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Prevalence and trends of drugged driving in Canada

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ABSTRACT

Objectives: This study evaluates prevalence and trends in drugged driving in Canada based on multiple indicators collected from the Road Safety Monitor (RSM) and Canada's National Fatality Database maintained by the Traffic Injury Research Foundation (TIRF). The objective of this paper is to identify the state of drug-positive driving in Canada, as well as to make comparisons with data from previous years to determine whether changes have occurred.

Methods: Available data from the RSM on self-reported drugged driving behaviours were collected and analyzed using multivariate techniques in various years spanning from 2002 to 2015. Data from TIRF's National Fatality Database from 2000 to 2012 were also analyzed to evaluate trends and prevalence of drugs in fatally injured drivers across Canada. Additionally, differences among drugged drivers with respect to gender and age were studied.

Results: Analyses of the RSM data and of the National Fatality Database showed that, as a whole, the prevalence of drugged driving has remained relatively stable over the past decade, with some changes noticed in specific years for some drug types. Specifically from the RSM, there was a 62.5% increase from the 1.6% of drivers reporting driving within two hours of using marijuana in 2013 to 2.6% in 2015. The analyses of the fatality data revealed a 16.9% increase in the percentage of fatally injured drivers testing positive for drugs between 2000 and 2012 (from 33.56% to 39.24%). Cocaine-positive fatally injured drivers increased from 3.6% in 2000 to 6.2% in 2012. Similarly, marijuana-positive fatally injured drivers increased from 12.8% in 2000 to 19.7% in 2012. Results showed varying characteristics with respect to gender and age among self-reported and fatally injured drugged drivers.

Conclusions: Drugged driving behaviours remain prevalent among Canadian drivers and drugs continue to be found in over one-third of tested fatally injured drivers. Although self-reported behaviours have neither decreased nor increased overall in the past decade according to RSM data, with the exception of driving within two hours of using marijuana, data from fatally injured drivers reveal that small, but significant increases in some behaviours have occurred.

1. Introduction

1.1. Drugs and driving

Despite a growing body of research on drugged driving, it can be argued that our understanding of how drugs affect driving behaviours is limited compared to what we know about alcohol. Cannabis, or marijuana, one of the most common substances found in drivers, has been shown to increase the risk of collision in drivers (Asbridge et al., 2012). However, tolerance to marijuana can also result in less impairment in drivers (Wolff et al., 2013), reaffirming the fact that setting standardized per se limits for drugs in drivers is more complicated, unlike in the case of alcohol impairment. Other illicit psychoactive drugs have been shown to cause side-effects which could impair driving abilities. Cocaine users, for example, have been associated with higher collision involvement compared to non-users (Stoduto et al., 2012). Prescription drug use is a particularly complex issue when assessing its involvement in drugged driving. On one hand, many medications may have no effect on driving abilities or may actually serve to improve driving at prescribed doses, particularly those used for pain control such as opioids (Wolff et al., 2013). On the other hand, CNS-depressants like benzodi-

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azepines are commonly prescribed drugs that have been shown to have several impairing side effects on the body that can affect driving including: sedation; amnesia; reduction in the ability to process information; and, reduction in reaction time (Wolff et al., 2013).

1.2. Prevalence of drugged driving

In Canada, the prevalence of drugs found in drivers has been shown to rival that of alcohol (Jonah, 2013). However, there are no standardized roadside measures, comparable to a breathalyzer, in Canada to detect the many different types and levels of drugs in drivers who are suspected of being impaired. Self-report studies provide useful information to ascertain the prevalence of specific driving behaviours and attitudes among drugged drivers. The Canadian Alcohol and Drug Use Monitoring Survey found that 2.6% of drivers of all ages admitted to driving after marijuana use in 2012 (CCSA, 2015). The percentage of fatally injured drivers who are tested for the presence of drugs varies widely across jurisdictions and tests may only be undertaken when the suspicion of drug involvement is noted. In Canada, drug testing of fatally injured drivers is increasing, with 77.4% of fatally injured drivers on highways being tested for drugs in 2012, up from the 72.8% that were tested in 2011 (Brown et al., 2014, 2015).

1.3. Objective

This study evaluates prevalence and trends in drugged drivers in Canada based on multiple indicators collected from self-reported data and fatally injured drivers. The objective of this paper is to identify the state of drugged driving in Canada, as well as to make comparisons with data from previous years to determine whether changes have occurred. Furthermore, differences among drugged drivers with respect to gender and age are also studied.

2. Methods

2.1. Data sources

Data on drugged driving behaviours and attitudes have been collected as part of the Traffic Injury Research Foundation (TIRF) series of Road Safety Monitor (RSM) surveys since 2002. The survey instrument contains a core set of items that are asked each year to provide information on trends in attitudes, opinions and behaviours. This is supplemented by a set of questions that probe more deeply into special, topical, and emerging issues (e.g., distracted driving, aggressive driving, elderly drivers, etc.). Results presented here include only those questions related to drugs and driving which have been asked in several years over the past decade. Details on the RSM series with respect to drugs and driving can be found in Pashley et al. (2014), Marcoux et al. (2011), Simpson et al. (2006) and Beirness et al. (2003). Details on the overall RSM methodology can also be found in a study on trends in drinking driving by Vanlaar et al. (2012) and a study on dangerous driving behaviours by Vanlaar et al. (2008). The survey was administered each year to a sample of Canadian drivers who had driven in the past 30 days and held a valid driver's licence.

In 2015, the most recent year for which data were collected, a total sample size of 1204 participants completed the RSM online. The survey required an average of approximately 10 min to complete. 2014 was the first year when all data (1031 participants) were collected online instead of the combination of online and telephone calls that was used since 2009. Before 2009, the RSM was entirely administered by telephone. Comparative analyses have been conducted and reported in Vanlaar et al. (2012) and no disruptions in trend series have been observed due to this gradual switch to an exclusive online methodology. Other years' RSM sample sizes include: 1201 participants in 2013 (phone: 301, online: 900); 903 in 2012 (phone: 225, online: 678); 1208 in 2011 (phone: 303, online: 905); 1603 in 2010 (phone: 401, online: 1202); 1218 in 2005; 1221 in 2004; and, 1212 participants in 2002. These years represent all of the surveys that included items on drugs and driving. Each sample was stratified by province and weighted according to gender and age to avoid bias. The total sample of all relevant data years combined consists of 10,801 participants. The data were analyzed taking account of the stratified and weighted sampling design to ensure the results were representative of the national population for each year.

To bolster the findings, data from TIRF's National Fatality Database were also used to identify the percentage of fatally injured drivers in Canada who were tested for drugs of any type between 2000 and 2012. Similarly, the percentages of drivers who tested positive for various drug types were also analyzed. The TIRF National Fatality Database includes collected statistics from police reports, coroners and medical examiners on persons fatally injured in motor vehicle collisions in all jurisdictions across Canada. The data in this study exclude British Columbia whose data for 2011 and 2012 were not available. Toxicological data among victims are obtained from files in coroners' and medical examiners' offices. Specific to drug use, the data collected contain approximately 500 codes for different drugs and have been consistently collected since 2000. The drug types can be more broadly classified into seven groups according to the Drug Classification Evaluation categories (i.e., cannabis, depressants, stimulants, narcotic analgesics, hallucinogens, dissociative anesthetics, and inhalants) (Jonah, 2012). A more detailed description of the methodology of this database is available in Mayhew (2011). Vanlaar et al. (2015, 2016) used this database for analyses of driving under the influence of alcohol and drugs in off-road vehicles (2015) and in relation to vulnerable road users (2016). Vanlaar et al. (2012) reported trends in alcohol-impaired driving in Canada that uses both databases, RSM data and the TIRF National Fatality Database.

2.2. Data analysis

All analyses were conducted using Stata 13 (StataCorp., 2013). The data from the RSM were analyzed, taking into account the stratified and weighted sampling design, using both univariate and multivariate approaches. Confidence intervals (95%) are also reported. Also, univariate and bivariate analysis techniques were used to analyze data from the National Fatality Database to ascertain the percentages of fatally injured drivers who have been tested for drugs as well as the percentage that tested positive for various drugs. Two-sample tests of proportions, piecewise regression and logistic regression analyses were conducted to evaluate statistical significance of results and possible trends while also controlling for gender and age differences within the population, where applicable. Piecewise regression was used specifically to study trends (see: McGee and Carleton, 1970).

3. Results

3.1. Percentage of self-reported drugged driving in Canada

In several years over the past decade, participants were asked whether or not they had driven within two hours of using marijuana/hashish, other illegal drugs, or prescriptions drugs that they had been advised might affect their driving during the previous 12 months. Fig. 1 shows the prevalence of self-reported drugged driving since 2002, for all years in which related items were included in the survey.

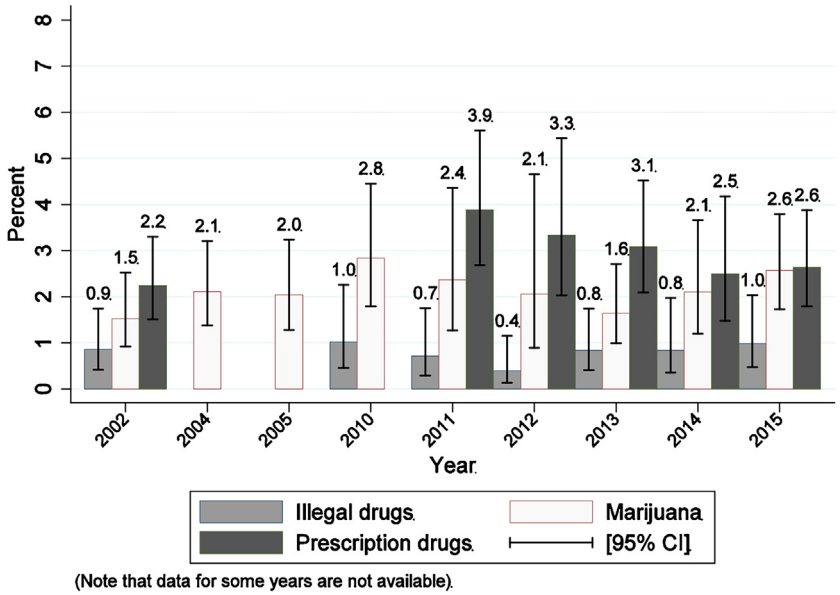

Fig. 1. Percentage who drove within two hours of taking drugs in the past 12 months: 2002–2015.

The prevalence of illegal drugged driving has remained steady over the past decade. In 2002, 0.85% [0.4, 1.7] of Canadians admitted to driving within two hours of taking an illegal drug at least once in the previous 12 months. In 2012, a low of 0.39% [0.1, 1.1] was reported, but this returned to 0.84% [0.4, 1.7] in 2013 with a similar 0.84% [0.4, 2] in 2014 and 0.98% [0.5, 2] in 2015. Tests of proportions between the proportions of drivers driving within two hours of taking an illegal drug did not reveal any significant difference in the prevalence of illegal drugged driving over the years.

A greater percentage of drivers have consistently admitted to driving under the influence of marijuana compared to illegal drugs. In 2002, approximately 1.52% [0.9, 2.5] of Canadians reported driving within two hours of using marijuana. This percentage was highest at 2.84% [1.8, 4.5] in 2010 but declined over the next three years to 1.64% [1,2.7] in 2013, and then rose again to 2.1% [1.2, 3.7] in 2014 and 2.57 [1.7, 3.8] in 2015. The apparent spike in 2010 to almost three percent of Canadian drivers is significantly higher than the percentage of drivers who reported driving while under the influence of marijuana in 2002 ($Z = -2.3$, $p = 0.01$) and in 2013 ($Z = 2.26$, $p = 0.02$). A regression model for the prevalence of marijuana using a piecewise linear function for time (knots in 2010 and 2013 where spikes were observed) reveals an increasing trend (coef. = 0.15, C.I. = [0.11, 0.19], $p < 0.001$) in the period 2002–2010, a decreasing trend (coef. = -0.4, C.I. = [−0.5, −0.29], $p < 0.001$) in the period 2010–2013 and an increasing trend again (coef. = 0.47, C.I. = [0.3, 0.63], $p = 0.032$) in the period 2013–2015.

Only six years of data were collected from the RSM with respect to the prevalence of prescription drug while driving. In 2002, 2.24% [1.5, 3.3] of Canadians admitted to driving within two hours of taking prescription drugs that they were advised may affect their driving. This percentage is significantly lower ($Z = -2.4$, $p = 0.02$) than the 3.9% [2.7, 5.6] of drivers who admitted to this behaviour in 2011, but not significantly different from the reported percentages in 2012 (3.3% [2.0, 5.4]), 2013 (3.1% [2.1, 4.5]), 2014 (2.5% [1.5, 4.2]) and 2015 (2.6% [1.8, 3.9]). While this does suggest that a slight increase in the use of prescription drug while driving occurred between 2002 and 2011, more recent data show that the percentage of drivers reporting prescription drugged driving has not increased significantly overall; if anything, there appears to be a downward trend between 2011 and 2015. A regression model confirmed the decreasing trend in the use of prescription drugs while driving between 2011 and 2015 (coef. = −0.33, C.I. = [−0.55, −0.11], $p = 0.017$).

3.2. Gender and age differences among self-reported drugged drivers in Canada

The analyses of the RSM data over all years reveal gender differences in the prevalence of illegal drugs and marijuana. Overall, 0.95% [0.65,1.4] of male drivers versus 0.34% [0.2,0.57] of female drivers reported driving within two hours of taking an illegal drug at least once in the previous 12 months; with the independence tests revealing significant differences ($F = 10.5$, $p = 0.001$). With respect to the prevalence of marijuana, 2.8% [2.2, 3.5] of male drivers versus 1.5% [1.2, 2] of female drivers reported driving within two hours of using marijuana; with the independence tests revealing significant differences ($F = 11.5$, $p = 0.0007$). No significant gender differences were found with respect to the prevalence of prescription drugs. Differences were also found with respect to age categories and the prevalence of illegal drugs and marijuana. A larger percentage of young drivers (aged 16–24) reported driving within two hours of taking an illegal drug (1.4%) or marijuana (6.1%) than any other age group, and the prevalence for both drugs decreased with the increase in age (see Table 1). No significant age differences were found with respect to the prevalence of prescription drugs.

Logistic regression models controlling for sex, age and RSM's year confirmed the above results (see also Table 1 below). The odds for male drivers reporting driving within two hours of taking an illegal drug are 2.5 times the odds for female drivers ($p = 0.005$). The odds for male drivers reporting driving within two hours of using marijuana are 1.7 times the odds for female drivers ($p = 0.006$). The odds for drivers aged 16–24 reporting driving within two hours of using illegal drugs are 6.2 times the odds for drivers aged 45–64 ($p < 0.001$). The odds for drivers aged 16–24 reporting driving within two hours of using marijuana are 45.7 ($p = 0.02$) times the odds for drivers aged 65 and older.

3.3. Percentage of fatally injured drivers tested for drugs in Canada

Fig. 2 shows the percentage of fatally injured drivers who were tested for drugs in Canada (except British Columbia) from 2000 to

Table 1
Percentage and odds ratios (OR) for drivers reporting driving within two hours of taking drugs in the past 12 months: 2002–2015 by sex and age. *p-value < 0.05; n.def. = not defined.

	Sex		Age			
	Female	Male	16–24	25–44	45–64	65 or older
Illegal drugs	0.34* (1.0)	0.95* (2.5*)	1.4* (6.2*)	0.96* (4.0*)	0.2* (1.0)	0.0* (n.def.)
Marijuana	1.5* (1.0)	2.8* (1.7*)	6.1* (45.7*)	2.8* (20.2*)	0.9* (6.2*)	0.1* (1.0)
Prescription drugs	1.6 (1.0)	2.2 (1.3)	2.8 (2.2*)	2.1 (1.4)	1.7 (1.2)	1.4 (1.0)

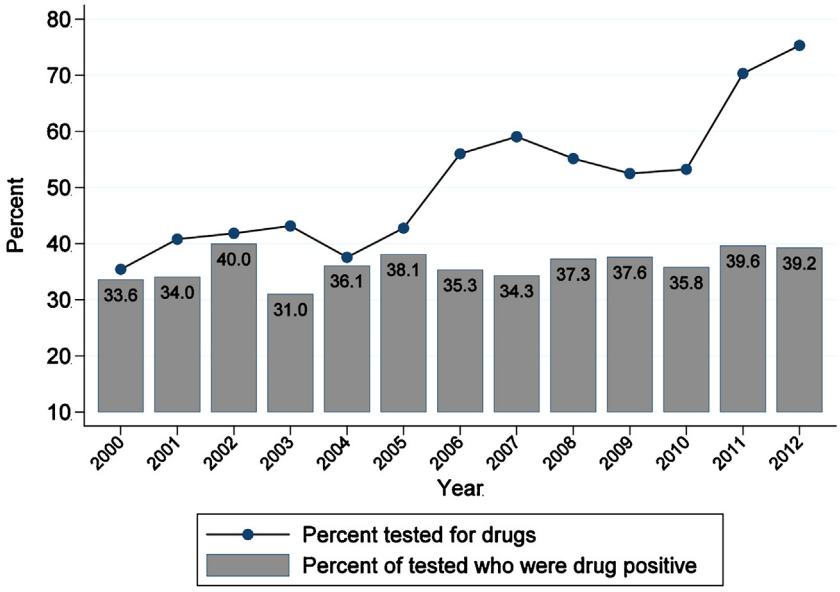

Fig. 2. Percentage of fatally injured drivers tested for drugs, and the percentage of fatally injured drivers testing positive for any substance: 2000–2012.

2012, as well as the total percentage of drug-positive fatally injured drivers among those who were tested. Drugged driving behaviours remain prevalent among Canadian drivers and drugs continue to be found in over one-third of fatally injured drivers who are tested. A steady increase in testing rates among fatally injured drivers can be seen from 2000 (35.4% of drivers tested) to 2007 (59.1% of drivers tested). Testing rates decreased from 2007 to 2009, with 52.5% of fatally injured drivers tested for drugs in 2009, to increase again with a high of 75.3% in 2012, the most recent year of available data.

Despite the 39.9 percent point (75.3–35.4) increase (or alternatively a 112.6% increase) in testing rates among fatally injured drivers, the percentage of drug-positive drivers has increased only by 5.6% point (or alternatively a 16.9% increase) in the past decade, ranging from 33.6% of drivers in 2000 to a low of 31% of drivers in 2003, and rising to 39.2% in 2012. This 16.9% increase in the percentage of fatally injured drivers testing positive for drugs from 2000 to 2012, represents a small, but significant increase ($Z = -2.27$, $p = 0.01$).

3.4. Percentage of fatally injured drivers testing positive for cocaine, CNS-depressants and marijuana in Canada

Fig. 3 depicts the percentage of cocaine, CNS-depressants, and marijuana-positive fatally injured drivers from 2000 to 2012. Overall, between 2000 and 2012, 5.8% of fatally injured drivers who were tested for drugs were cocaine-positive, 13.2% were positive for CNS-depressants and 15.5% of drivers were positive for marijuana.

The figure shows an overall increase in cocaine and marijuana-positive fatally injured drivers from 2000 (3.6% for cocaine and 12.8% for marijuana) to 2012 (6.2% for cocaine and 18.9% for marijuana). Test of proportions revealed that these increases (cocaine: 72.2%, marijuana: 47.7%) were statistically significant (cocaine: $Z = -2.2$, $p = 0.03$, marijuana: $Z = -3.2$, $p = 0.002$).

The percentage of fatally injured drivers that tested positive for CNS-depressants in 2000 was 12.6%. This percentage climbed to a high of 17% of fatally injured drivers in 2002, but declined overall in the following years to 11.5% of fatally injured drivers in 2010, to rise to 16.2% in 2011 and finally declined to 13.1% in 2012. The difference seen between 2000 (12.6%) and 2002 (17%) was found to be statistically significant ($Z = 2.2$, $p = 0.03$), however the difference between 12.6% in 2000 and 13.1% in 2012 was not statistically significant.

3.5. Gender and age differences among fatally injured drug-positive drivers in Canada

Gender differences among all drug-positive fatally injured drivers (i.e., those who tested positive for any substance) are consistent with the results from the RSM which showed some differences among males and females with respect to the prevalence of drugged driving (see Table 2). Between 2000 and 2012, 37% [36, 38.1] of fatally injured male drivers were positive for any type of drug, slightly but significantly larger than the 33.8% [31.7, 36] of females (two sample test of proportions: $z = -2.6$, $p = 0.01$). Further analysis of specific drug types found pronounced differences between fatally injured male and female drivers. Between 2000 and 2012, among those drivers tested, 17% [16.2, 17.8] of fatally injured male drivers tested positive for marijuana while 8.8% [7.5, 10.1] of female drivers tested positive for marijuana during this time period (two sample test of proportions: $z = -8.8$, $p < 0.0001$). A similar difference was found among cocaine positive drivers, with 6.4% [5.9, 7.0] of males testing positive versus 3% [2.2, 3.8] of females between 2000 and 2012 (two sample test of proportions: $z = -5.7$, $p < 0.001$).

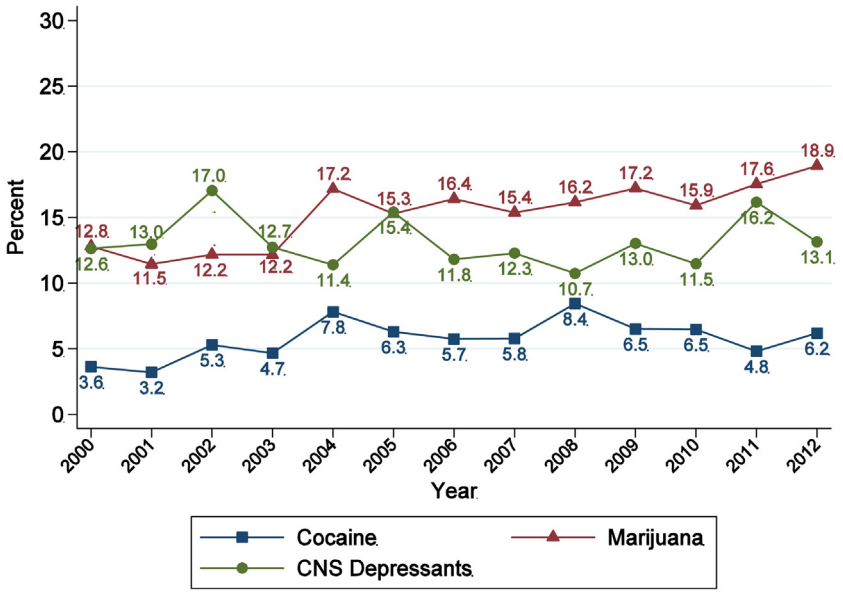

Fig. 3. Percentage of fatally injured drivers who were positive for cocaine, CNS-depressants or marijuana: 2000–2010.

Table 2
Percentage and odds ratios (OR) testing positive for drugs among fatally injured drivers who were tested: 2000–2012. *p-value < 0.05.

	Sex		Age			
	Female	Male	24 and under	25–44	45–64	65 or older
Any drug	33.8* (1.0)	37.0* (1.2*)	36.5* (1.2*)	40.0* (1.4*)	33.6* (1.1)	31.9* (1.0)
Cocaine	3.0* (1.0)	6.4* (2.2*)	5.4* (67.3*)	9.7* (126*)	3.6* (42.4*)	0.09* (1.0)
Marijuana	8.8* (1.0)	17.0* (2.2*)	24.8* (131*)	18.8* (90.7*)	8.8* (36.3*)	0.26* (1.0)
CNS-depressants	17.9 (1.6*)	12.1* (1.0)	5.1* (1.0)	12.8* (2.8*)	17.9* (4.1*)	21.0 (5.0*)

Conversely, more fatally injured female drivers (17.9% [16.2, 19.6]) tested positive for CNS-depressants compared to males (12.1% [11.4, 12.8]) (two sample test of proportions: $z = 6.7$, $p < 0.0001$).

With respect to age differences, similar to RSM data, among those fatally injured drivers who were tested for drugs, a larger percentage (24.8%) of young drivers (24 and under) tested positive for marijuana, than for any other age group, and the prevalence for this drug decreased with the increase in age (see Table 2). In the case of cocaine, it was the group of drivers aged 25–44 who had the larger prevalence (9.7%), followed by drivers under 25 years (5.4%). The oldest drivers (65 and older) had the larger prevalence of CNS-depressants with 21% testing positive. For this drug category, prevalence increased with age.

Logistic regression models controlling for sex, age and victim's year of death confirmed the above results (see Table 2). The odds for male drivers testing positive for any type of drugs are 1.15 [1.0, 1.3] times the odds for female drivers ($p = 0.01$). The odds for male drivers testing positive for marijuana are 2.2 [1.8, 2.6] and for cocaine 2.2 [1.7, 2.9] times the odds for female drivers ($p < 0.001$). The odds for female drivers testing positive for CNS-depressants are 1.6 [1.4, 1.8] times the odds for male drivers ($p < 0.001$). The odds for drivers under 25 years old testing positive for marijuana are 131 times the odds for drivers 65 or older; and 67.3 for cocaine (all p-values < 0.001). In the case of CNS-depressants, fatally injured drivers 65 or older have odds for testing positive 5 times the odds of drivers under 25 years old ($p < 0.001$).

4. Discussion

Analyses of the RSM data and of the National Fatality Database showed that, as a whole, the prevalence of drugged driving has remained relatively stable over the past decade, with some changes noticed in specific years for some drug types.

While the analyses of the self-reported data suggested that the overall percentage of drugged drivers neither significantly increased nor decreased during the period between 2002 and 2015, there were still a large number of Canadian drivers admitting to getting behind the wheel while under the influence of various substances, particularly prescription drugs, that may affect their driving. Of concern is the 62.5% increase in the percentage of drivers reporting driving within two hours of using marijuana from 1.6% in 2013 to 2.6% in 2015.

Furthermore, there was an approximate 17% increase in the percentage of fatally injured drivers testing positive for any drug type overall during the period between 2000 and 2012, indicating that the issue of using drugs and driving is a cause for concern. Significant increases in the percentage of marijuana-positive or cocaine-positive fatally injured drivers were found (47.7% and 72.2% respectively). As a comparison, another study showed that the percentage of fatally injured drivers of highway vehicles testing positive for alcohol decreased from 37.3% in 2006–2010 to 33.7% in 2011–2012, a 9.7% decrease (Brown et al., 2015). Similarly, the same study showed a 13.4% increase of fatally injured drivers of highway vehicles testing positive for drugs from 35.6% in 2006–2010 to 40.4% in 2011–2012.

Of particular concern is the apparent increase in the last two years of drivers admitting driving within two hours of smoking marijuana, especially among male and young drivers. Male and young drivers positive for marijuana are also overrepresented among fatally injured drivers. This should be considered in light of a recent report from George and Vaccarino (2015) stating that Canadian youth have the highest rates of marijuana use compared to youth in 28 other developed countries.

Our findings are consistent with other studies. To illustrate, a study in British Columbia showed that drivers using marijuana have odds of dying in a crash that are 4.95 times greater than a driver who has not used alcohol or drugs (Beirness et al., 2013). This same study reported odds ratios of 6.8 for drivers positive for alcohol only and 40 for drivers positive for alcohol and marijuana combined. Another study (Mann et al., 2010) based on self-reported crash risk in Ontario found that driving after marijuana use within the past 12 months had increased risk of crash involvement compared to those who never drove after using cannabis. This risk is greater than that associated with having reported driving after drinking within the past 12 months (odds ratios of 1.84 versus 1.34).

Finally, previous studies have indicated that drugged drivers are generally distinct from alcohol-impaired drivers in that male and female drivers are almost equally as likely to drive under the influence of drugs in general, whereas for alcohol males are more likely than females to drive after drinking (Beasley and Beirness, 2011). However, other studies have also shown differences among genders with respect to specific drug types, with a greater percentage of fatally injured males being found with marijuana in their system and a greater percentage of fatally injured females testing positive for depressants and narcotics (Romano and Pollini, 2013; Beasley and Beirness, 2011). In our study, male drivers were more likely to report using marijuana and other illegal drugs before driving. Among fatally injured drivers, males were also more likely to test positive for any drug, cocaine or marijuana while females were more likely to test positive for CNS-depressants.

4.1. Strengths and limitations

The strength of the RSM data is that these data have been collected consistently over a long period of time, thereby creating a series of data points that can be used to study trends. Given that the data are collected based on respondents self-reporting, it can be argued that some bias is likely unavoidable, for example due to social desirability. However, the RSM data have been found to be consistent with other, independent sources, notably crash data, both in this study, as well as others (see for example, Vanlaar et al., 2012). TIRF's National Fatality Database contains the population of fatalities, rather than a sample. This database has been maintained for several decades and is the subject of strict quality assurance procedures (Simpson et al., 1978). As such, the database contains very reliable data of high quality, representative of Canada. Nevertheless, data collection and interpretation of substances found in fatally injured drivers is difficult, given that it is often unknown whether substances were taken as prescribed by a physician or recreationally. As well, many drivers are found to have multiple substances in their system at the time of death, creating difficulty in determining whether or not certain drugs contributed to impairment.

Acknowledgements

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