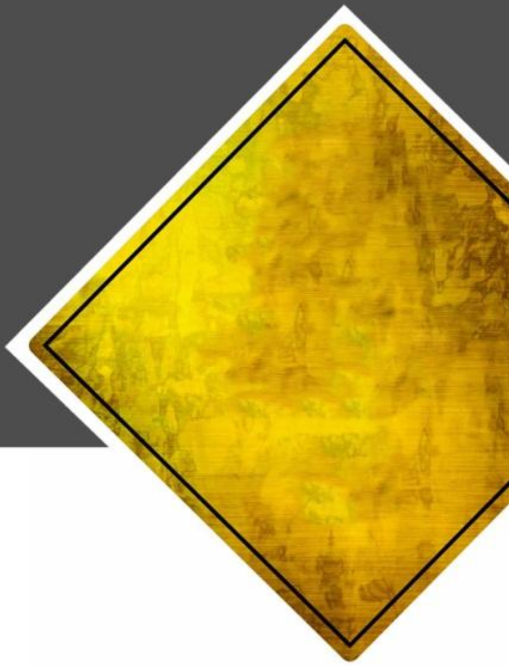


CCSA - CCLAT Canadian Centre on Substance Abuse

A Comparison of **Drug- and Alcohol-involved Motor Vehicle Driver Fatalities**

Erin E. Beasley, M.A.
Douglas J. Beirness, Ph.D.
Amy J. Porath-Waller, Ph.D.

Canadian Centre on Substance Abuse
75 Albert Street, Suite 500
Ottawa, ON K1P 5E7
tel.: 613-235-4048 | fax: 613-235-8101 | www.ccsa.ca

ACKNOWLEDGEMENTS

This project was made possible through a financial contribution from the Department of Public Safety Canada. The authors also wish to thank Transport Canada (Road Safety and Motor Vehicle Regulation) for its assistance with the motor vehicle crash and fatality data. The views expressed herein do not necessarily represent the official policies of Public Safety Canada or Transport Canada.

TABLE OF CONTENTS

A Comparison of Drug- and Alcohol-involved Motor Vehicle Driver Fatalities

EXECUTIVE SUMMARY

Drugs and driving is an emerging issue both within Canada and internationally, but knowledge about this topic is still in its infancy. This project was designed to complement and extend our previous and ongoing work on drug-impaired driving. Data from two distinct sources (coroners' reports and motor vehicle crash records) were merged to compare and contrast the circumstances and characteristics of fatally injured drivers of motor vehicles who have used either alcohol, drugs or both, and the crashes in which they were involved. The first of these datasets, the Fatality Database, houses information on all persons killed in motor vehicle collisions in Canada. This database contains the results of alcohol and drug tests performed by coroners on victims of motor vehicle collisions in Canada. These data were linked with detailed information about the crash contained in the National Collision Database, which is collected and maintained by Transport Canada.

From 2000–2007, 12,978 drivers died in vehicle crashes on public roadways in Canada. Of these driver fatalities, 84.0% were tested for alcohol and 46.4% were tested for drugs. There were 5,929 drivers that were tested for both alcohol and drugs. Of these drivers, 2,689 (45.4%) had no alcohol or drugs present, 1,097 (18.5%) tested positive for a psychoactive drug (but negative for alcohol), 1,301 (21.9%) tested positive for alcohol only, and 842 (14.2%) drivers tested positive for both alcohol and at least one psychoactive drug. These findings indicate that the extent of drug use among fatally injured drivers (33%) is comparable to that of alcohol use (37%).

The most common psychoactive substances found among fatally injured drivers were central nervous system depressants, cannabis, central nervous system stimulants, and narcotic analgesics. Different patterns of drug use by gender and age were also evident. An examination of the circumstances and factors associated with the crash provides evidence that collisions involving drugs were very different in nature than those involving alcohol. For example, whereas alcohol-involved fatal crashes were most common during early morning hours on weekends, drug-involved fatal crashes were more likely than alcohol-involved crashes to occur during daytime hours on weekdays. There was also a tendency for alcohol-involved crashes to involve a single vehicle; drug-involved crashes were more likely to involve more than one vehicle.

The overall pattern of findings indicates that the use of drugs by drivers is an issue distinct and separate from that of alcohol use by drivers and therefore requires a unique approach to prevention, education and enforcement to reduce the number of fatal crashes involving driver drug use and improve overall road safety in Canada.

BACKGROUND

The Drugs and Driving Problem

Following almost three decades of progress on the alcohol-crash problem, safety advocates, policy makers, legislators, and enforcement agencies have begun to express greater concern about the use of drugs by drivers. Although the misuse of drugs has long been considered a major social problem, the acute and devastating consequences of driving while under the influence of drugs has only recently come to the forefront as a public safety issue.

In many respects, our collective understanding of the drugs and driving problem is only in its infancy. The extent of knowledge on drugs and driving pales in comparison to that available on alcohol-impaired driving. Whereas research has clearly demonstrated impairing effects of alcohol on driving and exponential increases in crash risk associated with increasing concentrations of alcohol in the blood (e.g., Blomberg et al., 2009; Borkenstein et al., 1964), research on drugs and driving has only begun to document such effects and only for specific substances (e.g., Jones et al., 2003; Raes et al., 2008). To a large extent, the complexities of studying drugs and driving have hindered research. For example, there are numerous substances known to have the potential to impair driver performance. Some of these substances are illegal; others can be obtained only by prescription while others can be obtained over-the-counter for self-medication. Detecting the presence of these substances in the body requires a sample of blood, urine or oral fluid. None of these substances can be detected in breath samples (as is the case with alcohol). Such tests require special equipment and professional expertise to conduct the tests and interpret the results. These complexities limit the pace at which knowledge accumulates. Nevertheless, there is an ever-increasing body of scientific literature documenting the impairing effects of many substances and the elevated risk of traffic crash involvement following drug use (Beirness, Logan & Swann, 2010).

In Canada, data from various sources have begun to shed light on the magnitude of the problem of driving after drug use. Self-report data from the Canadian Addiction Survey show that 4.8% of drivers in Canada admitted driving within two hours of using cannabis at least once in the past year. Among those aged 16 to 18, 20.6% reported having driven after using cannabis, slightly higher than the 19.6% who reported driving after alcohol use (Beirness & Davis, 2007). A recent roadside survey of alcohol and drug use among drivers in British Columbia found 10.4% of drivers tested positive for drugs; 8.1% were found to have been drinking (Beirness & Beasley, 2009, 2010). Cannabis and cocaine were the most common drugs detected. Studies of drug use among fatally injured drivers in Canada indicate that drugs, sometimes in combination with alcohol, are detected in up to 30% of fatally injured drivers (e.g., Brault, Dussault et al., 2002; Cimbura et al., 1982; Mercer &

Jeffery, 1995). Such findings suggest that the drugs and driving problem is by no means insignificant and requires immediate public attention.

In recognition of the acknowledged magnitude of the drugs and driving problem and the need to take effective action, the Government of Canada passed new legislation (Bill C-2) that went into effect July 2, 2008. This series of amendments to the *Criminal Code of Canada* strengthened the laws related to drug-impaired driving, providing police with the power to demand a driver suspected of being impaired by drugs submit to a Standardized Field Sobriety Test, participate in an evaluation of drug influence by an officer trained in the Drug Evaluation and Classification (DEC) program, and provide a sample of blood, breath or oral fluid to determine the type of drug(s) used.

Although research is beginning to document the extent of the drugs and driving problem in Canada, there is also a need to further understand the behaviour and its similarities and differences with the alcohol-crash problem. For example, roadside surveys conducted in 2008 and 2010 in British Columbia (Beirness & Beasley, 2010, 2011) indicated that there was a different pattern for drug use and driving than was evident for alcohol use and driving. Whereas alcohol use was more common among young drivers and occurred at higher rates on the weekends and at later times of the survey night, drug use was more consistent across all ages of drivers and all survey nights and times. Although there are obvious similarities between drinking and driving and drug use and driving, it would appear that the aetiology of the behaviour and its consequences may be very different from that of drinking and driving. Hence, it cannot simply be assumed that the same techniques, policies, procedures and countermeasures that were developed and utilized effectively to combat drinking and driving can be readily adapted or transferred to deal with the drugs and driving issue. Recognizing that drugs and driving is a more complex issue than drinking and driving, there remains a great deal to learn about driving after drug use.

Purpose

The current project was designed to enhance our overall understanding of the drugs and driving issue by examining existing data on drug use by drivers who died in road crashes in Canada. In particular, the specific purposes were to:

- determine the extent to which drug use is involved in road crashes in which a driver is fatally injured;
- examine the characteristics of drivers involved in drug-involved fatal crashes and the circumstances surrounding these crashes; and,
- compare and contrast the characteristics of alcohol- and drug-involved traffic fatalities.

METHODS

Data from two separate sources were matched and merged to provide the most comprehensive information available on crashes in which a driver was fatally injured. The first dataset was the National Fatality Database, which contains information from coroners' files on the results of toxicological tests for alcohol and drugs performed on persons killed in motor vehicle collisions in Canada. For over three decades, data on alcohol use by fatally injured drivers contained in this database have been used to assist policy development, public awareness and monitoring of alcohol-impaired driving in Canada. These data are collected by the Traffic Injury Research Foundation (TIRF) on behalf of Transport Canada and the Canadian Council of Motor Transport Administrators (CCMTA) (e.g., TIRF, 2010). In 2000, the database was expanded to include the results of toxicological tests for drugs other than alcohol.

An initial examination of the Fatality Database revealed that from 2000 through 2007 there were 15,487 drivers who died in vehicle crashes in Canada. Although more than 80% of fatally injured drivers were tested for alcohol, drug testing has yet to become routine practice in all provinces and territories. Hence, testing rates vary considerably among provinces, ranging from over 80% to below 30%. The policies and processes surrounding drug testing are neither well understood nor well documented.[1] The data suggest that drivers are sometimes tested for a wide variety of drugs, including many substances not known to have psychotropic properties and unlikely to cause driving impairment (e.g., acetaminophen). Therefore, as an initial step, we reviewed every substance listed in the database and recoded them into categories corresponding to those used by the Drug Evaluation and Classification (DEC) program—central nervous system (CNS) depressants, inhalants, dissociative anaesthetics, cannabis, CNS stimulants, hallucinogens, and narcotic analgesics (IACP, 1999). Substances not consistent with these categories were coded as "other". Drivers that only tested positive for a drug(s) in the "other" category were considered to be drug negative. Up to six substances were recorded for each fatally injured driver.

The other data set used in this project was the National Collision Database (NCDB). Developed and maintained by Transport Canada, this database contains detailed records of motor vehicle crashes that occur on public roadways in Canada, including the types of vehicles involved; crash configuration; location; apparent driver actions; road, weather and light conditions; and contributing factors. The database is extensive and detailed and provides a wealth of information about the circumstances and factors contributing to motor vehicle crashes.

---

[1] A separate, ongoing project is investigating the approaches to drug testing among fatally injured drivers in Canada.

Although each database provides interesting and valuable information, together they were used to explore the nature of driver fatal crashes at a level not possible with either one alone. It should be noted that the Fatality Database and the NCDB use slightly different inclusion criteria. In particular, the NCDB includes information on crashes that occur on public roadways in Canada; the Fatality Database includes information on all persons who die in motor vehicle related events regardless of where the event occurs. The set of cases common to both databases were merged through a unique collision report code with the help of Transport Canada. The final merged data set included records on 12,978 drivers who died in crashes on public roadways in Canada between 2000 and 2007. This project used this latter set of cases for all analyses.

To determine the set of personal, vehicular and crash factors that best distinguished alcohol-involved fatal crashes from drug-involved fatal crashes, a series of logistic regression analyses were performed (Tabachnick & Fidell, 2007). Logistic regression allows the prediction of an outcome variable that has two categories from a set of predictor variables that may be continuous, discrete, dichotomous, or some combination of variable types. Classification rates for the outcome categories were also calculated as part of the logistic regression analyses. These provide an estimate of the success of the model in correctly predicting the outcome category for cases for which the outcome is known (Tabachnick & Fidell, 2007).

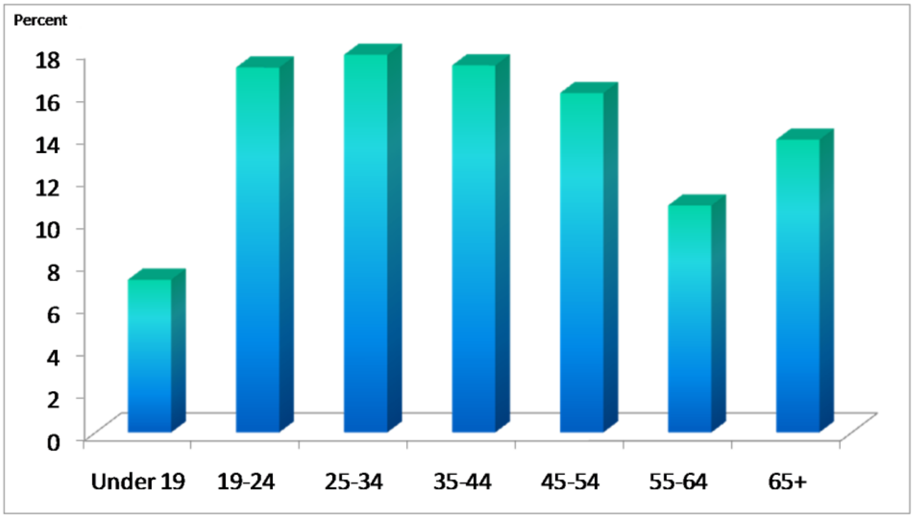
RESULTS

Characteristics of the Sample

Over the eight-year period from 2000 through 2007, there have been no substantial increases or decreases in the annual number of drivers who died in crashes on public roadways in Canada. The lowest number of driver fatalities (1,577) was recorded in 2001 and 2007; the highest number (1,692) was in 2005. Of the 12,978 drivers in the database, 78.2% were male; 21.8% were female.

Figure 1 illustrates the age distribution of victims. Victims ranged in age from 4 through 96 years with a mean of 41.5 years (sd=18.8). Together, drivers age 19 to 24, 25 to 34 and 35 to 44 accounted for 53.3% of all driver fatalities. It is important to remember that the term ‘driver’ not only includes drivers of automobiles, but also bicycles and all-terrain vehicles (ATVs). These latter types of vehicles account for the majority of deaths of those under the age of 16.

Figure 1: Age Distribution of Driver Fatalities Canada (2000–2007)



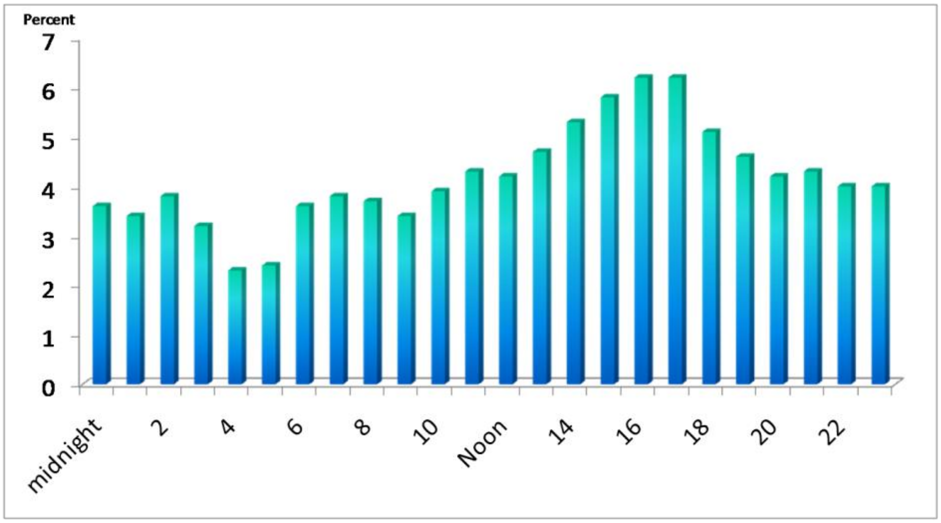
A valid licence was held by 88% of fatally injured drivers; the remaining 12% had a revoked, suspended, invalid or cancelled licence. The vast majority (94%) had a licence issued by the jurisdiction in which the crash occurred.

Driver fatalities were not evenly distributed throughout the year. The largest number of driver deaths occurred during summer months (June, July, August) and the smallest number occurred during spring months (March, April, May) (30.3% and 21.4%, respectively).

Fatalities were also not distributed evenly across days of the week. The highest percentage of fatalities occurred on Friday (17.0%) and Saturday (16.8%). The day with the lowest percentage of fatalities was Tuesday (12%). The weekend (as defined from 6 p.m. Friday to 6 a.m. Monday) accounted for 38.7% of all fatalities.

Figure 2 shows the variability in the hourly distribution of driver fatalities. The highest numbers of crashes (6.1%) occurred between 16:00 and 16:59 and 17:00 and 17:59; the least number of crashes occurred between 4:00 and 4:59 (2.3%).

Figure 2: Hourly Distribution of Crashes



Characteristics of Crashes

Drivers of automobiles accounted for 58.2% of fatalities. This is followed by drivers of pick-up trucks (11 %), light trucks (5.9%), motorcycles (9%), vans (5%), and bicycles (2.7%). Drivers of buses, mopeds, farm tractors, heavy trucks (i.e., > 4,536 kg), tractor trailers, motor homes, and emergency vehicles contributed less than 2% each.

Almost 41% of driver fatalities involved only a single vehicle; 49% involved one other vehicle. The remaining 10% involved more than two vehicles. The maximum number of vehicles recorded in a single crash was 77.

In 71% of the cases, the driver was the only occupant in the vehicle; in 19.6% of cases, the driver had a single passenger. It should be noted, however, that this information was missing in about 40% of cases.

In 85.3% of cases, the driver was the only fatality. In 11.2% of cases, there was one additional fatality. The highest number of deaths recorded in a single crash was eight. There were no injuries reported in 53.9% of cases. One recorded injury occurred 26% of the time and 11.8% of the time there were two injured individuals. The maximum number of injuries recorded was 71.

With regards to severity of damage, 86.6% of vehicles were demolished, followed by 8.5% that were categorized as severe damage. Less than 0.5% had no visible damage.

One-quarter (25.5%) of fatally injured drivers were reported as not using a safety device such as helmet, lap belt or shoulder belt. From the limited data available, 26.8% of fatally injured drivers were ejected from their vehicle; 6.2% were partially ejected.

The most common types of crash configurations were head-on collision (26.1%), right angle collision (12.5%), and running off the right shoulder (12.7%). All configurations were grouped into three categories. Two vehicles in motion with different directions of travel accounted for 46% of crash configurations, followed by single vehicle in motion (43.6%) and then two vehicles travelling in the same direction (9.3%). In the majority of cases (84.9%), drivers were reported as driving straight ahead when the crash happened as opposed to turning, reversing or swerving.

The NCDB records the events occurring to each vehicle and its involvement in the collision. Hitting a moving object was reported in 48.5% of crashes, followed by non-collision events (e.g., rollover) (37%), followed by hitting a non-moving object. More specifically, hitting another vehicle is the most common first event followed by running off roadway, skidding and rolling over.

Driver condition was deemed a contributing factor in 58.1% of crashes, followed by driver action (35.7%) such as inattention or driving too fast for conditions. Vehicular issues and environmental factors were less frequently deemed contributing factors. Of interest, more specifically within the category of driver condition, under the influence of alcohol was recorded by the investigating police officer as a contributing factor 26.9% of the time compared to 2.6% for under the influence of drugs. (Objective measures of alcohol and drug use are explored in detail in a subsequent section.)

The weather was recorded for each of the fatalities and appears to play very little role in the vast majority of crashes. The weather conditions were reported as clear for 66.7% of fatalities, followed by 14.4% that took place during times when the conditions were overcast but without precipitation. The presence of extreme weather that limited visibility, such as freezing rain or snow, was less common (10.2%). Furthermore, the roads were described as dry in 67.4%, followed by wet in 15.1% of cases. Rarely were the roads icy, muddy, or snow covered. The conditions of the roads themselves were described as being “normal” 79.1% of the time as opposed to bumpy or full of pot holes.

Road alignment was reported as straight and level in 54.7% of the fatalities, followed by curved but level (17.6%), straight but with a gradient (12.6%) and curved with gradient (12.2%). Most crashes (83%) took place where there was no traffic control measure such as traffic signs or signals present. Crashes were most common on the following types of roads: rural (74.9%) in comparison to urban; freeways (73.6%) in comparison to collector or local roads; and multilane roads (74.3%) in comparison to single lane or one-way roadways.

Almost 40% of crashes occurred on roadways with a posted speed limit of 80 km/h or higher. Almost one in five drivers (18.1%) was estimated to be travelling in excess of 100 km/h. Furthermore, 38.3% of drivers were estimated to be travelling faster than the posted speed limit.

Drug and Alcohol Testing

Testing for the presence of alcohol among fatally injured drivers has become commonplace over the past few decades. Overall, 10,900 or 84% drivers in the merged database were tested for the presence of alcohol. There was little variation in alcohol testing rates among and within jurisdictions across years.

Testing for the presence of drugs is not as common as testing for alcohol. In fact, of the 12,978 drivers in the database, 6,016 (46.4%) were tested for drugs. Table 1 presents the number of driver fatalities and drug testing rates by jurisdiction for the period 2000–2007. The last column of Table 1 shows drug testing rates for 2007 (the most recent year for which data are available). Initiatives in some jurisdictions have served to increase testing rates for drugs. As a result, 64% of driver fatalities in 2007 were tested for drugs. This is a considerable increase from 2006 when 45.3% were tested. Alberta is of note, with testing rates increasing to 85.4% in 2007. Although Ontario contributes the largest number of cases to the database (3,818 or 29.4%), the testing rate for drugs was 35.6% in 2007.

Table 1: Drug Testing Rates by Jurisdiction

Jurisdiction	N Fatally Injured Drivers (2000-2007)	Percent Tested for Drugs (2000-2007)	Percent Tested for Drugs (2007)
CANADA	**12978**	**46.4**	**64.0**
NF	164	30.4	31.5
PEI	92	72.9	80.0
NS	399	78.0	83.3
NB	453	80.2	84.0
QC	3200	47.3	60.6
ON	3818	24.6	35.6
MB	489	90.1	89.7
SK	694	81.3	86.3
AB	1687	34.7	85.4
BC	1922	61.0	79.5
NT, YK, NU	59	72.5	85.7

The Involvement of Drugs and Alcohol

Drug- and alcohol–positive rates

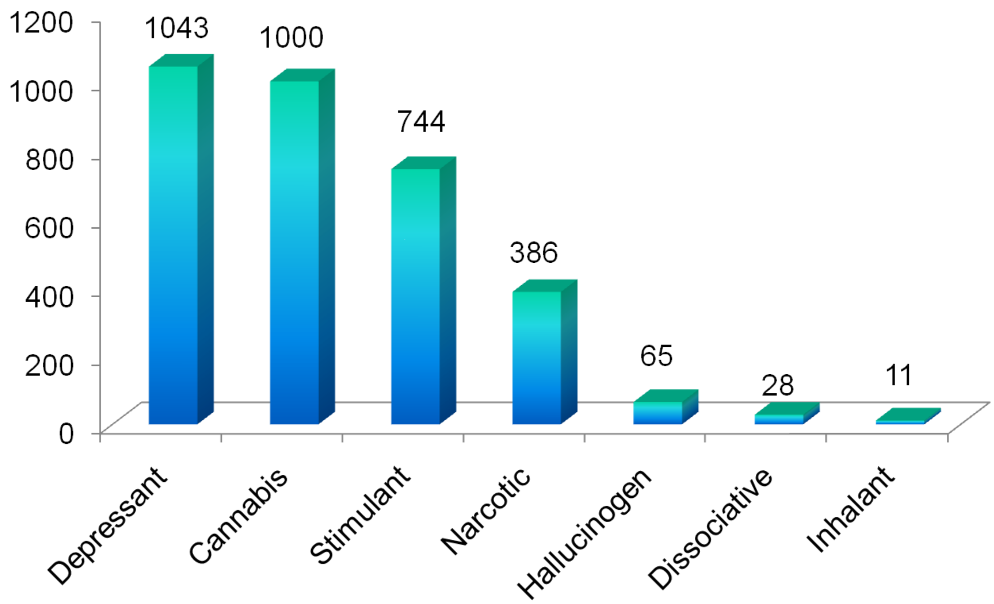
Of the 10,900 cases that were tested for alcohol, 3,984 (36.6%) were positive. Of the 6,016 cases that were tested for drugs, 1,973 (32.8%) were positive for at least one of the seven classes of psychoactive drugs.

Drugs

Of those drivers testing positive for a psychoactive drug, 59% tested positive for a single drug, 22.1% for two drugs, 10% for three drugs, 4% for four drugs and 4.5% for five drugs.

Figure 3 presents the frequency with which the seven drug categories were found among fatally injured drivers. Central nervous system (CNS) depressants were the most commonly found drugs, followed by cannabis and CNS stimulants. Inhalants, dissociative anaesthetics and hallucinogens are rarely found in fatally injured drivers.

Figure 3: Frequency of Drug Categories Detected

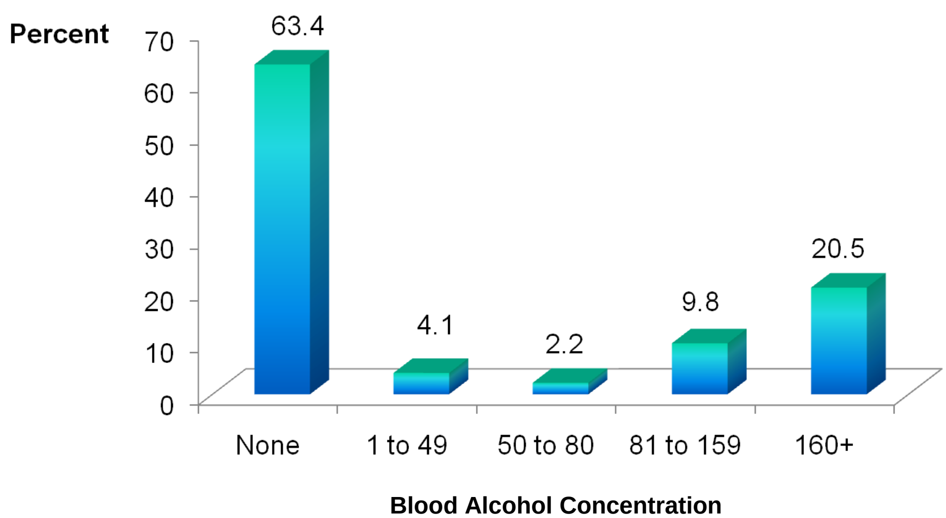


It should be noted, however, that not all cases are subjected to comprehensive drug screens. Some cases may be screened for only specific substances based on suspicion; others may be screened for the most common substances. It should also be noted that the presence of a drug does not necessarily imply that the person's ability to operate a vehicle was impaired. Whereas research has established levels of alcohol that render a presumption of impairment, (i.e., 80 mg%); such levels have yet to be established for drugs.

Alcohol

The distribution of blood alcohol concentration (BAC) among drivers is displayed in Figure 4. High BACs are common among fatally injured drivers—9.8% had a BAC of between 81 mg% and 160 mg%, and 20.5% had a BAC over 160 mg%. Among drivers who tested positive for alcohol, 83.5% had a BAC in excess of 80 mg%.

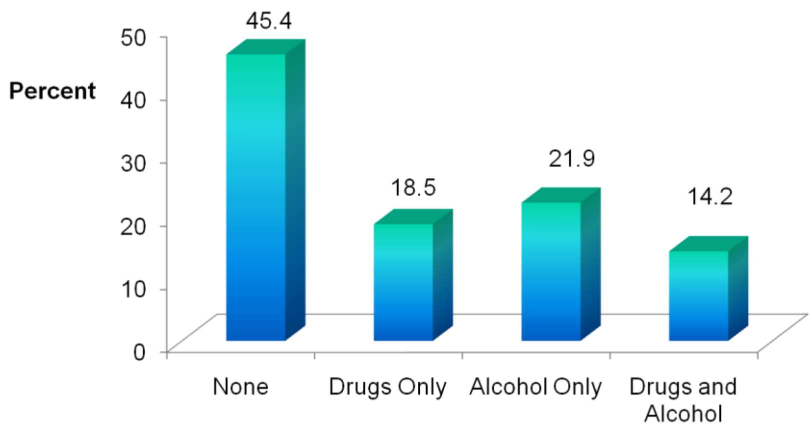
Figure 4: Blood Alcohol Concentration Among Fatally Injured Drivers



Drivers tested for both drugs and alcohol

There were 5,929 drivers that were tested for both alcohol and drugs. Figure 5 depicts these results. Of these drivers, 2,689 (45.4%) had no alcohol or drugs present, 1,097 (18.5%) tested positive for a psychoactive drug (but negative for alcohol), 1,301 (21.9%) tested positive for alcohol only, and 842 (14.2%) drivers tested positive for both alcohol and at least one psychoactive drug. These four groups based on the presence of alcohol, drugs or both alcohol and drugs were used in all subsequent analyses.

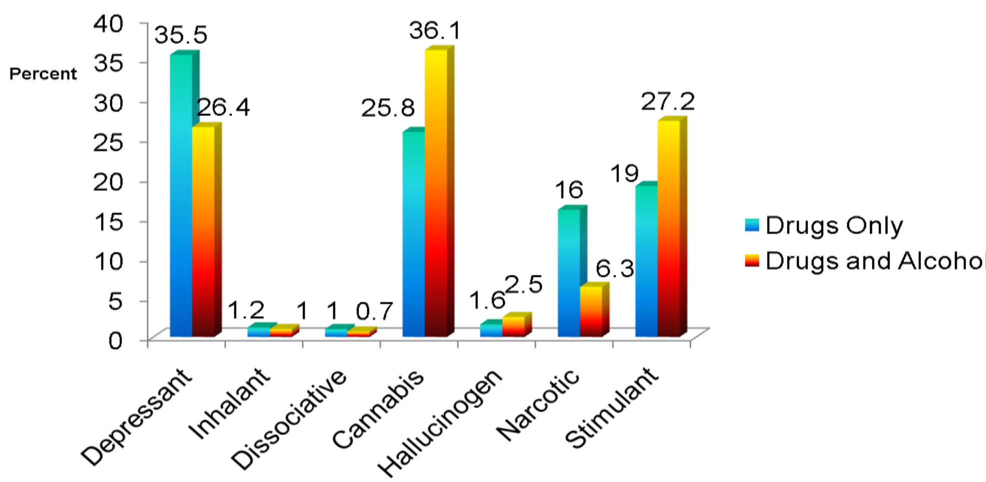
Figure 5: Results of Drivers Tested for Both Drugs and Alcohol



The distribution of BAC was extremely similar between drivers who tested positive for alcohol only and those who were positive for both alcohol and drugs. For example, 54.4% of the those who tested positive for alcohol only had a BAC over 160 mg% compared to 55.6% who tested positive for alcohol and drugs. Similarly, 28.1% of those with just alcohol had a BAC between 81 and 160 mg% compared to 26.4% of those who tested positive for alcohol and drugs.

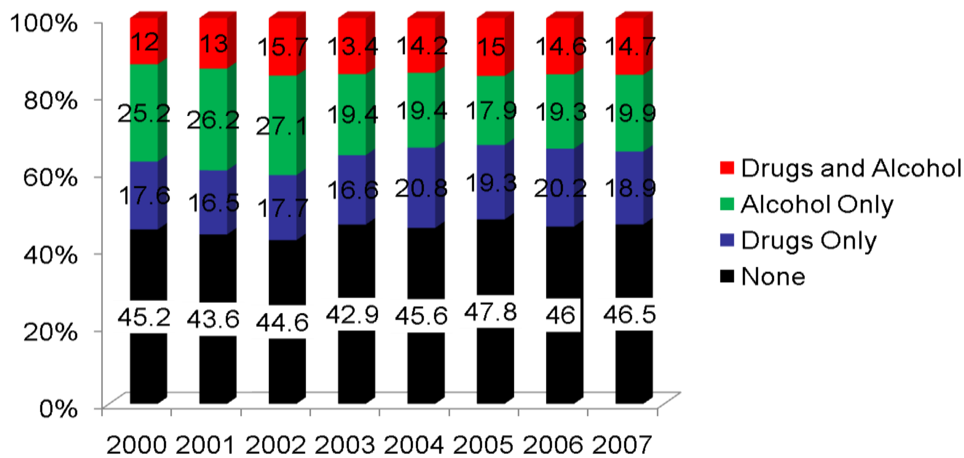
There were, however, differences in the drug categories among the group of drivers that tested positive for only drugs and those who tested positive for both alcohol and drugs. As illustrated in Figure 6, CNS depressants and narcotic analgesics were more common among those who were positive for drugs only. Cannabis and CNS stimulants were more common among those also testing positive for alcohol.

Figure 6: Drug Categories Detected Among Drug Only and Drug- & Alcohol-positive Drivers



As shown in Figure 7, there was only minor variation in the distribution of driver fatalities that tested positive for drugs, alcohol, or both alcohol and drugs according to year (2000–2007). For example, the percentage of those testing positive for both drugs and alcohol has varied from 12% (2000) to 15.7% (2002). The variation in the percentage of alcohol only cases is slightly greater, ranging from 17.9% (2005) to 27.1% (2003). Cases involving only drugs were ranged from 16.5 (in 2001) to 20.8% (2004).

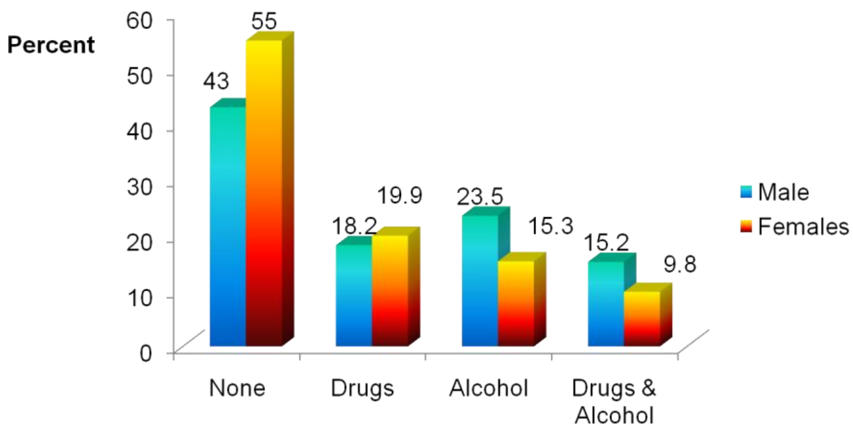
Figure 7: Distribution of Drug- and Alcohol-positive Cases According to Year of Crash



Driver sex

There were 4,781 males and 1,148 females tested for both alcohol and drugs. Figure 8 depicts the differences in alcohol and drug use between men and women. Females were more likely than males to test negative for both alcohol and drugs (χ^2 = 77.83, df= 3, p<.001). When females did test positive, it was most likely for drugs only; males were most likely to test positive for alcohol only.

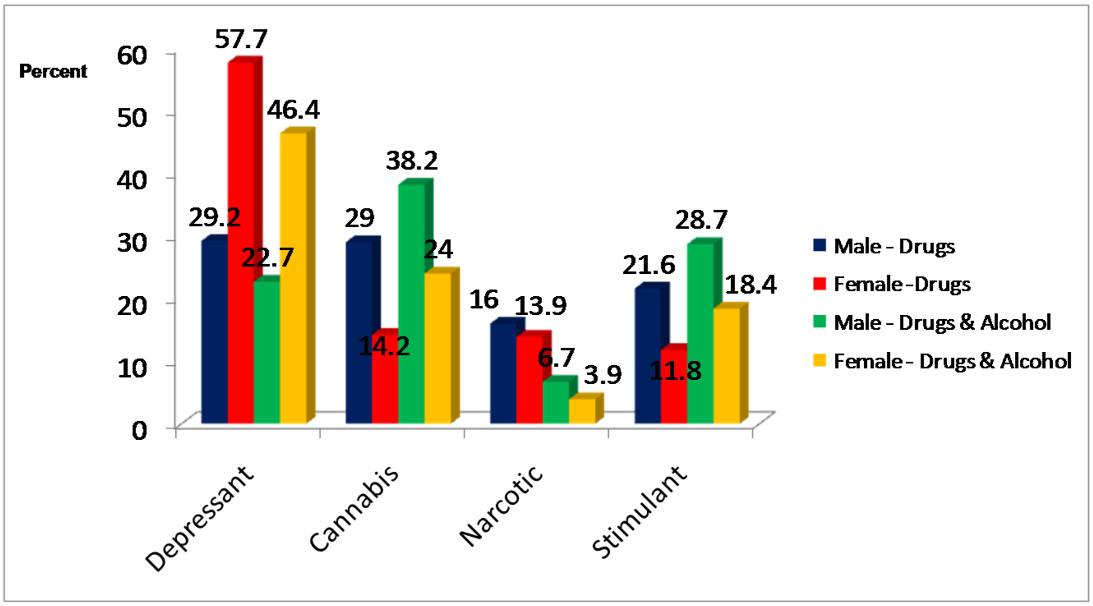
Figure 8: Alcohol and Drug Positive Cases According to Sex



Males who tested positive for alcohol only were just as likely to have a BAC over 160 mg% (54.6%) as those that also tested positive for alcohol and drugs (54.9%). However, females who tested positive for drugs (60.2%) were more likely to have a BAC over 160 mg% than those who tested positive for alcohol only (53.4%).

As illustrated in Figure 9, drug category varied according to sex as well as according to whether the driver tested positive for drugs only or drugs and alcohol. Inhalants, dissociative anaesthetics, and hallucinogens are not included in the figure as these substances accounted for less than 3% across all groups. Most noticeable is the predominance of CNS depressants among females, regardless of whether they tested positive for alcohol.

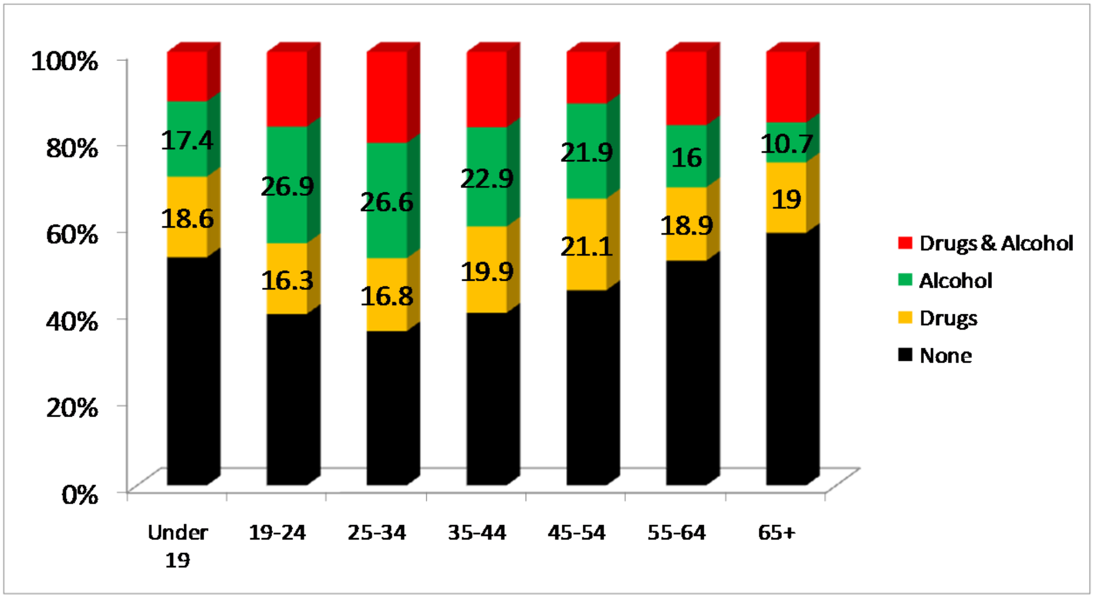
Figure 9: Drug Category According to Sex and Alcohol and Drug-positive Results



Driver age

Figure 10 shows differences in alcohol and drug positive cases according to driver age (χ^2 = 351.9, df = 18, p<.001). It should be noted, however, that younger drivers were slightly more likely to be tested for drugs and this may introduce a bias. Younger drivers (19 to 24 and 25 to 34) were more likely than older drivers (age 55 and over) to test positive for a substance. Alcohol only use was more common among younger drivers than older drivers. When older drivers tested positive for substance use, it was most likely either drugs only or a combination of drugs and alcohol. Rates of drug use (without alcohol) remained relatively constant across all age groups.

Figure 10: Alcohol- and Drug-positive Cases According to Driver Age



Figures 11 and 12 illustrate differences in age groups according to the most commonly found drugs and differences in drug categories among those who tested positive for drugs only and those who tested positive for both drugs and alcohol.

Figure 11: Frequency of Drug Categories According to Age Among Drivers Testing Positive for Drugs Only

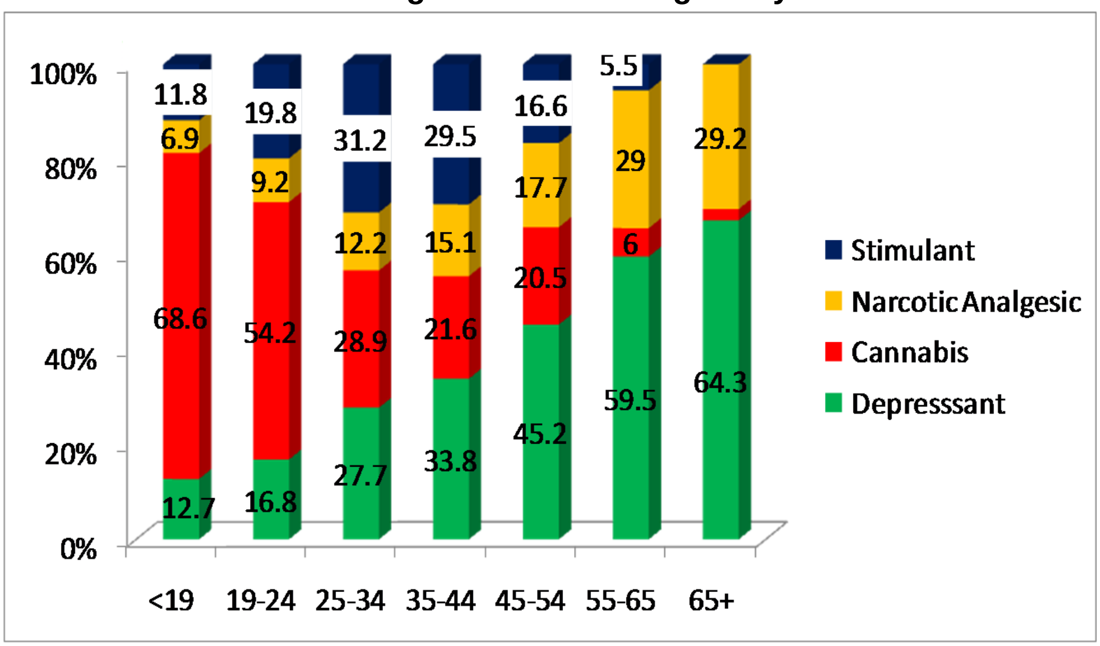
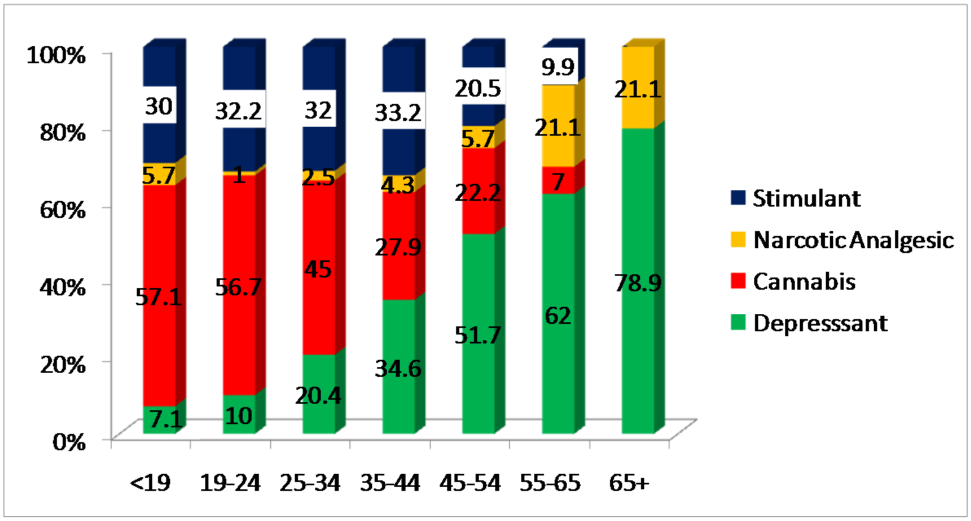


Figure 12: Frequency of Drug Categories According to Age Among Drivers Testing Positive for Drugs and Alcohol



Among cases where only drugs were found (Figure 11), cannabis was most commonly detected among drivers under 19 years of age. The frequency of cannabis decreased with increased age. Depressants and narcotic analgesics showed the opposite trend, being least common among younger drivers and increasingly prevalent among older drivers. Stimulants were most commonly found among drivers age 25 through 44. Figure 12 shows very similar trends in the categories of drugs detected among drivers who also tested positive for alcohol and drugs.

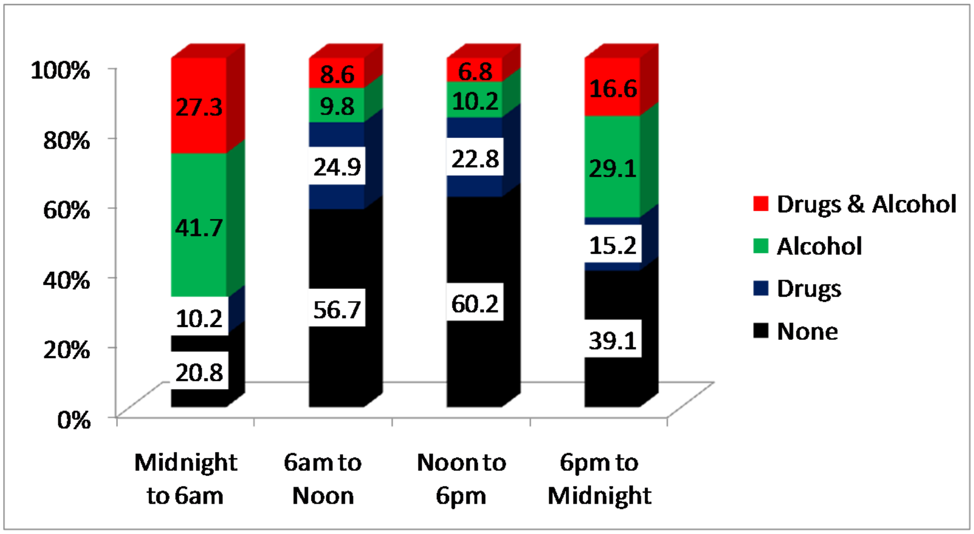
Licence status

There were no significant differences (χ^2 = 6.6, df= 3, p> .08) in drug and alcohol results between those with a valid licence and those with a revoked, suspended, invalid or no licence. Among those with a valid licence, 47.2% of drivers were negative for both alcohol and drugs compared to 45.9% among those who did not possess a valid licence.

Time and day

Figure 13 shows significant differences in drug and alcohol use among fatally injured drivers according to time of day (χ^2 = 1094.13, df = 9, p<.001). Between midnight and 6 a.m., 20.8% of drivers involved in fatal collisions were negative for both drugs and alcohol. This compares with 60.2% that tested negative for alcohol and drugs between noon and 6 p.m. and 56.7% that were free of alcohol and/or drugs between 6 a.m. and noon. Alcohol alone (41.7%) and a combination of alcohol and drugs (27.3%) were most commonly found between midnight and 6 a.m. Drug use alone was most frequently found between 6 a.m. and noon (24.9%) and between noon and 6 p.m. (22.8%).

Figure 13: Alcohol- and Drug-positive Cases According to Time of Day



Dividing the week into weekend and weekday periods revealed significant differences in alcohol and drug use among fatally injured drivers ($\chi^2 = 279$, df =3 , p< .001). Weekends were defined as 6 p.m. Friday to 6 a.m. Monday. Figure 14 shows these differences. Drivers were more likely to test positive for a substance, particularly alcohol, on the weekends. However, when a driver tested positive on a weekday, it was more likely to involve a drug than alcohol.

Figure 14: Alcohol- and Drug-positive Cases According to Weekend/Weekday

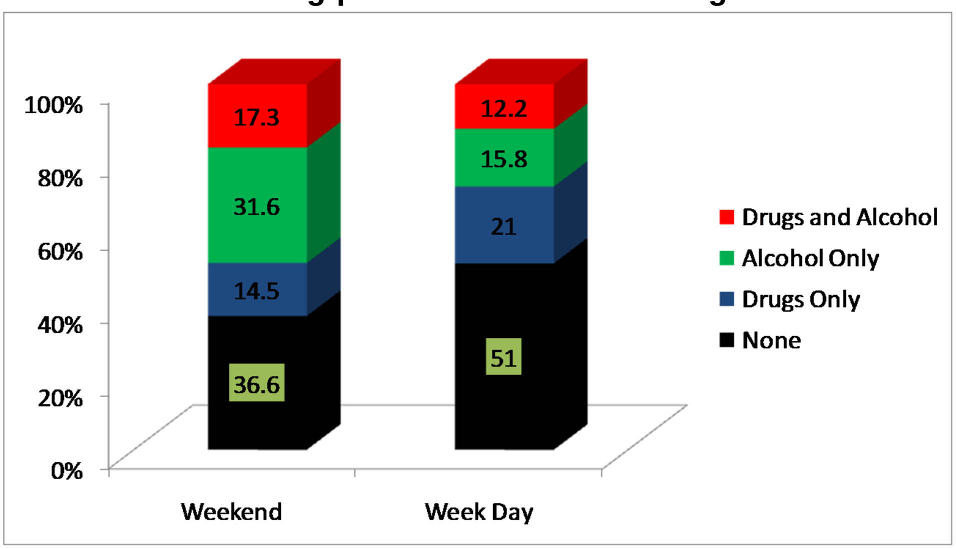
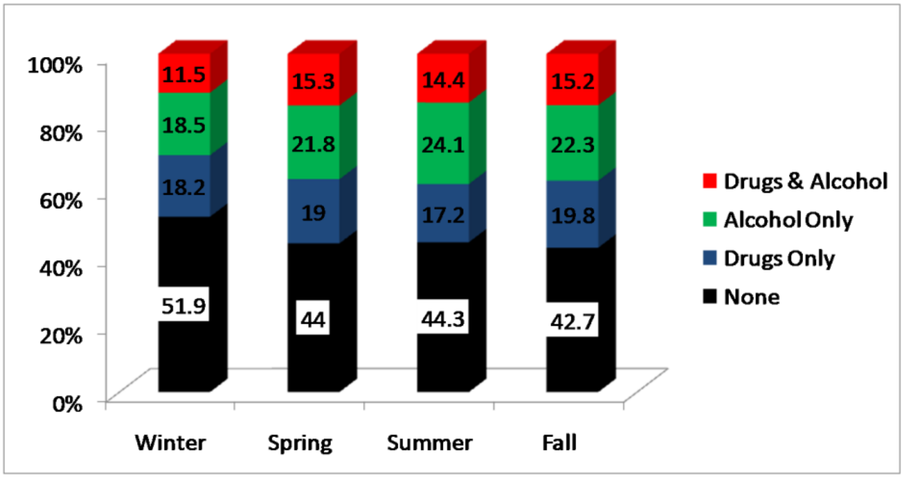


Figure 15 shows differences in drug- and alcohol-involved driver fatalities according to season (χ^2 = 37.1, df = 9, p<.001). Drivers were least likely to test positive for drugs and/or alcohol in the winter (48.1%) and most likely to test negative in the fall

(57.3%). Alcohol-only cases peaked in the summer months (24.1%); cases involving only drugs were more evenly distributed across all seasons.

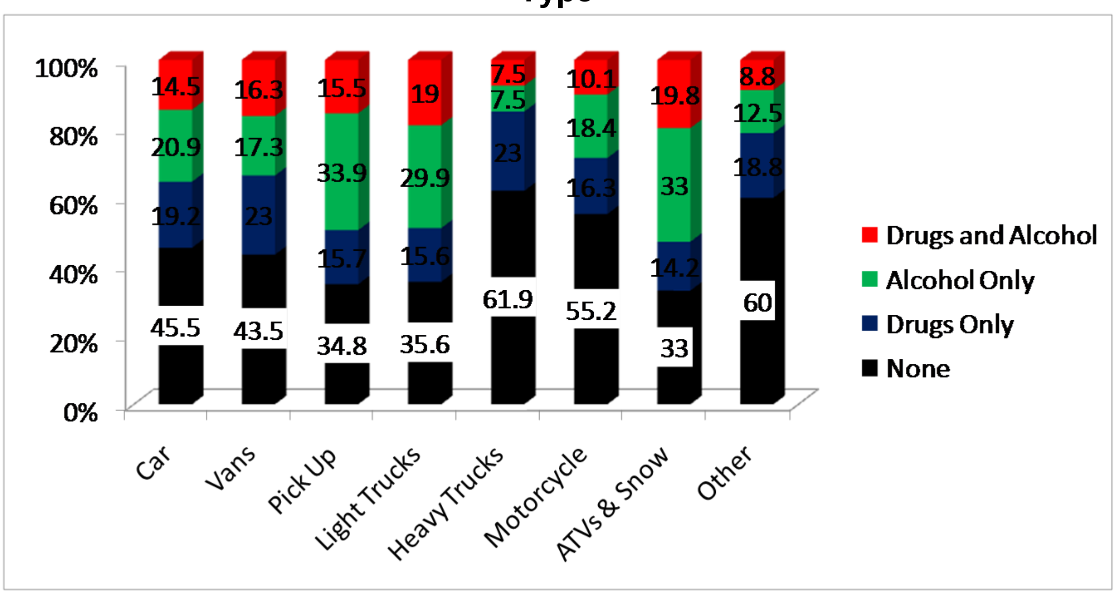
Figure 15: Drug- and Alcohol-positive Results According to Season



Vehicle type

Figure 16 displays significant differences in drug and alcohol use among driver fatalities according to vehicle type (χ^2 = 225, df = 21, p<.001). Drivers of pick-up trucks (65.2%) as well as off-road vehicles and snowmobiles (67.0%) were most likely to test positive for alcohol and/or drugs. Heavy-truck drivers had the lowest rates of alcohol and drug use, but when they did test positive, it was most likely for drugs only.

Figure 16: Drug- and Alcohol-positive Driver Fatalities According to Vehicle Type



Presence of passengers

Alcohol and drug use were related to the presence of other passengers in the vehicle (χ^2 = 740.4, df = 3, p<.001). Overall, alcohol and/or drugs were involved in 55% of crashes regardless of whether or not other passengers were present in the vehicle. However, when passengers were present, the driver was more likely to test positive for the presence of both alcohol and drugs (16.7%) than when no passengers were present (12.2%).

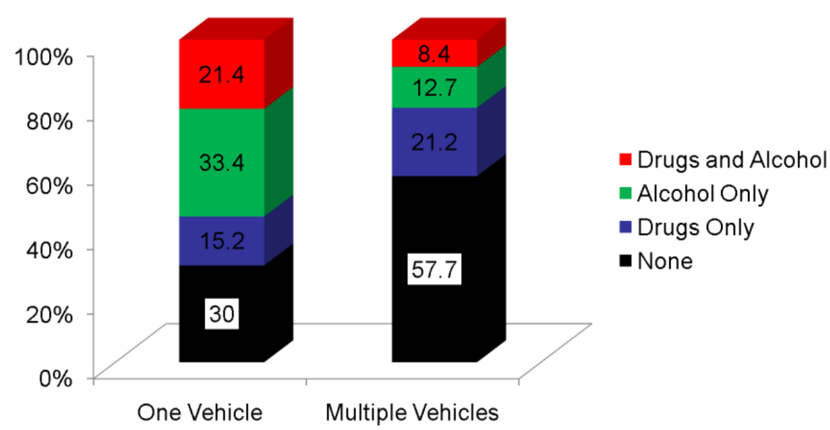
Safety device use

Drivers who did not use any safety devices (i.e., seat belts, helmets) were more likely to be positive for drugs and/or alcohol (71.4%) compared to those who did use a safety device (48.5%) (χ^2 = 408.3, df = 3, p<.001). Being ejected from the vehicle was more likely among those testing positive for drugs and/or alcohol (χ^2 = 119, df = 6, p<.001). For example, among those fully ejected from their vehicles, 64.4% tested positive for drugs and/or alcohol, 27.5% tested positive for alcohol only, 19.2% tested positive for both alcohol and drugs, and 17.7% tested positive for drugs only. Among those drivers who were not ejected, 48.9% were positive for drugs and/or alcohol.

Number of vehicles

Figure 17 illustrates differences in the number of vehicles involved in crashes according to drug and alcohol use (χ^2 = 740.4, df = 3, p<.001). Drivers who died in single vehicle crashes were more likely to test positive for drugs and/or alcohol than drivers in multiple vehicle collisions. Alcohol was more common among drivers in single vehicle crashes; drugs were more prominent among drivers killed in multiple vehicle crashes. The involvement of both alcohol and drugs was more prominent in single vehicle crashes than multiple vehicle crashes.

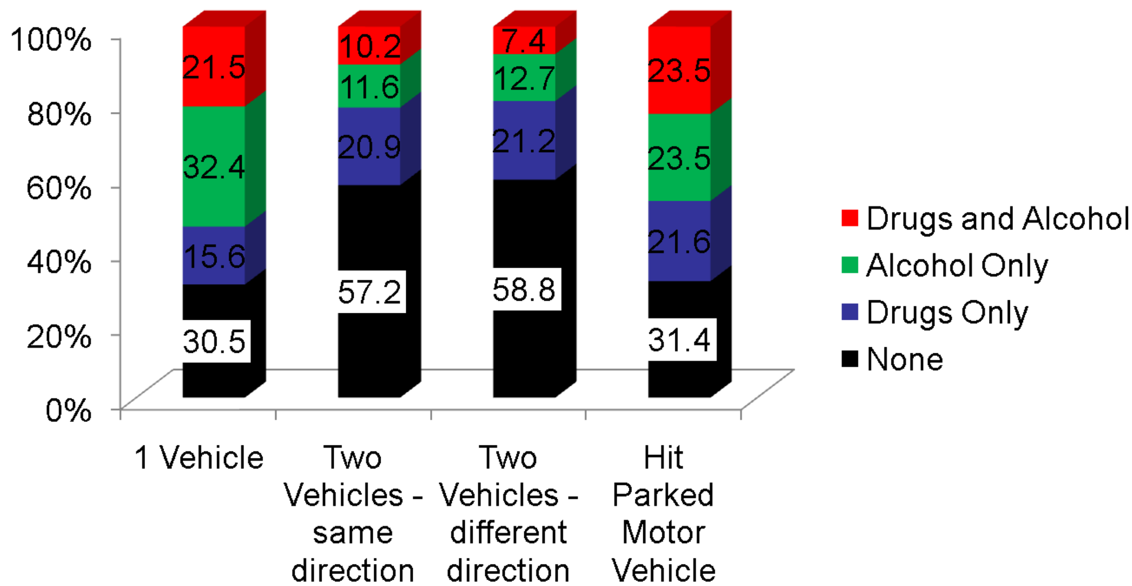
Figure 17: Drug and Alcohol Positive Cases According to Number of Vehicles



Vehicle configuration

There were significant differences in driver drug and alcohol use according to the configuration of vehicles involved in the crash (χ^2 =699.2, df = 9, p< .001). Figure 18 shows alcohol and drug use among driver fatalities according to the crash configuration. As indicated previously, crashes involving only one vehicle were most likely to involve drugs and/or alcohol. Approximately one-third of these crashes involved alcohol only (32.4%). When two vehicles were involved, whether the vehicles were travelling in the same or opposite direction was of little consequence in terms of drug and alcohol involvement. Although the absolute number of crashes involving a parked vehicle was small, these fatalities also had a high rate of alcohol and drug use (68.6%).

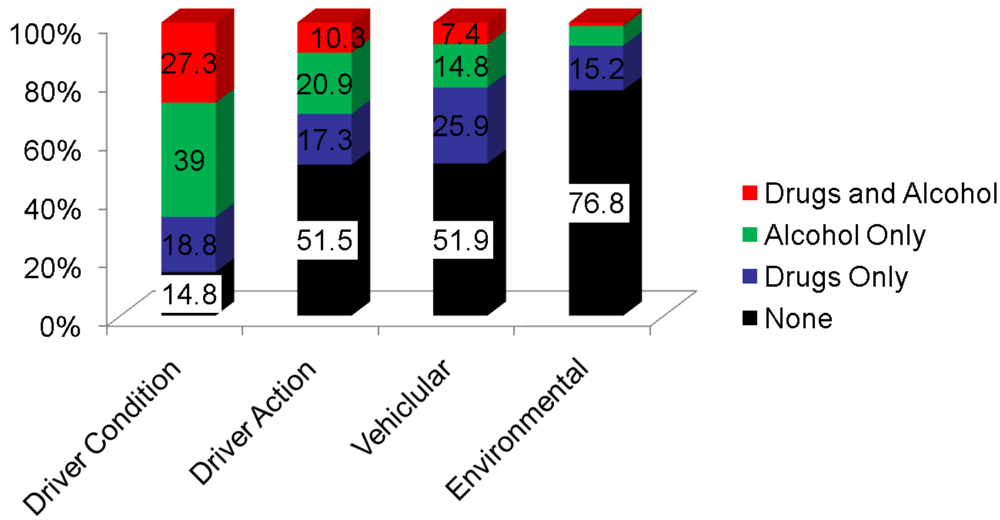
Figure 18: Driver Drug and Alcohol Use According to Crash Configuration



Contributing factors

There were significant differences between the four drug and alcohol groups according to the investigating police officer's opinion as to the factor(s) that appeared to have contributed to the crash (χ^2 = 600.7, df=9, p< .001). Figure 19 shows that among crashes where driver condition was deemed a contributing factor, alcohol and drug use was found in all but 14.8% of cases. It should be noted, however, that "driver condition" includes suspected alcohol and/or drug use. In crashes where environmental factors were considered to have been contributing factors, 23.2% involved alcohol and/or drug use.

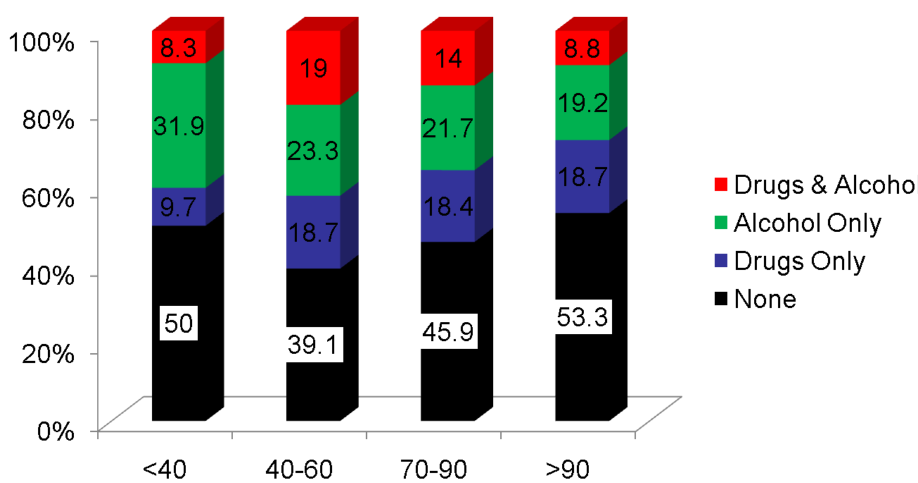
Figure 19: Drug- and Alcohol-positive Cases According to Contributing Factors



Posted speed limit

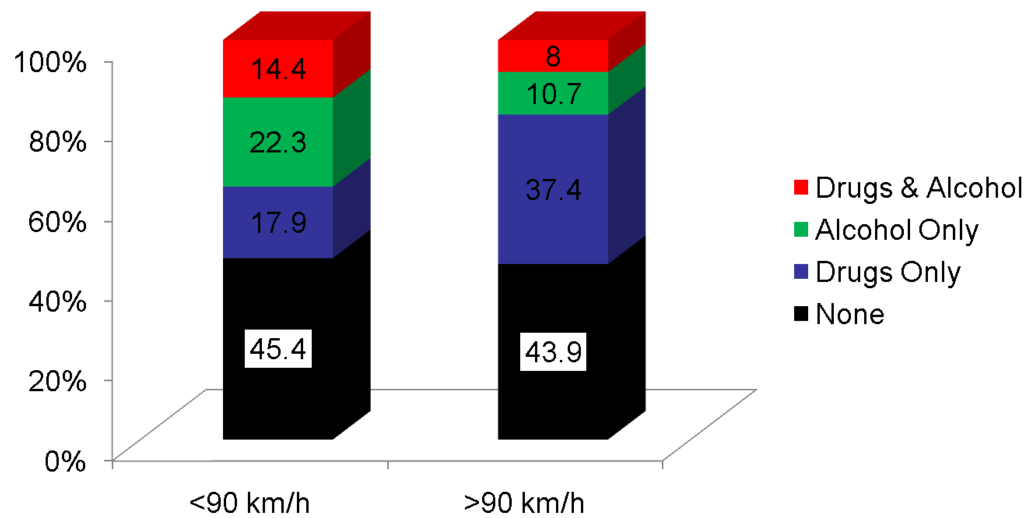
There were also significant differences in drug and alcohol positive cases according to the posted speed limit on the road where the crash occurred ($\chi^2 = 75.4$, df=9, p< .001). As illustrated in Figure 20, when a crash occurred on a road with a speed limit between 40 and 60 km/h, drivers were most likely to test positive for drugs and/or alcohol. Alcohol was most likely to be involved when the posted speed was lower (i.e., ≤ 40 km/h) compared to when the posted speed limit was higher (i.e., ≥ 90 km/h).

Figure 20: Drug- and Alcohol-positive Cases According to Posted Speed



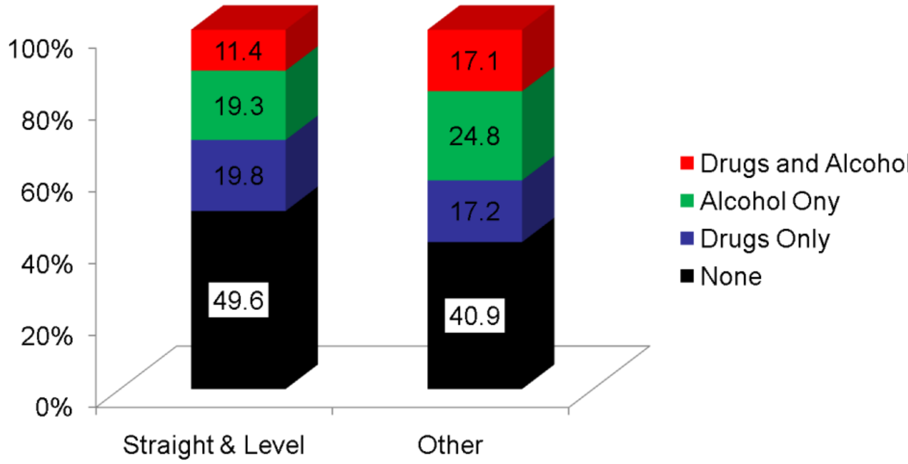
Estimated speed
There were also significant differences in the involvement of drugs and/or alcohol according to the estimated speed of travel (χ^2 = 58.8, df=3, p< .001). Figure 21 shows that drugs and/or alcohol are almost equally likely to be involved regardless of whether the estimated speed was above or below 90 km/h at the time of the crash. However, if the estimated speed was over 90 km/h, over one-third (38%) tested positive for drugs only. Alcohol was more likely to be involved when the estimated speed was less than 90 km/h.

Figure 21: Drug and Alcohol Involvement According to Estimated Speed



Roadway alignment
Road alignment was regrouped into two categories—straight and level, versus all others (e.g., curve, gradient, bottom of hill). Drug and alcohol use varied significantly according to road alignment (χ^2= 83.7, df=3, p< .001). Figure 22 shows that, overall, drivers were more likely to test negative for drugs and/or alcohol (49.6%) when the road was straight and level compared to when the road was not straight and level (40.9%). Alcohol, either alone or in combination with drugs, was somewhat more prevalent among drivers killed in crashes that occurred on roadways that were not straight and level.

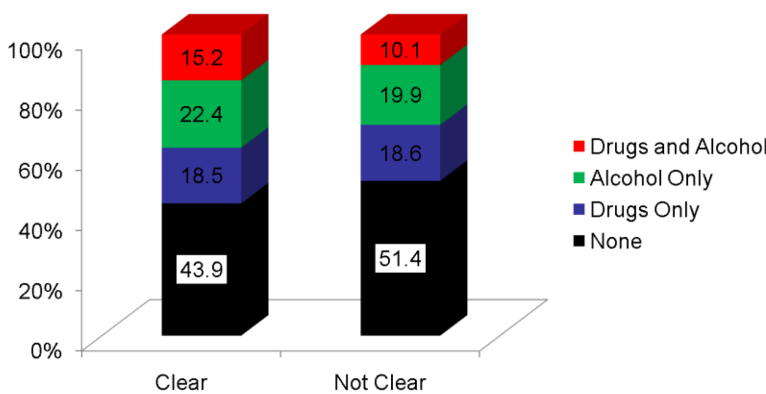
Figure 22: Drug- and Alcohol-positive Cases According to Road Alignment



Weather

Weather was regrouped into clear versus all other forms of inclement weather such as rain or snow. Figure 23 shows that drugs and/or alcohol were more likely to be involved when the weather was clear (56.1%) compared to inclement (48.6%) (χ^2=30.5, df=3, p< .001).

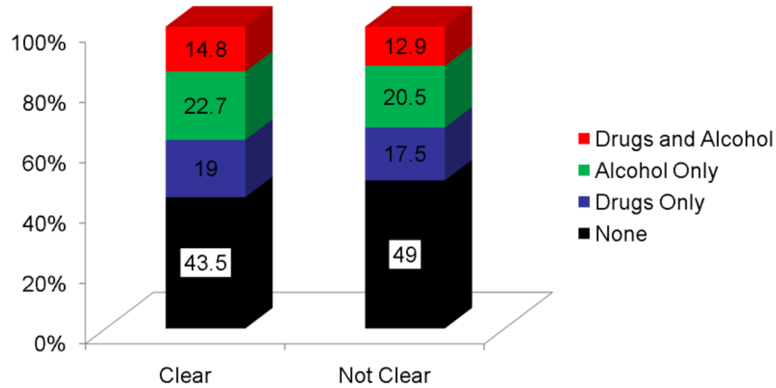
Figure 23: Drug- and Alcohol-positive Cases According to Weather



Road conditions

Road surface conditions were regrouped into clear and dry versus all other types of surface conditions (e.g., wet, snow, ice). Figure 24 shows differences in alcohol and/or drug involvement similar to those for weather condition (χ^2 = 16.5, df=3, p< .001). When the road was clear and dry, drivers were more likely to test positive for drugs and/or alcohol (56.5%) than when the roadway was wet, snow covered or icy (51%).

Figure 24: Drug- and Alcohol-positive Cases According to Road Surface Condition



Other factors

There were no significant differences across the four alcohol and drug groups according to whether the fatality occurred on an urban or rural roadway ($\chi^2 = 5.5$, df = 3, p>.16), the type of road (freeway, arterial, collector, or local road) ($\chi^2 = 7.4$, df = 9, p>.59), or the vehicle manoeuvre (going straight, turning, negotiating a curve) ($\chi^2 = 5.5$, df = 6, p>.13).

Logistic Regression Analysis

A series of logistic regression analyses were performed to identify the set of statistically significant variables that best predicted alcohol and/or drug use in fatally injured drivers. Variables included in the logistic regression models were the driver's sex and age ($\leq$ 35 years, >35 years), time/day of collision (weekend, non-weekend), number of vehicles involved in the collision (one, two or more), type of collision event (non-collision event, hit moving object, hit non-moving object), contributing factor to the crash (driver condition, driver action, vehicular contributing factor, environmental contributing factor), ejection from the vehicle by the driver (yes, no), vehicle type (car, van, pick-up truck, light or heavy truck, motorcycle, all terrain vehicle (ATVs), snowmobile, other), and estimated speed at the time of the collision ($\leq$ 90 km/h, > 90 km/h). A separate analysis was performed to predict alcohol use, drug use, a combination of alcohol and drug use, and a comparison of alcohol versus drug use by fatally injured drivers.

Alcohol use in fatally injured drivers

A logistic regression analysis was performed to identify the best set of driver and crash variables that predicted alcohol use among fatally injured drivers. Results indicated that the set of nine personal, vehicular and collision factors significantly distinguished fatally injured drivers who tested positive for alcohol from those had not consumed alcohol or drugs (χ^2= 617.01, df=13, p < .0001). An overall correct classification rate of 75.3% was obtained; thus, more than three-quarters of all cases were correctly classified based on the inclusion of the set of nine factors in the overall logistic regression model. Based on the set of nine factors, the classification rate for predicting alcohol use in fatally injured drivers was 69.3% and 79.9% for those cases that did not involve alcohol or drugs. Table 2 shows the unique contribution of the individual predictors to the overall logistic regression model by comparing models with and without each predictor. Six factors significantly[2] contributed to the prediction of alcohol use in fatally injured drivers—sex, age, time/day of collision, contributing factor to the crash, ejection from the vehicle and vehicle type. The number of vehicles involved and the type of event also significantly predicted alcohol use ($p < .05$).

Table 2: Contribution of Personal, Vehicular and Collision Factors in Predicting Alcohol Use in Fatally Injured Drivers

Factors	χ^2 to Remove	df
Sex	18.89**	1
Age	11.39**	1
Time/day	59.17**	1
Vehicles involved	6.60*	1
Type of event	7.10*	2
Contributing factor to the crash	246.09**	3
Ejection from vehicle	24.44**	1
Vehicle type	21.09**	2
Estimated speed	3.29	1

$^{*}p < .05$. $^{**}p < .0056$.

Table 3 presents the regression coefficients (β), chi-square (χ^2) tests, odds ratios (OR) and 95% confidence intervals (CI) for the ORs for determining the significance of variables predicting alcohol use among fatally injured drivers. The ORs indicate whether there is an increased or decreased likelihood of alcohol use by the driver. ORs greater than 1 reflect an increased likelihood whereas ORs less than 1 reflect a decreased likelihood. Results indicated that fatally injured drivers who had consumed alcohol were more likely to be male; younger than 36 years old; drive a car, van or pick-up truck; have crashed their vehicle during the weekend, and have been ejected from the vehicle when compared to fatally injured drivers who did not use alcohol or drugs (Table 3). In addition, the factors contributing to the crashes of drivers who had used alcohol were more likely to be driver-related rather than environmentally-related.

---

[2] A Bonferonni correction ($p < .0056$) was used to control for Type I error.

Table 3: Prediction of Alcohol Use in Fatally Injured Drivers

Factors	β	SE	Wald χ^2 Test	OR	95% CI for OR
Sex (male)	.69	.16	18.34*	2.00	1.46, 2.75
Age (≤ 35 years, >35 years)	.42	.12	11.34*	1.52	1.19, 1.94
Time/day (non-weekend, weekend)	-.95	.12	58.07*	.39	.31, .50
Number of vehicles involved (one, two or more)	.64	.25	6.56	1.89	1.16, 3.08
Type of event					
Non-collision vs. non-moving object	-.40	.17	5.84	.67	.49, .93
Hit moving object vs. non-moving object	-.57	.28	4.28	.57	.33, .97
Contributing factor to the crash					
Driver/pedestrian condition vs. environmental factor	3.05	.35	78.02*	21.18	10.76, 41.70
Driver action vs. environmental factor	1.38	.34	16.16*	3.98	2.03, 7.81
Vehicular factor vs. environmental factor	1.27	.68	3.56	3.58	.95, 13.44
Ejection from vehicle	-.71	.15	24.13*	.49	.37, .65
Vehicle type					
Cars, vans, pick-up trucks vs. motorcycles, ATVs, snowmobiles, other vehicles	.92	.21	20.01*	2.51	1.68, 3.75
Light and heavy trucks vs. motorcycles, ATVs, snowmobiles, other vehicles	.65	.25	6.94	1.91	1.18, 3.10
Estimated speed (≤ 90 km/h, > 90 km/h)	.71	.39	3.28	2.04	.94, 4.41

$^*p < .0056$.

Drug use in fatally injured drivers

A separate logistic regression analysis was performed to identify the best set of driver and crash variables that predicted drug use among fatally injured drivers. The results showed that the set of nine personal, vehicular and collision factors significantly distinguished drivers who tested positive for at least one type of drug from those who did not consume any drugs or alcohol (χ^2 = 173.58, df=13, p < .0001). Based on these nine factors, 69.9% of all cases were correctly classified, with classification being better for those cases that did not involve drugs or alcohol (83.4%) compared to cases involving drugs (43.9%). Only two factors significantly contributed to the prediction of drug use in fatally injured drivers: the contributing factor to the crash and the estimated speed at the time of the crash (p < .0056). Ejection from the vehicle was also found to significantly predict drug use (p < .05).

As shown in Table 4, the crashes of fatally injured drivers who had consumed drugs were more likely to be driver-related than environmentally-related. The estimated speed of these crashes was also more likely to be over 90 km/h.

Table 4: Prediction of Drug Use in Fatally Injured Drivers

Factors	β	SE	Wald χ^2 Test	OR	95% CI for OR
Sex	.09	.15	.41	1.10	.82, 1.47
Age (≤ 35 years, >35 years)	-.06	.12	.20	.95	.74, 1.20
Time/day (non-weekend, weekend)	-.09	.13	.45	.92	.71, 1.18
Number of vehicles involved (one, two or more)	-.18	.22	.64	.84	.55, 1.29
Type of event					
Non-collision vs. non-moving object	-.27	.19	1.99	.77	.53, 1.11
Hit moving object vs. non- moving object	-.39	.26	2.25	.68	.41, 1.13
Contributing factor to the crash					
Driver condition vs. environmental factor	1.73	.25	48.56*	5.62	3.46, 9.13
Driver action vs. environmental factor	.43	.24	3.16	1.54	.96, 2.47
Vehicular factor vs. environmental factor	.87	.52	2.83	2.39	.87, 6.62
Ejection from vehicle	-.36	.16	5.27	.70	.51, .95
Vehicle type					
Cars, vans, pick-up trucks vs. motorcycles, ATVs, snowmobiles, other vehicles	.18	.21	.76	1.20	.80, 1.79
Light and heavy trucks vs. motorcycles, ATVs, snowmobiles, other vehicles	.02	.25	.01	1.02	.63, 1.66
Estimated speed (≤ 90 km/h, > 90 km/h)	-1.01	.29	12.23*	.36	.21, .64

$^*p < .0056$.

Alcohol and drug use in fatally injured drivers

A third logistic regression analysis was conducted to identify the best set of driver and crash variables that predicted fatally injured drivers who had used both alcohol and drugs. Findings revealed that the set of nine factors significantly distinguished drivers who tested positive for alcohol and drugs from those drivers who did not consume either of these substances (χ^2 = 539.39, df=13, p < .0001). An overall classification rate of 78.9% was calculated based on these nine factors. Classification was better for those drivers who did not use alcohol or drugs (87.4%) compared to those who used both substances (61.1%). Seven factors significantly predicted alcohol and drug use among fatally injured drivers—sex, age, time/day of collision, number of vehicles involved in the crash, contributing factor to the crash, ejection from the vehicle, and vehicle type.

The results indicated that fatally injured drivers who had consumed both alcohol and drugs were more likely to be male; younger than 36 years old; drive a car, van or pick-up truck; have crashed their vehicle during the weekend; and be ejected from the vehicle when compared to fatally injured drivers who did not use alcohol or drugs (Table 5). The crashes of these drivers were more likely to involve only one vehicle and the factors contributing to the crashes were more likely to be driver- than environmentally related.

Table 5: Prediction of Alcohol and Drug Use in Fatally Injured Drivers

Factors	β	SE	Wald χ^2 Test	OR	95% CI for OR
Sex	.78	.20	15.18*	2.19	1.48, 3.24
Age (≤ 35 years, >35 years)	.57	.15	15.13*	1.77	1.33, 2.36
Time/day (non-weekend, weekend)	-.71	.15	23.02*	.49	.37, .66
Number of vehicles involved (one, two or more)	1.07	.29	13.25*	2.90	1.64, 5.15
Type of event					
Non-collision vs. non-moving object	-.17	.20	.74	.85	.57, 1.24
Hit moving object vs. non-moving object	.13	.33	.15	1.14	.60, 2.16
Contributing factor to the crash					
Driver condition vs. environmental factor	4.52	.73	37.79*	91.35	21.65, 385.36
Driver action vs. environmental factor	2.44	.74	11.03*	11.47	2.72, 48.42
Vehicular factor vs. environmental factor	2.26	1.06	4.55	9.62	1.20, 77.00
Ejection from vehicle	-.88	.17	27.68*	.41	.30, .58
Vehicle type					
Cars, vans, pick-up trucks vs. motorcycles, ATVs, snowmobiles, other vehicles	.87	.24	13.47*	2.38	1.50, 3.79
Light and heavy trucks vs. motorcycles, ATVs, snowmobiles, other vehicles	.62	.29	4.74	1.87	1.06, 3.27
Estimated speed (≤ 90 km/h, > 90 km/h)	.76	.43	3.18	2.13	.93, 4.90

*p < .0056.

Comparing fatally injured drivers who used alcohol versus drugs

A final logistic regression analysis compared fatally injured drivers who consumed alcohol to those who used drugs and the results revealed significant differences (χ^2 = 237.07, df=13, p < .0001). An overall correct classification rate of 71.1% was obtained, indicating that close to three-quarters of the cases were correctly classified based on the inclusion of the set of nine factors in the model. The classification rate for predicting alcohol use in fatally injured drivers (82.7%) was found to be higher than that for predicting drug use (53.9%). Six factors significantly contributed to the prediction of alcohol and drug use in fatally injured drivers—sex, age, time/day of collision, number of vehicles involved in the crash, contributing factors to the crash and estimated speed at the time of the crash ($p < .006$). The vehicle type and ejection from the vehicle were also found to be significant predictors ($p < .05$).

Results indicated that fatally injured drivers who had consumed alcohol were more likely to be male; younger than 36 years old; drive a car, van or pick-up truck; and have crashed their vehicle during the weekend versus drivers who used drugs (Table 6). Compared to drivers who used drugs, the crashes of drivers who used alcohol were more likely to involve one vehicle and have occurred at an estimated speed of less than 91 km/h. In addition, the factors contributing to the crashes of drivers who had consumed alcohol were more likely to be driver-related than environmentally related.

Table 6: Comparison of Alcohol use versus Drug use in Fatally Injured Drivers

Factors	β	SE	Wald χ^2 Test	OR	95% CI for OR
Sex	.55	.17	10.21*	1.74	1.24, 2.43
Age (≤ 35 years, >35 years)	.44	.13	11.31*	1.56	1.20, 2.01
Time/day (non-weekend, weekend)	-.89	.13	44.37*	.41	.32, .53
Number of vehicles involved (one, two or more)	.94	.29	10.55*	2.55	1.45, 4.48
Type of event					
Non-collision vs. non-moving object	-.23	.18	1.69	.79	.56, 1.12
Hit moving object vs. non-moving object	-.13	.31	.17	.88	.48, 1.63
Contributing factor to the crash					
Driver condition vs. environmental factor	1.30	.41	10.22*	3.68	1.66, 8.18
Driver action vs. environmental factor	.93	.41	5.13	2.54	1.13, 5.68
Vehicular factor vs. environmental factor	.10	.77	.02	1.10	.24, 4.97
Ejection from vehicle	-.38	.15	6.03	.69	.51, .93
Vehicle type					
Cars, vans, pick-up trucks vs. motorcycles, ATVs, snowmobiles, other vehicles	.67	.22	9.49*	1.96	1.28, 3.01
Light and heavy trucks vs. motorcycles, ATVs, snowmobiles, other vehicles	.73	.27	7.39	2.07	1.23, 3.51
Estimated speed (≤ 90 km/h, > 90 km/h)	1.78	.32	30.90*	5.93	3.17, 11.10

*$p < .0056$.

DISCUSSION

In Canada, testing for alcohol among drivers who die in motor vehicle crashes has become commonplace, with more than 80% of fatally injured drivers tested for the presence and amount of alcohol. Over the past three decades these data, compiled in the Fatality Database, have provided a valuable source of information on the magnitude of the alcohol-crash problem and have been instrumental in assessing changes in the problem over time. These data have also been utilized extensively in evaluating the impact of legislation and countermeasures in reducing the extent of the problem.

Since 2000, the results of drug tests on fatally injured drivers have been included in the Fatality Database. Yet the testing rate for drugs lags considerably behind (46.4%) that for alcohol, although due to the efforts of several jurisdictions in the past few years, drug testing rates have increased, providing a better—but still incomplete—picture of drug use among fatally injured drivers. The process surrounding drug testing is neither well understood nor extensively documented. Many factors are at work in determining which drivers get tested for drugs and which drugs are included in the testing protocol. In light of the bias that appears inherent in drug testing, the results presented in this paper should be viewed as preliminary and appropriate caution is urged in their interpretation. Further work is necessary with more extensive and comprehensive testing for drugs among fatally injured drivers to validate the results.

On the basis of the drug test data on fatally injured drivers provided by coroners and medical examiners from 2000 through 2007, over half of drivers who were tested for both alcohol and drug use were found to be positive for drugs and/or alcohol. Psychoactive drug use is almost as common as alcohol use among fatally injured drivers. Whereas 36.6% of drivers tested positive for alcohol, 33% tested positive for at least one of seven categories of drugs known to have a negative impact on the ability to operate a vehicle safely. It should be noted, however, that a positive drug test does not necessarily imply that the driver was impaired or that the use of the drug contributed to the crash. Whereas a presumption of impairment can be made on the basis of alcohol levels, research has yet to establish the same basis of evidence regarding the extent of impairment typically associated with the blood levels of psychoactive substances.

The most common drug categories found among drivers were CNS depressants, followed by cannabis, CNS stimulants and narcotic analgesics. Inhalants, dissociative anaesthetics and hallucinogens were rarely found among fatally injured drivers. The relatively low incidence of these latter three drug categories may, to some extent, be an artefact of the low testing rates for these substances.

The increased attention on drug use by drivers should not detract from the continued high rates of alcohol use by drivers. Although the past three decades have witnessed significant decreases in the extent of drinking and driving, alcohol use continues to be a factor in about one-third of driver fatalities. In particular, high BACs are common among driver fatalities, highlighting the fact that alcohol use by drivers persists as a significant problem on our roadways.

Through an examination of the characteristics of the drivers and characteristics and circumstances of the crashes in which they were involved, it was apparent that driving after drinking and driving after drug use present separate and distinct problems. For example, females were less likely than males to test positive for drugs and/or alcohol but when they did, drugs were most likely involved. On the other hand, males were more likely to test positive for alcohol only. Furthermore, the most common drug category found among females was CNS depressants. Among males, cannabis, narcotic analgesics and CNS stimulants were also common. Whereas alcohol use peaked between the ages of 19 through 44 and declined among older drivers, drug use remained constant across all ages. In fact, those aged 55 and over were more likely to test positive for drugs than alcohol. Among those under 19, drug use was more prevalent than alcohol use. The frequency of drug type also varied with age. Cannabis was the most common drug found among younger drivers. CNS depressants and narcotic analgesics were more commonly found among older drivers. CNS stimulants peaked among drivers aged 25 to 34.

There were also differences in the characteristics and circumstances of fatal crashes involving driver alcohol versus drug use. Driver fatalities involving only alcohol were most likely to occur during the summer and on the weekend, particularly in the early morning hours. The typical crash in which a drinking driver was killed involved a single vehicle without passengers veering off the road. Fatalities involving driver drug use were more evenly distributed across all hours of the day and all days of the week. Furthermore, drug-related crashes were more likely than alcohol-related crashes to involve another vehicle. In many ways, drug-involved fatal crashes resembled those where no drugs or alcohol are involved. On the other hand, driver fatalities involving both drugs and alcohol appeared more similar to crashes in which alcohol was the only substance involved.

The results of this study are consistent with those from recent roadside surveys of alcohol and drug use among drivers conducted in British Columbia in 2008 and 2010 (Beirness & Beasley, 2010; 2011). These studies found different patterns of alcohol and drug use among a random sample of drivers on the road during nighttime hours. For example, whereas drivers were most likely to test positive for alcohol during late night hours on the weekend, drug use among drivers was more evenly distributed across all times of night and on weekdays as well as weekends. Roadside surveys conducted during daytime hours may provide further evidence of the different pattern patterns of alcohol and drug use among drivers.

The merged databases used in this project provide a valuable source of information about fatal collisions involving driver alcohol and/or drug use. In working with these data, it became apparent that this database provides an opportunity to examine a variety of additional questions about alcohol and drug use among driver fatalities. For example, future studies should examine the personal and situational characteristics of crashes for each of the various drug classes separately. These analyses would help develop a profile of crashes according to drug type which would be useful for both prevention and enforcement. An analysis should be undertaken to further understand the similarities and differences among male and female fatally injured drivers. Once again, this information would be valuable for prevention. An analysis according to driver age could lead to further understanding of the collisions involving older versus younger victims. An examination of jurisdictional differences in rates for alcohol and drug use and the types of drugs used by drivers would help provincial and territorial authorities to identify patterns of substance use and take appropriate steps to prevent driving after substance use. Future projects could combine the fatality data with data from appropriate control populations to establish the relative risks associated with drug use by drivers.

While these findings are extremely enlightening and help advance the understanding of the drug-crash problem, it is important to acknowledge some of the shortcomings of this research. First, the low testing rates and inconsistent testing procedures could result in either underestimating or overestimating drug use among drivers. There is a need to implement systematic procedures for drug testing and to improve rates of drug testing to a level comparable to those of testing for alcohol among fatally injured drivers. Second, it was not possible to successfully match records from a number of fatally injured drivers with their collision records, thereby reducing the overall number of cases available for analysis. Third, several of the variables in the collision database suffer from extensive missing data, limiting the number of variables with usable data for analysis. Fourth, it should be noted that these results are based on drivers that die as a result of a road crashes and were also tested for alcohol and drugs. Drivers who survive fatal crashes are rarely tested for drugs or alcohol. Hence, these data fail to capture the full extent to which the injuries and/or death of passengers or pedestrians are a consequence of driver drug use. Finally, as stated previously, a positive drug test merely indicated the presence of a psychoactive substance and it cannot be conclusively determined whether the driver was impaired at the time of the crash or if the drug(s) contributed to the crash.

Despite these shortcomings, this research documents the fact that the extent of drug use among fatally injured drivers is comparable to that of alcohol and serves to highlight the need for societal action to deal effectively with the use of drugs by drivers. The current results also document the differences between the characteristics and circumstances of driver fatalities involving alcohol and those involving drugs. These latter findings indicate that the drugs-and-driving issue is separate and distinct from that of drinking and driving. This suggests the need to develop unique prevention and enforcement strategies. For example, enforcement responses need to occur not only during late night weekend hours as they do for alcohol, but during all hours of the day and across all days of the week.

It may also be helpful to view drug use by drivers as a series of separate issues. For example, it would appear that cannabis use is more common among younger drivers, depressants and narcotic analgesics are an issue among older drivers, and stimulant use occurs most commonly among middle-aged drivers. It is important to understand the differences in drug use and the reasons for use as this may hold the key to successful education and prevention programs. For example, although it was not possible in the present data to distinguish among illegal substance use, legitimate drug use for medicinal purposes and inappropriate use of pharmaceuticals (e.g., wrong dose), there would appear to be an opportunity for health care providers in prevention. There needs to be greater awareness among the general public that pharmaceuticals can cause impairment and driving after using certain drugs should be avoided.

In conclusion, the present research provides valuable information about the extent of involvement of drugs and/or alcohol in fatal collisions and enhances our understanding of the role of drugs in these crashes. It also challenges assumptions about patterns of drugs and driving. For example, it is not only young adults who use drugs and drive, but it is a behaviour common among all age groups. It points out that crashes involving driver drug use differ substantially from those involving driver alcohol use. Information such as this serves to provide policy makers with further evidence to advance efforts to develop and implement programs to deal effectively with driver drug use. The results also highlight the need for a comprehensive, national strategy on drugs and driving that deals with policy/legislation, enforcement, adjudication, rehabilitation/treatment and prevention. Collective efforts on all fronts will help ensure safer roadways for all Canadians.

REFERENCES

Beirness, D.J., & Beasley, E.E. (2009). *Alcohol and drug use among drivers: British Columbia Roadside Survey 2008*. Ottawa: Canadian Centre on Substance Abuse.

Beirness, D.J., & Beasley, E.E. (2010). A roadside survey of alcohol and drug use among drivers in British Columbia. *Traffic Injury Prevention*, *11*, 215–221.

Beirness, D.J., & Davis, C.G. (2007). Driving after drinking in Canada: Findings from the Canadian Addiction Survey. *Canadian Journal of Public Health*, *98*(6), 476–480.

Beirness, D.J., Logan, B., & Swann, P. (2010). *Drugs and driving: Detection and deterrence*. Paris: Organisation for Economic Cooperation and Development.

Blomber, R.D., Peck, R.C., Moskowitz, H., Burns, M., & Fiorentino, D. (2009). The Long Beach/Fort Lauderdale relative risk study. *Journal of Safety Research*, *40*, 285–292.

Borkenstein, R.F., Crowther, R.F., Shumate, R.P., Ziel, W.B., & Zylman, R. (1964). *The role of the drinking driver in traffic accidents*. Bloomington, IN: Department of Police Administration, Indiana University.

Cimbura, G., Lucas, D.M., Bennett, R.C., Warren, R.A., & Simpson, H.M. (1982). Incidence and toxicological aspects of drugs detected in 484 fatally injured drivers and pedestrians in Ontario. *Journal of Forensic Sciences*, *27*(4), 855–867.

Dussault, C., Brault, M., Bouchard, J., & Lemire, A.M. (2002). The contribution of alcohol and other drugs among fatally injured drivers in Quebec: Some preliminary results. In D.R. Mayhew & C. Dussault (Eds.), *Proceedings of the 16th International Conference on Alcohol, Drugs and Traffic Safety* (pp. 423–430). Quebec: Société de l'Assurance Automobile du Québec.

International Association of Chiefs of Police (1999). *The international standards of the Drug Evaluation and Classification Program.* DEC Standards Revision Subcommittee of the Technical Advisory Panel of the IACP Highway Safety Committee. Arlington, VA: IACP.

Jones, R.K., Shinar, D., & Walsh, J.M. (2003). *State of knowledge of drug-impaired driving*. DOT HS 809 642. Washington, DC: National Highway Traffic Safety Administration.

Mercer, G.W., & Jeffrey, W.K. (1995). Alcohol, drugs and impairment in fatal traffic accidents in British Columbia. *Accident Analysis and Prevention*, *27*, 335–343.

Raes, E., Van den Neste, T., & Verstraete, A.G. (2008). *Drug use, impaired driving and traffic accidents*. EMCDDA Insights 8. Lisbon: European Monitoring Centre for Drugs and Drug Addiction.

Tabachnick, B.G., & Fidell, L.S. (2007). *Using Multivariate Statistics* (5th ed.). Boston: Allyn and Bacon.

Traffic Injury Research Foundation (2010). *Alcohol crash problem in Canada: 2008*. Ottawa: Canadian Council of Motor Transport Administrators and Transport Canada.