window of 2 weeks, RR's increased to 6.5 and 5.6

Concomitant use of other drugs with sedative actions doubled the risk of accidents

Comments

Benzodiazepine use was not measured in crash involved drivers

- 33. Stoduto, G., Vingilis, E., Kapur, B. M., Sheu, W., McLellan, B. A., and Liban, C. (1993).** Alcohol and drug use among motor vehicle collision victims admitted to a regional trauma unit: Demographic, injury, and crash characteristics. *Accident Analysis and Prevention* 25(4): 411-420.

Overview

Study of traffic crash victims admitted to trauma centre in Toronto



Type of study, population(s) and proportion tested

854 seriously injured motor vehicle collision victims admitted to trauma unit in Toronto (drivers and passengers)

Time period of August 1, 1986 to August 31, 1989

Drugs examined

Benzodiazepines

Cocaine

Cannabinoids

Opiates

Alcohol

Method of testing and medium used

Blood samples for alcohol and additional blood and urine samples for drugs

Other dependent variables

Sex, age, occupant status, admission type, elapsed time from collision, injury severity, and crash variables (seatbelt usage, type of crash, speed, ejection)

Findings (including statistical methods)

Of the 339 drivers analyzed for drugs and alcohol, 35% were positive for alcohol and 41% were positive for at least one drug other than alcohol

Prevalence of cannabinoids the highest (14%), then benzodiazepines (12%), then cocaine and morphine (both at 5%)

Greater percentage of positive BAC subjects in single-vehicle collisions, not using seatbelts, and ejected from vehicle

- 34. Walsh, G., and Mann, R.E. (1999)** On the high-road: Driving under the influence of cannabis in Ontario. *Canadian Journal of Public Health* 90:260-263.

Overview

Random telephone survey of adult population of Ontario

Type of study, population(s) and proportion tested

N=5,497 Ontario adults over two years

Response rates >60%

Sub-sample of 4,735 with driver's licence used to predict driving under the influence of cannabis

Drugs examined (threshold values for detection)

Cannabinoids
Alcohol

Method of testing and medium used

Other dependent variables

Findings (including statistical methods)

1.9% reported driving under the influence of cannabis (22.8% of users)
Logistic regression used to show prime risk was men, <25, never or previously married, without a college degree
47% of those who reported driving under the influence of cannabis also reported driving after drinking



Denmark

35. **Behrendorff, I., and Steentoft, A. (2003).** Medicinal and illegal drugs among Danish car drivers. *Accident Analysis and Prevention* 35:851-860.

Overview

Roadside survey of drug use among drivers in Denmark

Type of study, population(s) and proportion tested

1000 car or small van drivers stopped randomly by police in a rural area of Denmark

Overall time period not mentioned but time of day for collection of samples was broken down into three sessions of 8:00-18:00, 18:00-24:00, 24:00-8:00

Drugs in question

Benzodiazepines
Cocaine
Cannabis
Opiates
Amphetamines

Method of testing and medium used

Saliva samples

Other dependent variables

Participants asked to complete and return, via mail, a questionnaire about their use of medicinal and illegal drugs prior to car driving and their opinion in police drug controls

Findings (including statistical methods)

Of 896 saliva samples, 2% positive for benzodiazepines or illegal drugs

Of that, 1.3% positive for illegal drugs; the majority concerned cannabis

In 0.7%, one or more benzodiazepines were detected

66% of questionnaires returned

6% stated using a medicinal or illegal drug within 24 hours of being stopped

3% indicated yes to driving despite the suspicion of being under the influence

4% admitted driving a few hours after have both illegal drugs and alcohol

9% admitted to driving a few hours after having a hazardous medicinal drug and alcohol

25% admitted driving when they suspected they were over the legal limit

- 36. Bernhoft, I. M., and Steentoft, A. (2002).** Licit and Illicit drugs among Danish car drivers. In D.R. Mayhew and C. Dussault (Eds.), *Proceedings of the 16th International Conference on Alcohol, Drugs and Traffic Safety*. Quebec: Société de l'Assurance Automobile du Québec.

Overview

Roadside survey of drivers on the road not suspected of drug use

Type of study, population(s) and proportion tested

Random roadside survey -- police stopped at random while on patrol

961 of 980 (98%) of drivers provided samples for analysis

896 of samples were adequate for testing

636 (66%) drivers returned a questionnaire

Drugs examined (threshold values for detection)

Cocaine
Cannabinoids
Alcohol
Opiates
Amphetamines

Method of testing and medium used

Saliva -- RapiScan replaced by Cozart (neither completely adequate)
Screening confirmed by GC/MS

Other dependent variables

Self-reported driving under influence of drugs

Findings (including statistical methods)

Screening: 7.1% positive for drugs

Confirmatory: 2.0%

0.7% benzodiazepines

1.3% amphetamines, cannabis, cocaine, opiates (0.8% cannabis)

6.0% admit to driving under influence of drugs past 24 hours

3.0% potentially hazardous prescriptions



2.8% other drugs not a hazard to road safety
0.2% illicit drugs

2.8% admit driving despite suspicion they were under influence

4% admit driving after using an illicit drug plus alcohol

8.5% admit driving after using a potentially hazardous drug plus alcohol

24.5% admit driving with BAC >.05%

Comments

“Random” stopping of drivers by police is questionable

Discrepancy between screening results and GC/MS results is troubling

37. Bernhoft, I. M., Steenhoft, A., Johansen, S., and Klitgaard, N. A. (2004).

A qualitative analysis of drugs as a contributing factor to accidents in Denmark.

In J. Oliver, P. Williams and A. Clayton (Eds.), *Proceedings of the 17th International Conference on Alcohol, Drugs and Traffic Safety* (CD). Glasgow: Scottish Executive.

Overview

Emergency room study of injured drivers

Type of study, population(s) and proportion tested

Injured drivers of cars, motorcycles, and mopeds brought to or visited emergency rooms in two selected hospitals in Denmark

Time period not given (mentioned a period of year to obtain this data)

Drugs examined

Benzodiazepines

Opiates (including morphine and codeine)

Amphetamines

Methamphetamines (including ecstasy)

Cannabinoids

Cocaine

Method of testing and medium used

Injured drivers in emergency rooms were asked to answer questions and give a saliva or blood sample (or both)

Those testing positive were asked to give an interview about their accident and drug use, physical and mental condition at time of accident, and knowledge of the influence of drugs on driving abilities

Other dependent variables

Findings (including statistical methods)

Of the 300 cases thus far, 21 confirmed positive (7%)

In this 7%, cannabinoids and benzodiazepines most common (67%)

15 of the 21 patients (71%) found positive for one drug (5 of these were also impaired by alcohol) and 6 (29%) were positive for two (3 of these also impaired by alcohol) – (38% total combined with alcohol)

Researchers characterized two common types of drug-impaired drivers:
Young men who take illegal drugs (amphetamines and cannabinoids) either during evenings or weekends, generally do not mix with alcohol, and who do not think it is dangerous to drive
Middle-aged men and women who stopped working because of their dependency, do not refrain from mixing drugs with alcohol, and do not feel that it is dangerous to drive

Comments

Study is ongoing

- 38. Johansen, S. S. (2002).** Ecstasy and designer amphetamines: Findings in drivers and post-mortem cases in Denmark. In D. R. Mayhew and C. Dussault (Eds.), *Proceedings of the 16th International Conference on Alcohol, Drugs and Traffic Safety*. Quebec: Société de l'Assurance Automobile du Québec.

Overview

Historical overview of presence of amphetamine and ecstasy in Denmark drivers

Type of study, population(s) and proportion tested

Traffic cases requested by police for analysis of drugs from 1995 to 2001
Between 201-235 cases annually

Drugs examined (threshold values for detection)

Common drugs with emphasis on amphetamines and designer amphetamines (ecstasy)
Narcotics
Alcohol

Method of testing and medium used

Blood and urine samples

Other dependent variables



Findings (including statistical methods)

Prevalence of amphetamines from 1995 to 1998 increased from 10 to 15%
This dropped to 10% in 2000, followed by an increase to 18% in 2001
This increase coincides with an increase in designer amphetamine prevalence
Prevalence of designer amphetamines rose from 1% in 1997 to 4% in 2000 (3% in 2001)

- 39. Steentoft, A., and Worm, K. (1996).** Drugs in Danish traffic cases where no alcohol was found present. *Journal of Traffic Medicine* 24(3-4): 73-76.

Overview

Study of suspected impaired drivers in Denmark

Type of study, population(s) and proportion tested

294 drivers suspected of driving under the influence of alcohol and/or drugs in Denmark
Blood samples reveal no alcohol (<.10mg/g)
Time period of half a year in 1991

Drugs examined

Benzodiazepines (.2 $\mu\text{mol/kg}$)
Morphine (.05 $\mu\text{mol/kg}$)
Cocaine (.3 $\mu\text{mol/kg}$)
Amphetamine (.2 $\mu\text{mol/kg}$)

Method of testing and medium used

Blood sample data obtained from Institute of Forensic Medicine in Copenhagen

Other dependent variables

None

Findings (including statistical methods)

Drugs detected in 27% of the 294 cases with 51% of these showing only one drug (mainly benzodiazepines)

23% of the 294 cases were positive for benzodiazepines

7% positive for morphine (all males)

5% positive for amphetamine

47% of the drug positive cases were connected with a traffic accident

France

40. Marquet, P., Delpla, P., Kerguelen, S., Bremond, J., Facy, F., Garnier, M., Guery, B., Lhermitte, M., Mathe, D., Pelissier, A., Renaudeau, C., Vest, P., and Seguela, J. (1998). Prevalence of drugs of abuse in urine of drivers involved in road accidents in France: A collaborative study. *Journal of Forensic Sciences* 43(4): 806-811.

Overview

Case-control study of patients reporting to ER in France

Type of study, population(s) and proportion tested

296 drivers of any motorized vehicle (18-35 years old) recruited in emergency rooms, regardless of severity of injury (in France)

Comparative group made up of 278 patients (18-35 years old) admitted during the same time for non-traumatic reasons

Case-control study

Time period not mentioned

Drugs examined (threshold values for detection)

Cannabinoids (50 ng/ml)

Opiates (40 ng/ml)

Cocaine and metabolites (50 ng/ml)

Amphetamines (200 ng/ml)

Method of testing and medium used

Urine sample

Other dependent variables

Findings (including statistical methods)

Stepwise logistic regression

In general, no significant differences between drivers and patients in cannabis prevalence (14% versus 8%, $p=0.054$)

Among drivers, users tended to be male (twice as many)



This difference was significant when looking at females only (adjusted for age) (8% for drivers versus 2% for patients)

Significantly higher prevalence of cannabinoids in male than in female drivers (16% versus 8%) as well as in patients (12% versus 2%)

In general, no significant differences between drivers and patients in opiate prevalence (11% versus 10%)

When looking at those who were positive for both cannabinoids and opiates, both male drivers and male patients had a significantly higher prevalence of opiates than negative-cannabinoid drivers and patients

Germany

- 41. Krüger, H., Schulz, E., and Magerl, H. (1995).** The German roadside survey 1992-1994. Saliva analysis from an unselected driver population: Licit and illicit drugs. In TS-'95. *Proceedings of the 13th international Conference on Alcohol, Drugs and Traffic Safety.* August 13 – August 18, 1995. Adelaide, Australia. Adelaide: NHMRC, Road Accident Unit, University of Adelaide.

Overview

Roadside survey in Germany

Type of study, population(s) and proportion tested

Drivers stopped at checkpoints by police
N=12,213 agreed to participate
Time period for collection was 1992 to 1994
Only data from 1992 was analyzed (n=2,234)

Drugs examined (threshold values for detection)

Cannabis (20 ng/ml)
Amphetamines (100 ng/ml)
Opiates (100 ng/ml)
Cocaine (200 ng/ml)
Benzodiazepines (5 ng/ml)
Barbiturates (100 ng/ml)

Method of testing and medium used

Saliva samples

Other dependent variables

Variables for weighting the tested sample, to better represent a random sample of drivers (n=30,000) from the Continuous Survey on Mobility, included age, gender, time of day, day of week, and prevalence of alcohol

Findings (including statistical methods)

Following weighting, 3% of all trips undertaken by drivers positive for benzodiazepines and 1% of those positive for illicit drugs, mainly cannabis

Approximately 1/3 of those who tested positive for an illicit drug also tested positive for alcohol



Italy

42. Zancaner, S., Georgetti, R., Fenato, F., Rossi, A., Tedeschi, L., Snenghi, R., Frison, G., Montisci, F., Tagliaro, F., Meroni, M., Giron, G., Marigo, M., and Ferrara, S. (1995). Psychoactive substances and driving disability: Epidemiological roadside surveys in north-east Italy. In *TS-'95. Proceedings of the 13th International Conference on Alcohol, Drugs and Traffic Safety*. August 13-August 18, 1995. Adelaide, Australia. Adelaide: NHMRC, Road Accident Unit, University of Adelaide.

Overview

Results from a police-selected roadside sample in Veneto Region of Italy

Type of study, population(s) and proportion tested

N=1,537 drivers stopped by police on Sunday from 1 to 7 am

Rapid screen for alcohol and drugs (optical and neurological tests)

N=309 suspected positive cases subjected to complete clinical and toxicological exam

17 refused breath test; 14 refused toxicological test

Final sample of 295 car drivers
249 blood tests, 221 urine tests

Drugs examined (threshold values for detection)

Cocaine
Cannabinoids
Alcohol
Amphetamines
Opiates
Benzodiazepines
Barbiturates

Method of testing and medium used

Breath test for alcohol
Blood and urine samples from suspected cases tested using "standardized analytical procedure"

Other dependent variables

Findings (including statistical methods)

51.4% alcohol positive (30.9% over 80 mg%)

10.2% positive for drugs of abuse or psychoactive drugs (n=10)

Cannabis most common drug found

Comments

Few details are provided

Not a random survey but a police enforcement activity



Ireland

43. **Cusack, D. A., Harrington, G., Furney, P., Flynn, K., and Leavy, C. P. (2002)** Driving under the influence of drugs in Ireland: A growing and significant danger. In D. R. Mayhew and C. Dussault (Eds.), *Proceedings of the 16th International Conference on Alcohol, Drugs and Traffic Safety*. Quebec: Société de l'Assurance Automobile du Québec.

Overview

Study of drug prevalence in a group of suspected drivers in Ireland

Type of study, population(s) and proportion tested

Suspected drugged drivers from 1998 to 2002
N=2,000

Drugs examined (threshold values for detection)

Amphetamines (300 ng/ml)
Methamphetamines (300 ng/ml)
Benzodiazepines (100 ng/ml)
Cannabinoids (20 ng/ml)
Cocaine (100 ng/ml)
Opiates (100 ng/ml)
Methadone (25 ng/ml)
Alcohol

Method of testing and medium used

Blood or urine samples
Drug analysis carried out by the Medical Bureau of Road Safety

Other dependent variables

Findings (including statistical methods)

Of the 1000 below the legal limit of alcohol, 26% tested positive for drugs
Of the 1000 above the legal limit of alcohol, 13% tested positive for drugs
Overall, 20% (391) of the 2000 were drug positive
Of the 391 confirmed analyses, 36% were positive for more than one drug
Most common drugs were cannabinoids (8-16%), followed by benzodiazepines (3-8%)

Netherlands

44. **Movig, K. L. L., Mathijssen, M. P. M., Nagel, P. H. A., van Egmond, T., de Gier, J. J., Leufkens, H. G. M., and Egberts, A. C. G. (2004).** Psychoactive substance use and the risk of motor vehicle accidents. *Accident Analysis and Prevention* 36:631-636.

Overview

Case-control study of injured drivers

Population(s) and proportion tested

110 injured drivers of car or vans needing hospitalization
Controls were randomly stopped on public roads
Netherlands
Time period of May 2000 to August 2001

Drugs examined (threshold values for detection)

Alcohol
Amphetamines
Barbiturates
Benzodiazepines
Cannabis
Methadone
Opiates
Tricyclic antidepressants

Method of testing and medium used

Blood and/or urine samples

Other dependent variables

Crash circumstances, injury severity, age, gender, BAC, drug concomitant, drug exposure, season, and time of day



Findings (including statistical methods)

40% of cases (versus 14% for controls) were positive for at least one or more drugs and/or alcohol

OR for road accidents and benzodiazepines use was 5.1, alcohol (BAC >.5 g/l) 5.5 (16 for BAC >.8 g/l)

Amphetamines, cocaine, and opiates had two-fold increase but not significant

Concurrent use of two or more drugs, compared to no drug use, resulted in an OR of 6.1

Comments

Different distributions of blood versus urine samples in the two groups may have led to information bias

New Zealand

45. **Fergusson, D. M., and Horwood, L. J. (2001).** Cannabis use and traffic accidents in a birth cohort of young adults. *Accident Analysis and Prevention* 33:703-711.

Overview

Survey of a cohort of young drivers

Type of study, population(s) and proportion tested

Birth cohort from New Zealand studied over the period of age 18-21 years
N=907, who reported driving a motor vehicle during that time, were included
Time period of study not mentioned

Drugs examined

Cannabis
Alcohol

Method of testing and medium used

Interviewed at age 21 about:
Cannabis use
Drink driving behaviours

Other dependent variables

Traffic accident involvement
Driver behaviours
Driver attitudes
Driver experience
Annual distance driven
Social, family, and individual factors

Findings (including statistical methods)

Used General Estimating Equation Model (Regression)

Frequency of cannabis use was significantly related to rates of active (responsible) accidents (both before and after controlling for measures of driving experience)

Those who used cannabis more than 50 times per year had a 1.16 higher rate of active accidents



Cannabis use not related to passive (not responsible) accidents
Once accounting for confounding factors (in particular, the significant correlation between cannabis use and risky/illegal driving behaviour), the OR dropped to .97, suggesting frequency of cannabis use was unrelated to active accidents

These findings were true even if cannabis frequency estimates were obtained from an informant and not directly from the individual

Researchers suggest that increased accident risk among cannabis users may be more related to the characteristics of the driver rather than the effects of cannabis on the driver behaviour

Norway

46. **Assum, T. (2004).** Drug and alcohol use among car drivers in Norway. Data collection problems and some preliminary results. In J. Oliver, P. Williams and A. Clayton (Eds.), *Proceedings of the 17th International Conference on Alcohol, Drugs and Traffic Safety* (CD). Glasgow: Scottish Executive.

Overview

Case/control study of drivers in Norway. In progress

Type of study, population(s) and proportion tested

Injured and killed drivers
General population of roadside drivers
Time period from May 2003 to June 2004

Drugs examined

Amphetamine
Benzodiazepines
Cannabis
Cocaine
Ecstasy
Opiates
Alone or in combination with alcohol

Method of testing and medium used

Blood samples taken from injured and killed drivers at hospitals
Oral fluid samples taken from general population roadside drivers in the same areas as those injured and killed

Other dependent variables

None

Findings (including statistical methods)

Data collection problems – major obstacle of obtaining written consent from driver

At time of paper, only 11 blood samples from injured and killed drivers available

Of the 196 oral fluid samples collected, 5 resulted in a positive screening with 3 confirmed for benzodiazepines, opiates, and cannabis (one for each)

No statistical analyses



Comments

Study is incomplete and has significant data collection problems

47. **Bachs, L., Bramness, J., Skurtveit, S., and Morland, J. (2004).** Morphine blood concentration and clinical impairment in a population of drugged drivers. In J. Oliver, P. Williams and A. Clayton (Eds.), *Proceedings of the 17th International Conference on Alcohol, Drugs and Traffic Safety* (CD). Glasgow: Scottish Executive.

Overview

Study of morphine use among suspected drugged drivers in Norway

Type of study, population(s) and proportion tested

Suspected drugged drivers
Epidemiological study
Time period from 1999 to 2003

Drugs examined

Morphine

Method of testing and medium used

Blood sample and Clinical Test for Impairment (CTI) data obtained from the Norwegian Institute of Public Health

CTI consisted of 3 elements:

- Short drug history
- Set of tests for impairment and conclusion
- An evaluation of other possible reasons for impaired driving (disease, etc.)

Other dependent variables

Findings (including statistical methods)

Of the 21,700 cases of suspected drugged driving (blood samples), 2,000 (9.2%) were positive for morphine (≥ 9 ng/ml)

Majority (92%) were in combination with other drugs, mostly benzodiazepines

Of those samples containing only morphine, 98 were subject to further analysis for this study

Of the 98 cases, 77% were "impaired"

Of that 77%, 52% were mildly impaired, 35% moderately, and 13% highly

Morphine concentration groups of low, moderate, medium, and high were formed based on 9-14, 15-29, 30-59, and 60-85 ng/ml respectively

No significant difference in blood morphine concentration between those “impaired” versus “not impaired”

Tolerance and sensitization were offered as possible explanations

Comments

Study is based on a very select subsample (98 of 21,700) suspected drugged drivers

- 48. Christopherson, A. S., and Mørland, J. (1997).** Drugged driving, a review based on the experience in Norway. *Drug and Alcohol Dependence* 47:125-135.

Overview

The incidence of drugged driving in Norway is discussed as well as compared to other countries. Apprehended, injured, and fatally injured driver research is reviewed

Type of study, population(s) and proportion tested

Literature review

Drugs examined (threshold values for detection)

Benzodiazepines
Opiates
Cannabis
Amphetamines
Alcohol

Findings (including statistical methods)

Apprehended drivers in Norway:

1995 – 67% detected with one or more drugs other than alcohol
Cannabis, amphetamine, benzodiazepines, and morphine most common
60% with multi-drug detections (90% in 1992)

For 15 years, cannabis, amphetamine, and benzodiazepines most prevalent as well as more frequent heroin use

Benzodiazepines generally not taken according to recommended dose, often in combination with other drugs or alcohol, and more frequently found in females

Norway compared to other countries:

Drug driving appears to be a larger (7-fold) problem in Norway than in other countries, however, drug problem not considered higher



This could be due to:

- Police focus and enforcement on drugs
- Other countries focus more on drinking and driving
- Other countries do not have a system to handle drugged driving, including blood sampling, clinical assessment, etc.

Fatally Injured:

Norway – 16% with drugs only: benzodiazepines and cannabis most common (1989-1990)

Australia – 22% with drugs only: cannabis, amphetamines, and Benzodiazepines most common (1990-1993)

USA – 7-30% with drugs only: cannabis and cocaine most Common (1986-1989)

Canada – 26% with drugs only: cannabis, cocaine, and amphetamines most common (1982)

Norway injured drivers:

Drugs alone in 10-13% of cases with benzodiazepines and amphetamines most common
Risk for injury accident with high dose benzodiazepines increased by a factor of 19, and, with amphetamine and cannabis, a factor of 10

- 49. Gjerde, H., Beylich, K., and Mørland, J. (1993).** Incidence of alcohol and drugs in fatally injured car drivers in Norway. *Accident Analysis and Prevention* 25:479-483.

Overview

Small study of fatally injured drivers in Norway

Type of study, population(s) and proportion tested

159 fatally injured drivers in Norway
Time period of 1989 to 1990

Drugs examined (threshold values for detection)

- Alcohol
- Benzodiazepines
- Amphetamine
- Cannabinoids
- Cocaine
- Opiates

Method of testing and medium used

Blood samples

Other dependent variables

None

Findings (including statistical methods)

Alcohol alone in 21% of cases

Drugs alone in 9% of cases

Combination of alcohol and drugs in 8% of cases

For those positive cases, most frequently found drugs were benzodiazepines and cannabinoids

Prevalence of alcohol and drugs was higher for those involved in single-vehicle accidents (42% and 22%, respectively) than multiple-vehicle

- 50. Mørland, J., Ripel, Å., and Øgaard, T. (2002).** Methadone detections in blood samples from apprehended drugged drivers. In D. R. Mayhew and C. Dussault (Eds.), *Proceedings of the 16th International Conference on Alcohol, Drugs and Traffic Safety*. Quebec: Société de l'Assurance Automobile du Québec.

Overview

Study of suspected drugged drivers in Norway

Type of study, population(s) and proportion tested

Suspected drugged driver toxicology results analyzed and all methadone positive cases were identified

Methadone positive cases between 2000 and 2002 analyzed (n=104)
Time period of 1997-2002

Drugs examined

Methadone of main interest

Morphine, heroin, cannabis, amphetamine, methamphetamine, benzodiazepines, and cocaine also mentioned

Method of testing and medium used

Blood sample information from the National Institute of Forensic Toxicology

Other dependent variables



Findings (including statistical methods)

Number of positive cases for one or more non-alcohol drugs rose from 2,927 in 1997 to 4,029 in 2001

Number of methadone positive cases rose from 3 in 1997 to 69 in 2001 (over 20-fold)

Of the 104 methadone positive cases from 2000 to 2002, 97% were positive for other drugs (though the concentration of methadone was roughly the same despite the presence of other drugs)

Benzodiazepines the most common in combination with methadone (72% of cases), then morphine (mostly attributable to heroin) (35%), then cannabis (31%), then amphetamine (25%)

Methamphetamine and cocaine also found in combination, but in a small number of cases

- 51. Skurtveit, S., Christopherson, A. S., and Mørland, J. (1999).** Increase in driving under the influence of amphetamine. *Journal of Traffic Medicine* 27:17-24.

Overview

Study of amphetamine use among suspected drugged drivers in Norway

Type of study, population(s) and proportion tested

753 amphetamine positive cases (from suspected drugged driver info from the National Institute of Forensic Toxicology in Oslo, Norway)
Time period of 1995

Drugs examined

Amphetamines (main drug in question)
Morphine
Benzodiazepines
Cannabinoids

Method of testing and medium used

Blood samples from suspected drugged drivers

Other dependent variables

None

Findings (including statistical methods)

Amphetamine use increased from 14% in 1991 to 30% in 1995

Majority of amphetamine positive cases also positive for other drugs:

43% with benzodiazepines
42% with cannabinoids
6% with alcohol

71% of these drivers were arrested previously during the period of 1984 to 1995

Drug of use, at that time, was generally “weaker” (alcohol or cannabinoids)
Movement towards “harder” drugs



Scotland

- 52. Ingram, D., Lancaster, B., and Hope, S. (2000).** *Recreational Drugs and Driving: Prevalence Survey*. Edinburgh: The Scottish Executive Central Research Unit.

Overview

Survey of drugs and driving among Scottish young adults

Type of study, population(s) and proportion tested

Telephone survey
N=1,008 Scottish drivers aged 17-39

Drugs examined (threshold values for detection)

Cannabis
Alcohol
Others

Method of testing and medium used

Other dependent variables

High-risk behaviours -- e.g., speeding, drug use

Findings (including statistical methods)

20% reported driving over legal alcohol limit lifetime -- 5% past 12 months

33% reported drug use lifetime -- 14% past 12 months

Most common among young males

Cannabis most common drug reported, amphetamines second

9% driven under influence of drugs lifetime -- 5% past 12 months

Males, 20-24 years most common

Most felt drugs did not affect driving ability

Most drug driving occurred on the weekend

Most engaged in other risk-taking behaviours

- 53. Neale, J., McKeganey, N., Hay, G., and Oliver, J. (2000).** *Recreational Drug Use and Driving: A Qualitative Study*. Edinburgh: the Scottish Executive Central Research Unit.

Overview

Qualitative study of drugs and driving in Scotland

Type of study, population(s) and proportion tested

Examined groups at varying risk for drug driving

1. n=61 semi-structured interviews at nightclubs with drug users who reported having a driver's licence
2. n=88 nightclub attendees who returned a self-completion questionnaire on drugs and driving behaviour
3. n=536 at bridge toll booths (536 questionnaires returned out of 1,850 distributed)
4. 10 focus groups

Drugs examined (threshold values for detection)

Cannabis, alcohol, others

Method of testing and medium used

Self-reported

Other dependent variables

Attitudes, opinions, circumstances of drug use, driving

Findings (including statistical methods)

13% of toll bridge respondents (age 17-39) used drugs in past 12 months

76% of nightclub attendees used drugs in past 12 months

Drug use more common among young, males -- cannabis most common

Drug driving common among nightclub attendees, not among the general population -- young, males

Drug driving associated with particular lifestyle

Frequency decreased with age

Cannabis considered by users to be less dangerous than other drugs when driving

Users commonly reported they were aware of how their driving was affected but felt capable of taking compensatory action

Alcohol-impaired driving was considered dangerous

Riding as a passenger in a car with a drug driver was common

Poor overall knowledge of the law on drug driving



Spain

- 54. Alvarez, F. J. (2004).** Medicinal drugs and driving among Spaniards: Data from national survey. In J. Oliver, P. Williams and A. Clayton (Eds.), *Proceedings of the 17th International Conference on Alcohol, Drugs and Traffic Safety* (CD). Glasgow: Scottish Executive.

Overview

Self report survey of medication use among Spanish drivers

Type of study, population(s) and proportion tested:

Survey of 2,000 Spanish drivers, who attended one of 23 official driver testing centres in different parts of Spain, in order to undergo an evaluation of their psycho-physical capacity to drive

1,297 males and 703 females
Ages 14 - 69

Drugs examined

Medicinal drugs
Alcohol

Method of testing and medium used

Interview/self-report

Dependent variables:

Sociodemographic aspects and driving patterns
Self-evaluation of health status
Pathological processes:

Different illnesses suffered
Whether driver had to stop driving or change driving patterns due to illness
Whether driver was warned by doctor about effects of illness on their ability to drive

Pattern of medicinal drugs taken:

What drugs were being taken at time of interview
Duration of treatment
Who prescribed the medication
If driver believed the medication affected their ability to drive
Whether doctor warned driver to not drive while taking the medication
Whether the driver had taken alcohol while taking the medication

Alcohol and illicit drug consumption patterns

Findings (including statistical methods)

Statistical methods were not mentioned

16% suffer some kind of pathological process (no difference between sexes, though the reporting of an illness was more frequent as age increased, especially after 40)

83% of these drivers did not change their driving patterns because of the illness, though 25% of them had been warned by their health professional about the effects of their illness on their driving ability

17% (335 drivers) were taking some form of medication at the time of interview (more females reported this than males (18% versus 16%) and more frequently reported as age increased)

These 335 drivers were taking a total of 465 different medications, with majority (68%) only taking one

The mean number of medications increased with age

The majority of medications taken were for chronic illness (376) (this increased with age) and the remainder for acute illness

The majority of the medications were prescribed by doctors (82%)

Most frequently consumed medications were from the "therapeutic groups of alimentary tract and metabolism" (20%), followed by cardiovascular system (19%), and then central nervous system (15%)

91% believed the medication did not affect their ability to drive

The majority had not received warnings from their doctor about the effects of the medication on their ability to drive (79%)

The majority tried to not consume alcohol while taking the medication (79%)

Comments

Study documents medication use patterns in relation to driving but no evidence of drug-impaired driving

- 55. del Rio, C. M., and Alvarez, F. J. (2000).** Presence of illegal drugs in drivers involved in fatal road traffic accidents in Spain. *Drug and Alcohol Dependence* 57:177-182.

Overview

Study of drug tests among fatally injured drivers in Spain

Type of study, population(s) and proportion tested

285 fatally injured drivers in Spain
Time period of January 1994 to October 1996



Drugs examined

Benzodiazepines
Cocaine
Cannabis
Opiates
Amphetamines
Synthetic drugs
Hallucinogenic drugs

Method of testing and medium used

Blood samples taken within 8 hours of victim's death

Other dependent variables

None

Findings (including statistical methods)

Illegal drugs in 10% of cases, alcohol in 51%, and medicines in 9%
8% had illegal drugs with other substances (4% with alcohol)

Cocaine (7%) most frequently detected, followed by opiates (5%), then amphetamines and cannabis (both with 1.4%)

Of those with illegal drugs, 20% with alcohol as well

Most common illegal drug in combination with alcohol was cocaine (57% of the above 20%)

Comments

No indication of how cases were selected for inclusion or what proportion of cases were tested

Sweden

56. **Sjögren, H., Björnstig, U., Eriksson, A., Öhman, U., and Solarz, A. (1997).** Drug and alcohol use among injured motor vehicle drivers in Sweden: Prevalence, driver, crash, and injury characteristics. *Alcoholism: Clinical and Experimental Research* 21(6): 968-973.

Overview

Study of injured and dead drivers in Sweden

Type of study, population(s) and proportion tested

130 injured drivers who were hospitalized (UHD-Umeå hospitalized drivers) and 111 fatally injured drivers who were autopsied in Sweden

Two regions for fatals: Umeå (UFD- Umeå fatal drivers) and Gothenburg (GFD- Gothenburg fatal drivers)

Time period of May 1991 to December 1993

Drugs examined

Benzodiazepines

Barbiturates

Amphetamines

Heroin

Cocaine

Cannabinoids

Alcohol

Method of testing and medium used

Blood samples in ER or at autopsy

Other dependent variables

Police reports used to obtain crash characteristics

Findings (including statistical methods)

19% of UHDs, 26% of UFDs, and 21% of GFDs tested positive for drugs and/or alcohol

Drugs in 10% UHDs and 7% UFDs (not significantly different)

Alcohol in 13% UHDs, 21% UFDs, and 20% GFDs

Drugs and alcohol in 2% UHDs, 6% UFDs, and 3% GFDs

Benzodiazepines and opiates most common (3 – 8%)



Most common illegal drugs were cannabinoids (4%) and amphetamine (3%) (this is only in UHDs, no info for fatalities)

Those with positive BAC were younger and those in combination with drugs crashed between midnight and 6am

Drugs only crashes evenly at different times throughout the day

Those positive for drugs and/or alcohol were involved in more single-vehicle crashes

United Kingdom

57. **Barbone, F., McMahon, A. D., Davey, P. G., Morris, A. D., Reid, I. C., McDevitt, D. G., and MacDonald, T. M. (1998).** Association of road-traffic accidents with benzodiazepine use. *Lancet* 352:1331-6.

Overview

Within-person case-crossover study of crashes among psychoactive drug users

Type of study, population(s) and proportion tested

All drivers 18 years or older who experienced a road-traffic accident between August 1, 1992 to June 30, 1995, which was attended by Tayside (UK) police Residents in Tayside and had been registered with a Tayside general practitioner between January 1992 and January 1995
Had been using a psychoactive drug at some time during the study period

Drugs examined

Benzodiazepines
Tricyclic and related antidepressants
Selective serotonin-reuptake inhibitors and related antidepressants
Other psychoactive drugs

Method of testing and medium used

Road-traffic accident data available from police
Drug data available from the Medicines Monitoring Unit (MEMO)
Linked by a unique patient identifier

Other dependent variables

Findings (including statistical methods)

Identified 1,731 users of any study drug
793 tricyclic antidepressants
334 serotonin-reuptake inhibitors
916 benzodiazepines
138 other psychoactive drugs

Using logistic regression, the odds ratios for having a road-traffic accident on a day of drug use for different drugs were:

Benzodiazepines = 1.62
Tricyclic antidepressants = 0.93



Serotonin-reuptake inhibitors = 0.85
Too few cases for other psychoactive drugs

Risks associated with benzodiazepine use:

Greater among drivers younger than 30
Decreased with increasing age (not raised in people 65 and older)
Decreased as number of vehicles involved in accident increased
Higher with accidents where the driver was judged to be at fault

Was significant in drivers who failed a breath test for alcohol but was much stronger in those with a positive test (this difference in risk was significant)

Benzodiazepines with a long half-life were associated with an increased risk of accident

- 58. Buttress, S. C., Tunbridge, R. J., Oliver, J. S., Torrance, H., and Wylie, F. (2004).** The incidence of drink and drug driving in the UK – A roadside survey in Glasgow. In J. Oliver, P. Williams and A. Clayton (Eds.), *Proceedings of the 17th International Conference on Alcohol, Drugs and Traffic Safety* (CD). Glasgow: Scottish Executive.

Overview

Roadside survey as part of a larger case-control study

Type of study, population(s) and proportion tested

Non-accident involved drivers at sites within the area of the hospitals from which they obtained their accident-involved sample
Collected at same times of day as the people in the accident sample had their accidents
Time period from July 2003 to June 2004

Drugs examined (threshold values for detection)

Benzodiazepines (100 ng/ml)
Opiates (300 ng/ml)
Methadone (300 ng/ml)
Amphetamines (500 ng/ml)
Ecstasy (500 ng/ml)
Cannabis (50 ng/ml)
Cocaine (150 ng/ml)
Alcohol

Method of testing and medium used

Drivers stopped at random and asked to offer a sample of saliva and complete a questionnaire about items such as alcohol consumption, driving habits, use of drugs and medicines

Other dependent variables

None

Findings (including statistical methods)

As of March 2004, chemical analysis completed on 386 saliva samples

Eighteen drugs detected (incidence of 4.7%)

Much lower than the 22.9% found previously in their road fatality study

Ecstasy was most common, followed by cocaine and cannabis

However, only 65 of the 386 cases had been tested for cannabis so researchers suggest that cannabis is likely to be the most common once all analyses are complete

No questionnaires analyzed at this point

Comments

Study is ongoing

- 59. Sexton, B. F., Tunbridge, R. J., Board, A., Jackson, P. G., Wright, K., Stark, M. M., and Englehart, K. (2002).** *The Influence of Cannabis and Alcohol on Driving*. TRL Report 543. Crowthorne, England: Transport Research Laboratory.

Overview

Study of the effects of cannabis in combination with alcohol

Type of study, population(s) and proportion tested

Male drivers

Simulator and laboratory tasks

Drugs examined (threshold values for detection)

Cannabis

Alcohol

Method of testing and medium used

Other dependent variables



Findings (including statistical methods)

Under the influence of cannabis subjects: reduced speed, increased headway, were aware of the effects, were less accurate in maintaining lane position, had poorer tracking, performed more poorly on sobriety tests

Subjects actively attempted to compensate for the effects

Alcohol and cannabis together produced an effect slightly greater than cannabis alone

- 60. Tunbridge, R. J., Keigan, M., and James, F. (2002).** A comparison of the incidence of drugs in drink drivers and fatal road casualties. In D. R. Mayhew and C. Dussault (Eds.), *Proceedings of the 16th International Conference on Alcohol, Drugs and Traffic Safety*. Quebec: Société de l'Assurance Automobile du Québec.

Overview

Comparison of drug use trends in drinking drivers and fatal road users

Type of study, population(s) and proportion tested

Random selection of drinking driver cases from TRL for England and Wales (n=2,000)
Fatal road casualties (n=1,184)
Time period of 1997

Drugs examined

Amphetamines
Cannabis
Cocaine
Benzodiazepines
Opiates
Methyl amphetamines
Methadone
Tricyclic antidepressants
Alcohol

Method of testing and medium used

Blood sample information from Forensic Science Service

Other dependent variables

Sex and age

Findings (including statistical methods)

27% of drinking drivers tested positive for drugs, with 23% testing positive for one drug and 4% testing positive for multiple drugs

Cannabis accounted for 18% of that 23%

24% of fatally injured road users tested positive for drugs, with 18% testing positive for one drug and 6% testing positive for multiple drugs

Pattern of drug usage generally the same for these two populations

For drinking drivers, males and females did not differ in drug use

Illicit drug use in fatally injured drivers was predominantly (90%) in younger (under 40) individuals

Medicinal drug use in fatally injured drivers was largely (78%) in older (40 and over) individuals



United States

61. **Jones, R. K., Shinar, D., and Walsh, J. M. (2003).** State of Knowledge of Drug-Impaired Driving. DOT HS 809 642. Washington, DC.: U.S. Department of Transportation, National Highway Traffic Safety Administration.

Overview

This is a reasonably comprehensive review of drugs and driving divided into four main areas: detection and measurement; experimental research; epidemiologic research; and countermeasures

Type of study, population(s) and proportion tested

Literature review

Drugs examined (threshold values for detection)

Narcotics
CNS depressants
CNS stimulants
Cannabis
Antidepressants
Antihistamines

Findings (including statistical methods)

Detection:

Point-of-contact testing devices of promise but further development is necessary

Experimental research

Drugs with high potential for impairment of driving-related performance:

Narcotics
Long-life benzodiazepines (therapeutic doses)
Short-life benzodiazepines (high doses)
Barbiturates
First generation H1 antihistamines
Some antidepressants

Drugs with low potential for impairment

CNS stimulants
Second generation antihistamines
Most other antidepressants

Cannabis has a moderate potential for impairment

Epidemiologic research

Drug use less common among drivers than alcohol

Cannabis the most frequently used drug by drivers

Cannabis found among an average of 14% of driver fatalities (7 to 37%)

Only cannabis and benzodiazepines found in more than 1% of not-crash involved drivers

The role of drugs as a causal factor in crashes is not well understood

- 62. Lillis, R. P., Good, R. G., Kwong, T., Gajary, E., and States, J. D. (1999).** Incidence of drug use among drivers treated in emergency departments. In *43rd Annual Proceedings of the Association for the Advancement of Automotive Medicine*. September 20-21, 1999. Barcelona, Spain. Rochester University, NY: AAAM.

Overview

Study of drivers injured in crashes

Type of study, population(s) and proportion tested

Drivers brought to ER by ambulance from crash (n=888)

Time period not mentioned

Drugs examined (threshold values for detection)

Ethanol

Common drugs of abuse (cocaine, marijuana, and prescription/over-the-counter drugs)

Method of testing and medium used

Blood samples

Other dependent variables

None

Findings (including statistical methods)

33% positive for at least one substance

Ethanol (13%)

Cannabis (6%)

Benzodiazepine (4%)

Cocaine or cocaine metabolite (3 – 4%)

23% positive for one substance and 8% positive for two



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- 63. Logan, B. K., and Schwilke, E. W. (1996).** Drug and alcohol use in fatally injured drivers in Washington State. *Journal of Forensic Sciences* 41(3): 505-510.

Overview

Study of fatally injured drivers in Washington state

Type of study, population(s) and proportion tested

Fatally injured drivers who died within 4 hours of collision (n=318)
Time period of September 1992 to August 1993

Drugs examined

Opiates (50 ng/ml)
Cocaine (50 ng/ml)
Cannabinoids (50 ng/ml)
Alcohol

Method of testing and medium used

Blood sample and, when available, urine

Other dependent variables

None

Findings (including statistical methods)

46% had BAC > .01 g/100ml

60% killed in single vehicle collision had positive BAC compared to 31% killed in multiple vehicle collisions

37% positive for alcohol only, 10% alcohol plus at least one drug, 15% no alcohol but at least one drug

Drugs encountered most frequently were cannabinoids, cocaine, and amphetamines

11% positive for cannabinoids with 63% of those also positive for alcohol
25% positive for stimulants with 3% positive for cocaine and 2% for methamphetamine

9% positive for depressant drugs with 27% of those showing combined use of alcohol and depressant use

- 64. Logan, B. K., and Schwilke, E. W. (2004).** Changing patterns of alcohol and drug use in fatally injured drivers in Washington State 1992-2002. In J. Oliver, P. Williams and A. Clayton (Eds.), *Proceedings of the 17th International Conference on Alcohol, Drugs and Traffic Safety* (CD). Glasgow: Scottish Executive.

Overview

Study of fatally injured drivers in Washington state

Type of study, population(s) and proportion tested

Fatally injured drivers who died within 4 hours of crash (n=370)
Time period from February 1, 2001 to January 31, 2002

Drugs examined

Cocaine
Opiates
Benzodiazepines
Barbiturates
Cannabinoids
Amphetamines
PCP
Propoxyphene
Methadone
Tricyclic antidepressants
Alcohol

Method of testing and medium used

Blood and serum samples

Other dependent variables

Findings (including statistical methods)

41% positive for alcohol
39% for CNS active drugs
14% for CNS depressants
13% for cannabinoids
10% for CNS stimulants
3% for narcotic analgesics (excluding morphine)

Presence of methamphetamine increased from 2% to 5% between 1992 and 2002

65. **Maio, R. F., Guthrie, S. K., Hill, E. M., Gregor, M., Waller, P. F., and Blow, F. C. (2000).** Benzodiazepine, alcohol and other drug use among injured motor vehicle crash drivers. In *Proceedings of the 44th Annual Conference of the Association for the Advancement of Automotive Medicine*, pp. 505-507. Des Plaines, IL: Association of the Advancement of Automotive Medicine.



Overview

Study of alcohol and drug use among motor vehicle crash victims in Michigan

Type of study, population(s) and proportion tested

Motor vehicle crash victims (in Michigan)
708 frozen serum samples from a previous study were used
Time period not mentioned

Drugs in question (threshold values for detection)

Benzodiazepines
Cocaine
Cannabinoids
Opiates
Alcohol

Method of testing and medium used)

Breath for alcohol and blood for drugs

Other dependent variables

Sex, age, injury severity, crash severity, type of crash, and culpability

Findings (including statistical methods)

3% positive for benzodiazepines

No significant differences with respect to age, gender, type of crash, crash severity or culpability

Seatbelt use lower for those positive for benzodiazepines

Injury severity lower for those positive for benzodiazepines

13% more benzodiazepine positive cases were culpable than negative cases

Almost 60% of benzodiazepine positive cases tested positive for alcohol

- 66. Soderstrom, C. A., Kearns, T. J., Kufera, J. A. and Dischinger, P. C. (2002).** Alcohol and drug use among a large cohort of injured vehicular occupants and pedestrians treated in a trauma center. In D.R. Mayhew and C. Dussault (Eds.), *Proceedings of the 16th International Conference on Alcohol, Drugs and Traffic Safety*. Quebec: Société de l'Assurance Automobile du Québec.

Overview

Study of vehicle occupants reporting to a trauma centre in Maryland

Type of study, population(s) and proportion tested

N=9,947 vehicle occupants reporting to trauma centers in Maryland from 1996 through 2000
(a further 1,547 pedestrians but not reported here)
98% tested for alcohol
47.4% tested for drugs (urine)
61% male

Drugs examined (threshold values for detection)

Cocaine
Cannabinoids
Alcohol (20 mg/dL)
opiates

Method of testing and medium used

Gas-liquid chromatograph for alcohol
Urine tested by enzyme immunoassay for drugs

Other dependent variables

Sex, age

Findings (including statistical methods)

Alcohol 20%
Cannabis 15%
Opiates 18%
Cocaine 9%

Comments

No indication of how many occupants tested were drivers
Urine tests indicative of use, not necessarily impairment

67. Townsend, T. N., Lane, J., Dewa, C. S., and Brittingham, A. (1998). *Driving after Drug or Alcohol Use: Findings from the 1996 National Household Survey on Drug Abuse.* Washington: NHTSA.

Overview

Study of random sample of drivers in the USA interviewed about drug use and driving

Population(s) and proportion tested (including type of study)

N=11,847
In-home personal interviews of drivers who reported driving a vehicle at least once within the last 12 months before the interview



Drivers were 16 and older and were NHSDA respondents
Drivers questioned about driving following the intake of drugs or alcohol
Time period of 1996

Drugs examined (threshold values for detection)

Drugs in general
Marijuana
Alcohol

Method of testing and medium used

Interview

Other dependent variables

See below

Findings (including statistical methods)

28% reported driving within 2 hours of using drugs or alcohol (5% after drug use, with or without alcohol, and 23% after alcohol use only)

Those who drove after drug use tended to be younger, male, single, unemployed, and had been arrested or on probation

Marijuana most common illicit drug used by those who reported driving after drug use

These people tended to be heavy or weekly users within the last year, and those 21 and older were more likely to report driving after taking marijuana in combination with alcohol

The majority (84%) of those who used sedatives or tranquilizers drove after taking them for medicinal purposes, compared to 43% of those who took stimulants medical purposes

Driving after drug use tended to be on smaller, urban roads, on weekends, and between 6 pm and 11:59 pm



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