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Canadian Council of Motor Transport Administrators
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A Compilation of Jurisdictional Roadside Surveys Conducted Prior to Cannabis Legalization

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EXECUTIVE SUMMARY

In the two years prior to the legalization of cannabis, five jurisdictions in Canada (British Columbia, Manitoba, Ontario, Yukon, and Northwest Territories) conducted roadside surveys of drivers to obtain an objective, valid estimate of the prevalence of driving after drinking and driving after drug use. The use of similar methods facilitated the compilation of the results of these jurisdictional surveys to provide a baseline of cannabis use by drivers prior to the pending legalization of cannabis.

Drivers were randomly sampled from the traffic stream at pre-selected locations between the hours of 21:00 and 03:00 on Wednesday through Saturday nights and invited to participate in a voluntary study of alcohol and drug use. Participants were asked to provide a breath sample to measure their alcohol use and an oral fluid sample to be tested subsequently in a toxicology laboratory for the presence of drugs. Of the 7,265 vehicles randomly selected for the survey, 80.7% of drivers agreed to participate. Of these drivers, 97.7% provided a breath sample and 90.2% provided an oral fluid sample.

Key findings include:

- 4.4% of drivers were positive for alcohol;
    - 0.8% had a blood alcohol concentration (BAC) under 50 mg/dL;
    - 0.7% had a BAC of over 80 mg/dL;
- 10.2% of drivers tested positive for drugs;
- 7.6% of drivers tested positive for cannabis (THC);
- Overall, 12.9% of drivers were positive for alcohol, drugs or both;
- Drivers age 25-34 were most likely to have been drinking (5.1%);
- Drug use was most prevalent among drivers aged 20 to 24 (14.0%) and decreased with increasing age;
- Only 2.1% of drivers aged 16 to 19 tested positive for alcohol; however, 10.4% of this age group tested positive for cannabis;
- Alcohol use was most common on Friday and Saturday nights (4.6% and 6.2%, respectively); cannabis use did not differ across survey nights, varying between 6.9% and 9.0%;

Compared to data from similar surveys conducted over the past 20 years, the results from this recent set of surveys show substantial reductions in the prevalence of alcohol use by drivers. However, there has been an increase in the percentage of drivers who tested positive for cannabis since drug use was first assessed in British Columbia in 2008. As Canada enters a new era with greater access to recreational cannabis, public health, enforcement, and road safety professionals will need to be vigilant and responsive to changing patterns of cannabis use so that policies and programs are targeted to deal directly with high-risk patterns of cannabis and other drug use by drivers.

INTRODUCTION

As Canada moved towards the legalization of the possession and sale of cannabis for recreational purposes, foremost among the concerns was the potential negative impact on road safety. Acknowledging that increased access to cannabis could lead to an increase in cannabis use by drivers, impaired driving legislation was amended to enhance measures to deal with drivers affected by drugs. Among other things, the legislation introduced roadside oral fluid drug screening and established *per se* limits for cannabis.[1]

Assessing the impact of cannabis legalization on road safety can include many sources of information, such as counts of adverse events such as impaired driving charges, crashes, and licence suspensions. The extent to which drivers engage in driving after the use of cannabis can be determined through telephone or internet-based population surveys and surveys conducted with drivers on the road. Whereas population surveys assess self-reported behaviour, roadside surveys are unique in that they provide objective information on the extent of cannabis (as well as alcohol and other drug) use from samples of breath and oral fluid collected from random samples of drivers who are driving at night. Such surveys conducted before and after the legalization of cannabis will contribute to our understanding of the impact of legalization on driver behaviour.

Five such surveys were conducted in various jurisdictions in Canada in the two years prior to the legalization of cannabis in October, 2018. The Canadian Council of Motor Transport Administrators (CCMTA) contracted Beirness & Associates to merge the data from these five surveys into a single database to provide an assessment of the nature and extent of alcohol and drug use by drivers. These data could then be used to provide a baseline against which to assess the extent of change in driving after cannabis (and other drug) use in the period following cannabis legalization. This report presents the findings from the combined surveys.

Roadside Surveys

Roadside surveys have been conducted periodically in various jurisdictions in Canada for many years. Originally developed to assess the extent of alcohol use by drivers, the method has been updated over the years to improve the efficiency of the operation and to provide for the collection of oral fluid samples to test for the presence of drugs. A standard methodology for these surveys was prepared by the Canadian Council of Motor Transport Administrators (CCMTA) to enhance the comparability of data across years and jurisdictions (Boase, 2012).

The roadside method involves randomly selecting non-commercial vehicles from the traffic flow at pre-determined locations (sites) between the hours of 9 PM and 3 AM on Wednesday through Saturday nights. A team of 4-5 interviewers under the supervision of a crew chief conducts voluntary interviews with drivers for a period of 90 minutes at each site. The number of survey teams and the total number of sites varies according to the population of the jurisdiction. For example, an urban municipality would be allocated two survey teams who would each conduct interviews at two sites each night on

[1] In this report, the term "cannabis" refers to tetrahydrocannabinol, or THC, which is the primary psychoactive component of cannabis. *Per se* laws and oral fluid screening cutoff values are stated in terms of the concentration of THC.

Wednesday through Saturday nights, for a total of 16 sites. A police officer is present at each site to assist with traffic.

Participation in the survey is voluntary and confidential. Drivers who provide a breath sample and an oral fluid sample are given a gift card worth $10 of gas.[2] The information collected includes observations (e.g., vehicle type, driver sex, occupant configuration), and responses to a few initial questions (e.g., trip origin and destination, year of birth, recent alcohol use). Drivers are then asked to provide a breath sample to test for alcohol and an oral fluid (saliva) sample that is sent to a toxicology laboratory to test for the presence of drugs. During the 2 to 3 minutes required to collect the oral fluid sample, drivers are asked to complete a pencil and paper questionnaire on alcohol, drugs and driving. The specific questions on the self-completion questionnaire varied somewhat among the jurisdictional surveys.

The oral fluid samples were initially screened at the laboratory for cannabis, cocaine, opioids, amphetamines, methamphetamine and benzodiazepines using enzyme immunoassay (ELISA) technology.[3] Samples with a positive screen were confirmed by liquid chromatography/tandem mass spectrometry (LC-MS/MS). The list of drugs and detection thresholds for each substance are presented in Table 1.

Table 1: Included Drugs and Detection Thresholds[4]

Drug	Elisa (ng/mL)	LC-MS/MS (ng/mL)
THC	4	2
Cocaine: benzoylecgonine, cocaethylene	20	8
Amphetamine: MDA, MDEA, phentermine	25	10
Methamphetamine: MDMA (ecstasy)	25	10
Benzodiazepines: diazepam, nordiazepam, oxazepam, temazepam, clonazepam, alprazolam, lorazepam, tiazolam, chorldiazepoxide, nitrzepam, estaxolam, fluazepam, midazolam, phenazepam, bromazepam	5	1
Opioids: morphine, codeine, 6-AM, hydrocodone, hydromorphone	20	10
Oxycodone: oxymorphone,	20	10
Fentanyl: norfentanyl	1	0.5
Zolpidem	10	10

Drivers whose breath test indicated a blood alcohol concentration (BAC) in excess of 50 mg/dL or who appeared to be adversely affected by drugs were provided with alternative transportation. Self-identified novice drivers who had a positive BAC or displayed any evidence of drug use were also provided with alternative transportation.

[2] MADD Canada provided the gas cards. Gift cards for Tim Horton's were used in some locations.
[3] Toxicological analyses were performed by Immunalysis Corporation.
[4] The detection threshold is the concentration below which a substance cannot be detected reliably.

Pre-legalization Surveys

Roadside alcohol and drug surveys were conducted in five jurisdictions in Canada in the two years prior to cannabis legalization. The jurisdictions, municipalities/regions, and the dates of the surveys are presented in Table 2.

Table 2: Jurisdictional Surveys

Jurisdiction	Municipalities/Regions	Date
Manitoba	Winnipeg, Brandon, Thompson, Steinbach Portage la Prairie,	September, 2016
Ontario	London, Renfrew County, North Bay, Timmins, Trenton, Peterborough, Peel Region	October, 2017
British Columbia	Vancouver, Victoria, Abbotsford, Kelowna, Prince George	June 2018
Yukon Territories	Whitehorse	June 2018
Northwest Territories	Yellowknife	September, 2018

Each of the jurisdictional surveys was distinct and separate from the others. The selection of municipalities/regions was dictated by population, distribution of the population within the jurisdiction, geographic distribution of municipalities, agreement of local police to participate, and/or specific requirements of the jurisdiction. Although the surveys generally followed the standard CCMTA protocol, variations were introduced in some jurisdictions to deal with local situations.

In Ontario, the inclusion of “rural” sites was requested by the jurisdiction. Conducting this type of survey in a rural area presents a host of challenges. First and foremost, traffic volume in rural areas at night is typically too low to warrant the time and effort necessary to achieve a sample size of sufficient magnitude to generate reliable estimates of alcohol and drug use. Communities with populations below 20,000 present challenges due to limited traffic late at night and the probability of repeatedly selecting the same drivers. The solution was to identify a distinct geographic area (e.g., county) and allocate sites to each of the smaller communities within the region in proportion to their population. For example, the four communities in Renfrew County (i.e., Pembroke, Petawawa, Arnprior and Renfrew) were used in this manner.

In each of the Yukon and Northwest Territories, there is only one population centre of sufficient magnitude to support a survey. To avoid over-saturation, one survey team was used to conduct interviews at three sites per night, each of 90-minutes duration, for a total of 12 sites. This compromise was deemed appropriate to collect a sufficient number of interviews with drivers at a variety of locations throughout the city.

In Manitoba, interviews were conducted "downstream" from police checkpoints. Hence, survey sites had to be identified or approved by the police as suitable for their needs. More importantly, police "pre-screened" drivers for alcohol and possible drug use prior to their selection as part of the survey sample. Drivers suspected of alcohol or drug use were subject to further police investigation were removed from the pool of drivers eligible for the survey. The impact was evident on the prevalence of alcohol among drivers who participated in the survey. It is not known the extent to which the presence of the police checkpoint influenced the likelihood of drivers' willingness to participate in the survey, particularly those who had been drinking or using drugs but were not detected in the police checkpoint. In addition, some sites began at 8 PM and the duration of some sites was longer than 90 minutes. In the interests of consistency, the alcohol data from Manitoba and interviews conducted prior to 9 PM have not been included in the analyses.[5]

[5] A total of 110 interviews conducted prior to 9PM were excluded from the final sample

APPROACH

The data from the five jurisdictional surveys were merged into a single database for analysis. This task was facilitated by the comparable methods and data elements across the surveys. Where there were differences in response options or coding, values were collapsed and/or recoded to correspond to the lowest common level. For example, as part of the interview, one jurisdiction included a longer list of response options for the question about trip origin. These additional options were selected infrequently by participants and were recorded as “other” to match the categories used by other jurisdictions and avoid the responses being treated as “missing values”. Variables unique to a particular jurisdiction were not included.

The combined dataset was viewed as a set of surveys conducted in a number of municipalities/regions in Canada rather than a series of five distinct jurisdictional surveys. The data were weighted by traffic volume at the site and municipal population (a surrogate for the number of licensed drivers in the municipality) but not by province/territory.

The results are presented together as one survey. No jurisdictional comparisons have been made. Only in cases where a unique and relevant finding was evident have the results from a single jurisdiction been highlighted.

RESULTS

Response Rates

Across the five jurisdictional surveys, a total of 7,265 vehicles were randomly sampled from the traffic flow for participation in the survey. Of these, 5,866 (80.7%) drivers agreed to participate. Of those who agreed, 5,556 (94.7%) provided a breath sample and 5,293 (90.2%) provided a sample of oral fluid for analysis.

Despite the relatively high participation rates, concern remains that drinking drivers and those using drugs might be more likely to refuse to participate, thereby introducing a conservative bias into the estimates of alcohol and drug use. To assess the impact of refusal bias, the 2007 U.S. National Roadside survey used two techniques. One involved the use of passive alcohol sensors[6] to provide an initial estimate of driver BAC (Lacey et al., 2009). The passive sensor reading was combined with other variables (e.g., driver sex, time of night) to impute BACs for those who refused. The distribution of imputed BACs was virtually identical to that of drivers who provided a breath test. Second, some drivers who initially refused were offered an additional incentive of up to $100 to participate. Of those who accepted the additional incentive, the percentage of alcohol positive cases (13%) was just marginally higher than among those who initially agreed (12.4%). There was a slightly higher percentage of drug positive cases among those who supplied an oral fluid sample in response to the additional incentive (17% vs 14.4%) but the difference was not statistically significant. These findings provide confidence that drivers who refuse to provide a sample of breath or oral fluid are not necessarily doing so because they had been drinking or using drugs.

Drivers who refused to participate in the jurisdictional surveys were asked to indicate a reason for not participating. The most common reasons cited were “in a hurry” and “not interested”. “Civil rights” was mentioned by a small number of drivers as a reason not to participate. Some did not want to “provide their DNA”[7] while others simply felt the collection of oral fluid was too invasive and made them uncomfortable.

Characteristics of the Sample

This section describes the characteristics of the sample. Unweighted data were used for these analyses so as to provide a picture of the sample of drivers who were randomly selected from the traffic stream to participate in the survey.

Driver sex

Men (80.4%) and women (81.9%) were equally likely to participate ($\chi^2(1, N=7190)=2.38, p> 0.1$). However, male drivers comprised 65.0% of the sample.

The distribution of male and female drivers did not vary according to night of the week ($\chi^2(3, N=5816)=6.20, p>.10$). There was, however, a significant difference in the proportion of male and female drivers according to the time of night ($\chi^2(5, N=5714)=79.7, p<.001$). The percentage of female drivers decreased from 40.6% between 9 and 10 PM to 21.5% between 2 and 3 AM.

[6] A passive alcohol sensor measures the alcohol in the ambient air in the vicinity of the driver’s face and does not require the driver to provide a breath sample.
[7] Oral fluid samples were not used for DNA analysis.

Driver age

Driver age was determined from reported year of birth[8]. Participants ranged from 16 to 94 years of age with a mean of 38.1 years (SD =15.6). The distribution of driver age in the roadside sample was compared to the age distribution of the general population of licensed drivers in the jurisdictions and revealed that the roadside sample was comprised of a greater proportion of drivers under 35 years of age, indicating that younger drivers were more likely than older drivers to be out driving at night.

The mean age of drivers was similar among men (38.2) and women (37.9) ($t(5607)=0.60$, $p>.5$). The distribution of driver age varied according to day of the week ($\chi^2(18, N=5653)=30.08$, $p<.05$). Although the proportion of all age groups increased on weekend nights, the magnitude of the increase was considerably larger among the youngest age group (i.e., 16-18 years of age). Driver age also differed according to time of night ($\chi^2(30, N=5653)=137.2$, $p<.001$). The percentage of younger (aged 16 to 18) and older (aged 46 and over) drivers decreased during late night hours, whereas the percentage of those aged 19 to 25 and 26 to 35 increased throughout the night.

Vehicle types

The majority of vehicles selected for the survey were passenger cars (54.1%). Sport utility vehicles (SUVs) accounted for 21.5% of vehicles selected, followed by pickup trucks (15.7%), vans (4.7%) and minivans (3.8%).

Occupant configuration

Over half of all drivers (56.9%) were the sole occupant of the vehicle. Drivers with one passenger of either the opposite sex (20.0%) or same sex (10.4%) were the next most common occupant configurations. Vehicles containing a family, same-sex group or mixed-sex group represented 4.2%, 2.0%, and 5.6%, respectively.

The distribution of occupant configurations varied by day of the week ($\chi^2(15, N=6986)=195.8$, $p<.001$). The percentage of vehicles with only the driver accounted for two-thirds of vehicles on Wednesday and Thursday nights but decreased to 53.4% on Fridays and 48.5% on Saturdays. Vehicles with a driver and an opposite sex passenger increased from 16.3% on Wednesday night to 24.1% on Saturday night. Vehicles with mixed sex groups also increased on weekend nights.

Graduated licensing

Graduated Licensing was introduced to help reduce the risk of collisions for new (i.e., "novice") drivers regardless of age, by requiring them to progress through a tiered licensing system to obtain a full (unrestricted) driver's licence.[9] The system requires novice drivers to adhere to a set of driving restrictions designed to reduce their exposure to high-risk driving situations. One notable restriction is that all novice drivers must be free of alcohol and drugs when operating a vehicle.

[8] Age was calculated as of the end of the calendar year in which the survey occurred. Although this does not necessarily provide an exact age, it was deemed adequate for purposes of the survey.

[9] These stages are referred to variously in the jurisdictions as "Learner/Novice/Probationary/G1/G2". For present purposes, persons holding one of these classes of licence will be referred to as novice drivers.

A total of 914 (19.8%) of the drivers interviewed indicated that they were a novice driver under the licensing scheme in their jurisdiction. Although there is a tendency to consider all new drivers as young, in fact, 30.0% of drivers who indicated they were a novice driver were over 25 years of age.

Licence class

Drivers were asked to indicate their class of licence as part of the self-report questionnaire that was completed while the oral fluid sample was being collected. Hence, these data are only available for participants who consented to provide an oral fluid sample. The majority of drivers (65.5%) indicated they had a "regular" licence (i.e., passenger vehicles). Other classes of licence were reported, including those required to operate tractor-trailers, heavy trucks, buses, and/or school buses. A small number of drivers reported having a licence from another province or state.

Seat belt use

Rates of seat belt use were high among both drivers and front seat passengers. Among drivers, 99.3% were wearing their seat belt; among front seat passengers, 97.7% were belted.

Origin and destination

Drivers were asked during the interview where they were coming from, how long ago they left that location, and the nature of their destination. The mean travel time from the point of origin was 21.4 minutes (SD =48.3; *Mdn*=10) and ranged from 1 to 840 minutes. The majority of participants (72.3%) had been driving for 15 minutes or less.

Table 3 displays the distribution of reported trip origin and destination. The "services/errands" category refers to locations such as a gas station, grocery store, or convenience store. "Sports/recreation" encompasses a wide range of leisure activities including the movies, concerts and sporting events – either watching or participating. The most common point of origin reported by participants was work or school (22.9%), followed by the home of a friend or relative (22.1%). The majority of participants (68.4%) were on their way home.

Table 3: Participants' Trip Origin and Destination

Location	Trip Origin (%)	Trip Destination (%)
Work/School	22.9	5.3
Home	17.7	68.4
Home of friend/relative	22.1	11.7
Restaurant	8.4	4.1
Bar/Pub/Nightclub	3.0	1.2
Sports/Recreation	11.6	2.3
Services/errands	6.7	2.3
Other	7.6	4.5

Overview of Alcohol and Drug Use by Drivers

The unweighted data showed that 175 drivers (4.1%) who provided a breath sample had a positive BAC (i.e., ≥ 5 mg/dL).[10] Of these 175 drivers, 118 had a BAC below 50 mg/dL; 32 had BACs between 50 and 80 mg/dL; and 25 had a BAC over 80 mg/dL. Among this latter group, 4 drivers had a BAC of 150 mg/dL or greater. Among drivers who had been drinking, 21.9% also tested positive for drugs.

An examination of the unweighted data also revealed that 643 drivers (12.4% of those who provided an oral fluid sample) tested positive for drugs. Of the drug-positive cases, 84.2% involved a single drug and 15.7% tested positive for more than one drug. Of those who tested positive for drugs, 39 drivers (6.2%) also tested positive for alcohol.

Cannabis was the most frequently found substance – 72.9% of drug-positive drivers tested positive for tetrahydrocannabinol (THC), the substance primarily responsible for the psychoactive effects of cannabis. Stimulants (e.g., cocaine, methamphetamine) were detected in 31.3% of drug-positive drivers and opioids (e.g., fentanyl, oxycodone) were detected in 11.5%.[11] Benzodiazepines were rarely detected.[12]

Overall, 15.3% drivers who provided both a breath sample and an oral fluid sample tested positive for alcohol or drugs or both alcohol and drugs.[13]

In the subsequent sections, driving after drinking and driving after drug use are discussed separately. In these sections, the raw data have been weighted to adjust for differences in the traffic volume at the various sites. This weighting procedure places greater emphasis on interviews from sites with higher traffic volumes. The data were also adjusted for population in each community and combined into a weighted total. This weighting procedure provides an estimate of the results of the survey across all five regions.

[10] As noted previously, the data on alcohol use by drivers in Manitoba were not included in the analyses. A review of the unweighted data from Manitoba show that 14 drivers (1.1%) tested positive for alcohol. Weighted data, excluding drivers interviewed prior to 9 PM, shows 0.5% of drivers were positive for alcohol.

[11] Percentages add to more than 100% due to more than one drug being detected in some drivers.

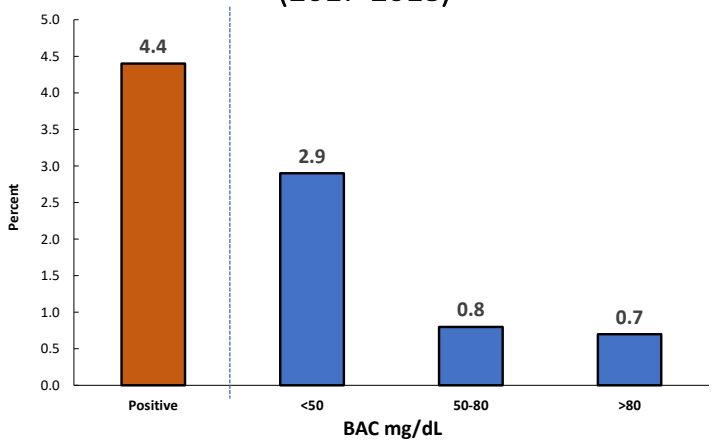
[12] The low number of benzodiazepines detected is likely related to the fact that these substances do not transfer well into oral fluid.

[13] Weighted percentage is 12.9%.

Driving after Drinking

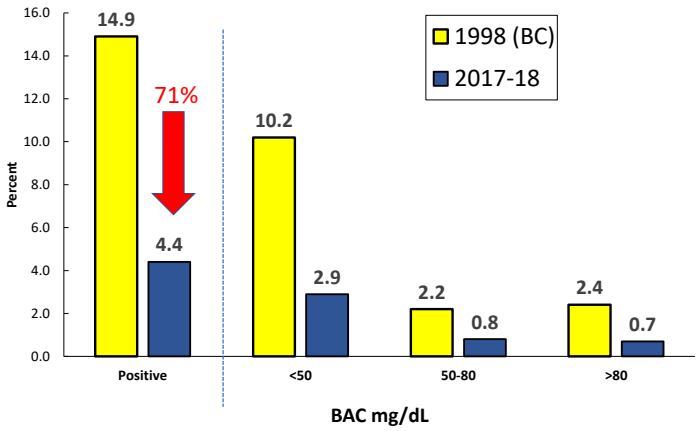
Figure 1 presents the weighted percentage of drivers who tested positive for alcohol and the distribution of positive BACs. Overall, 4.4% of drivers who provided a breath sample tested positive for alcohol. Most drivers who had been drinking had a BAC below 50 mg/dL (i.e., 2.9%); 0.8% had a BAC between 50 and 80 mg/dL; and 0.7% had a BAC over 80 mg/dL.

Figure 1: Distribution of BAC Among Drivers (2017-2018)



Comparison of the BAC distribution of drivers in these recent surveys with that in previous surveys shows a substantial reduction in the proportion of drivers who had been drinking. For example, Figure 2 presents the BAC distribution from the five jurisdictional surveys and that from the roadside survey conducted in British Columbia in 1998 (Beirness et al., 1999). Over this 20-year period, the proportion of drinking drivers decreased by 71%. Reductions in every BAC category were evident.

Figure 2 : Change in BAC Distribution of Drivers (1998 vs 2017-18)



Characteristics of Drinking Drivers

This section examines the characteristics of drivers who tested positive for alcohol – e.g., age, and sex. These data help to identify those drivers most likely to engage in drinking-driving behaviour, providing valuable information for targeting prevention messages.

Driver sex

Males were overrepresented among drinking drivers. Males comprised two-thirds of all drivers who provided a breath sample but 77% of drivers who had been drinking. The percentage of male drivers who had been drinking (5.2%) was significantly higher than females (2.7%) ($\chi^2(1, N=4274)=16.1$, $p<.001$). Men were also more likely than women to have a BAC of at least 50 mg/dL (2.0% vs 0.5%). The numbers, however, are small and should be interpreted with caution.

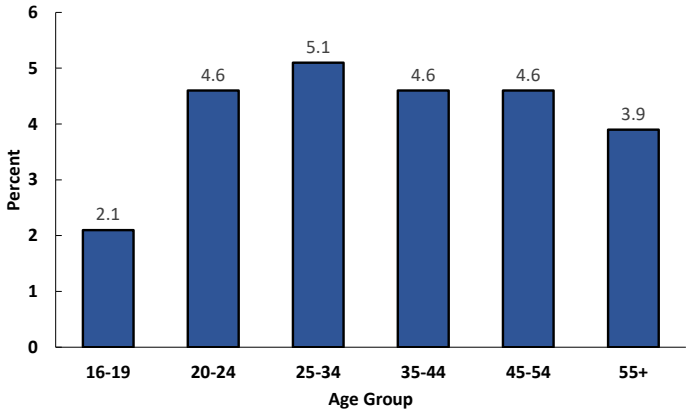
Driver age

Figure 3 presents the distribution of drivers with positive BACs according to age group. The percentage of drinking drivers with positive BACs did not differ according to age group ($\chi^2(5, N=4242)=5.41$, $p>.3$). Drivers aged 16 to 19 were the least likely to test positive for alcohol (2.1%), drivers aged 25 to 34 were most like to have been drinking (5.1%). Drivers aged 20 to 24 had the highest percentage of BACs over 50 mg/dL (2.3%).

Graduated licensing

As part of jurisdictional Graduated Driver Licensing programs, drivers who hold a first or second stage licence (i.e., novice drivers) are subject to a number of restrictions, including zero tolerance for alcohol and drugs when driving. Among this group of novice drivers, 2.9% had a positive BAC; 81% of these alcohol-positive novice drivers were 20 years of age or over.

Figure 3: Percentage of Drivers Positive for Alcohol According to Age Group



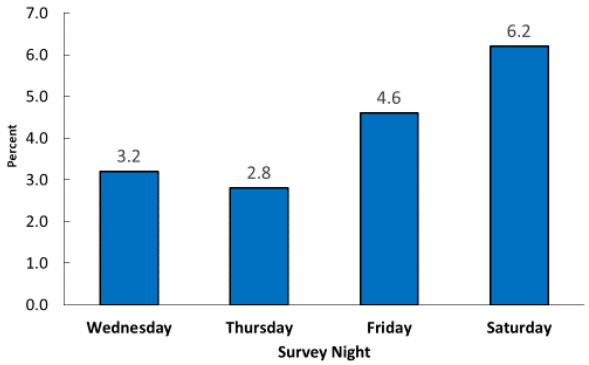
Characteristics of Drinking and Driving

This section examines the temporal and environmental circumstances surrounding drinking and driving behaviour -- e.g., day of the week, time of day, type of vehicle, and trip origin. These characteristics can help identify situations under which drinking and driving is most common and can be of value in prevention and enforcement efforts.

Survey night

Figure 4 presents the distribution of drivers with a positive BAC according to survey night. The proportion of drinking drivers was higher on weekend nights than weekday nights ($\chi^2(3, N=4262)=18.6$, $p<.001$). The highest percentage of drinking drivers was found on Saturday night, reflecting a long-standing pattern noted in many previous surveys.

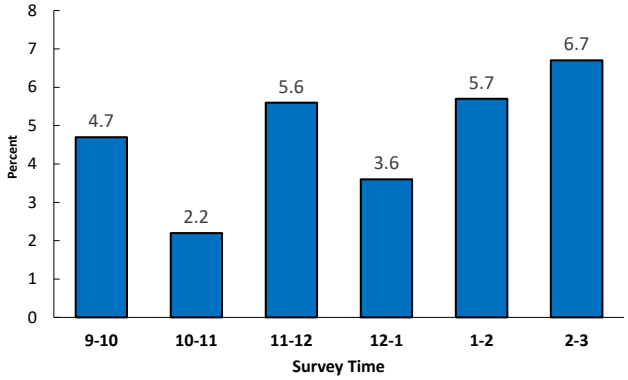
Figure 4: Drivers with Positive BACs According to Survey Night



Survey time

The percentage of alcohol-positive drivers according to the time of night during which they were interviewed is presented in Figure 5. The percentage of drinking drivers differed significantly across the time periods ($\chi^2(5, N=4263)= 19.6$, $p<.001$). Drinking drivers were most prevalent after 1 AM.

Figure 5: Drivers with Positive BACs According to Survey Time



Vehicle type

The percentage of drivers who had been drinking differed according to the type of vehicle driven ($\chi^2(4, N=4114)=18.2$, $p<.001$). Drivers of pickup trucks were most likely to test positive for alcohol (6.1%), followed by drivers of SUVs (5.1%). Drivers of vans and minivans were least likely to have been drinking (<1%).

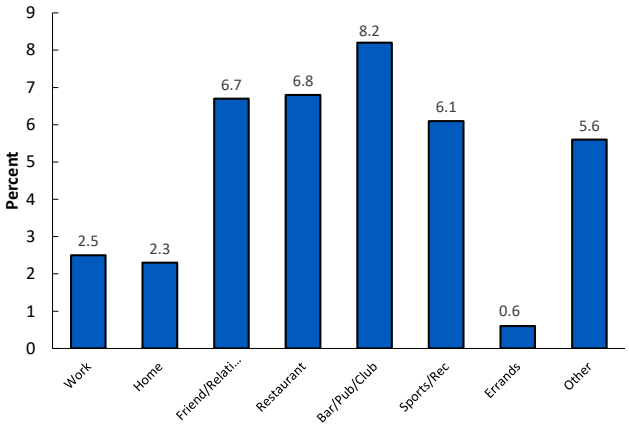
Occupant configuration

The configuration of vehicle occupants was not related to driver alcohol use ($\chi^2(5, N=4253)=7.84$, $p>.15$).

Trip origin

Figure 6 displays the percentage of drivers with positive BACs according to the reported origin of their trip. Drivers who reported coming from a bar, pub, club, or tavern were most likely to have been drinking (8.2%) followed by a restaurant (6.8%), the home of a friend or relative (6.7%), and a sport or recreation event (6.1%) ($\chi^2(7, N=4244)=52.6$, $p<.001$). Drivers coming from a bar, pub or tavern were most likely to have a BAC of 50 mg/dL or greater (3.5%).

Figure 6: Drivers with Positive BACs According to Trip Origin



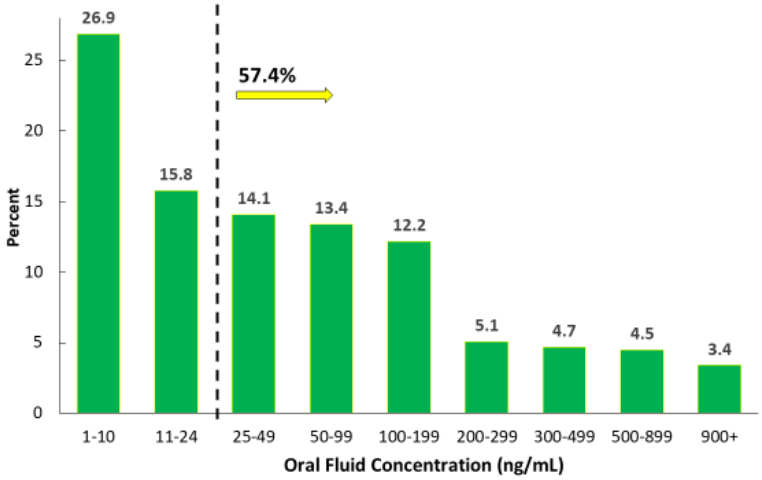
Drugs and Driving

Among drivers who provided an oral fluid sample, 10.2% tested positive for the presence of at least one potentially impairing substance other than alcohol; 7.6% tested positive for cannabis.

Whereas the concentration of alcohol in breath can be directly related to levels of alcohol in blood as specified in impaired driving legislation, the same is not true of THC concentrations in oral fluid. At best, oral fluid THC concentrations can be compared to the cutoff concentration in approved drug screening equipment (ADSE) that police are authorized to use at roadside (i.e., 25 ng/mL).

Figure 7 presents the distribution of oral fluid THC concentrations in drivers who tested positive. Over half (57.4%) of THC-positive drivers had a THC concentration sufficient to have triggered a positive result on ADSE – i.e., at least 25 ng/mL. In an enforcement setting, a positive ADSE result could lead to further investigation such as a demand to participate in a Standardized Field Sobriety Test (SFST), evaluation by a Drug Recognition Expert, and/or a blood test. Extremely high oral fluid THC concentrations are often indicative of very recent use, possibly just prior to – or during -- driving.

Figure 7: Distribution of THC Concentration (ng/mL)



In recognition of the high level of interest in cannabis, in the following sections, the use of cannabis by drivers is presented separately as a subset of overall drug use. The difference between the percentage of drivers who tested positive for cannabis and the percentage who tested positive for any drug thus represents the percentage of drivers who were positive for drugs other than cannabis.

Characteristics of Drug-drivers

This section examines the characteristics of drivers who tested positive for at least one drug as a means to identify those most likely to drive after using drugs.

Driver sex

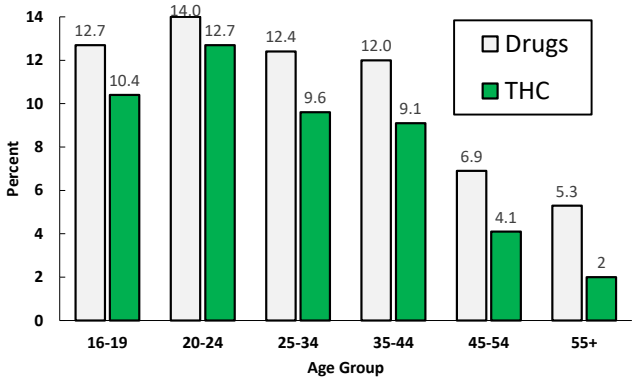
Male drivers were more likely than females drivers (12.0% and 7.4%, respectively) to test positive for drugs ($\chi^2(1, N=5177)=27.9$, $p<.001$). Male drivers were also significantly more likely than female drivers to test positive for cannabis (9.4% and 4.7%, respectively; $\chi^2(1,N=5178)=38.3$, $p<.001$).

Driver age

Figure 8 presents the percentage of each age group of drivers that tested positive for drugs; the percentage testing positive for cannabis is also shown. Drug use varied significantly according to driver age ($\chi^2(6, N=5116)=64.0$, $p<.001$). Drug use was most prevalent among drivers 20 to 24 years of age (14.0%) and decreased with increasing age. Drivers over 55 years of age were least likely to test positive for drugs (2.0%).

Drivers aged 20 to 24 were also most likely to test positive for cannabis (12.74%) and drivers over 55 years of age were least likely to test positive for cannabis (2.0%) ($\chi^2(6, N=5119)=101.8$, $p<.001$).

Figure 8: Drivers Positive for Drugs/THC According to Age Group



It was previously noted that 2.9% of drivers in the graduated driver licensing program had been drinking. Among novice drivers who provided an oral fluid sample, 14.9% tested positive for drugs; 12.1% were positive for cannabis. Among drug-positive novice drivers, the majority (67.8%) were 20 years of age or older.

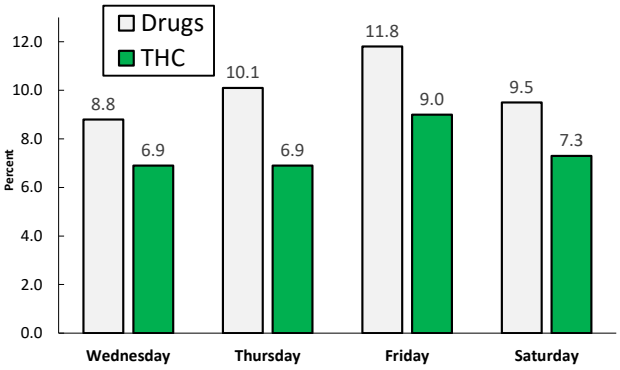
Characteristics of Drug-driving

This section examines the temporal and environmental circumstances surrounding drug use and driving behaviour—e.g., day of the week, time of day, type of vehicle, and trip origin. These characteristics can help identify situations under which drug use and driving is most likely to occur, information that can assist in prevention and enforcement efforts.

Survey night

Figure 9 presents the percentage of drivers who tested positive for drugs according to survey night. Although overall drug use and cannabis use were most prevalent on Friday night, the differences across days of the week were not statistically significant (All drugs, $\chi^2(3, N=5218)=7.39$, $p>.06$; THC, $\chi^2(3, N=5219)=6.02$, $p>.1$).

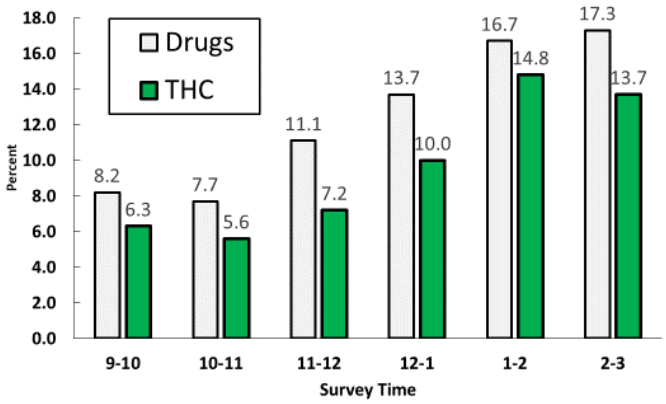
Figure 9: Drivers Positive for Drugs/THC According to Survey Night



Survey time

Figure 10 displays the percentage of drivers who tested positive for drugs and the percentage who tested positive for cannabis according to the time of the survey. The percentage of drug-positive drivers varied according to time of night, reaching the highest level between 2 and 3 AM (17.3%) ($\chi^2(3, N=5220)=55.3, p<.001$). Cannabis use by drivers followed a similar pattern, with the highest proportions after 1 AM ($\chi^2(3, N=5218)=54.7, p<.001$)

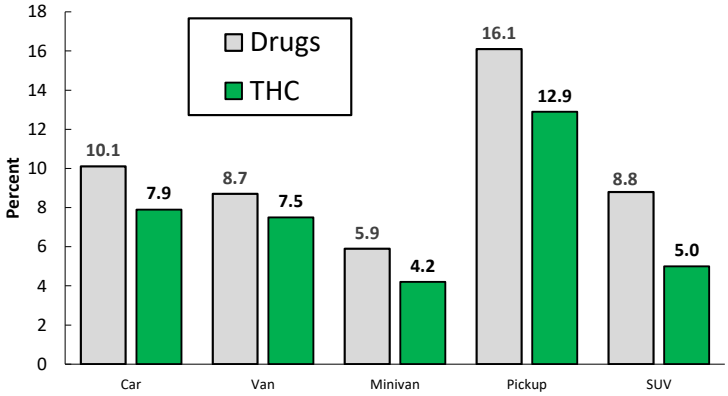
Figure 10: Drivers Positive for Drugs/THC According to Survey Time



Vehicle type

Figure 11 displays the percentage of drivers testing positive for drugs and cannabis according to vehicle type. Drivers of pickup trucks were most likely to test positive for drugs ($\chi^2(5, N=5080)=32.13, p<.001$) and cannabis ($\chi^2(5, N=5080)=32.13, p<.001$).

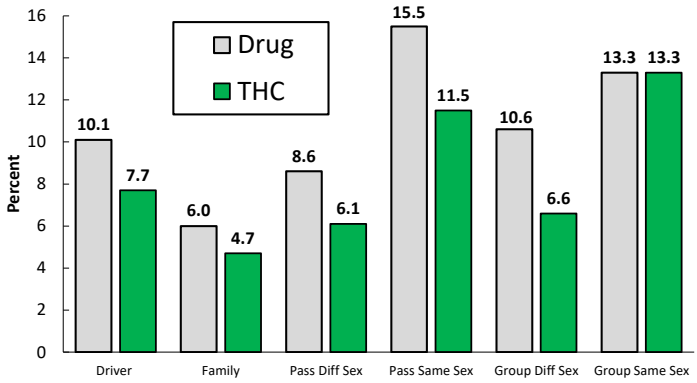
Figure 11: Drivers Positive for Drugs/THC According to Vehicle Type



Occupant configuration

Figure 12 shows the percentage of drivers who tested for drugs and the percentage who tested positive for cannabis according to occupant configuration. Drivers with one for more same-sex passengers were most likely to test positive for drugs (15.5% and13.3%, respectively) ($\chi^2(5, N=5161)=26.97$, $p<.001$). This was also true of drivers who tested positive for cannabis ($\chi^2(5, N=5162)=22.34$, $p<.001$). Drivers who were the only vehicle occupant comprised over half of all drivers who were positive for drugs.

Figure 12: Drivers Positive for Drugs/THC According to Occupant Configuration



Trip origin and destination

Drivers who indicated their point of origin was home or the home of a friend or relative were most likely to test positive for drugs (13.9% and 12.4%, respectively).

Among drivers who indicated their destination was the home of a friend or relative, 17.1% tested positive for drugs; 16.2% of those on their way to a restaurant were positive for drugs.

Of all drivers surveyed, 22.3% indicated they were coming from work. Within this group, 7.2% tested positive for drugs.

Drivers who reported they were on their way to work comprised only 4.5% of those surveyed. However, within this group, 10.3% were positive for drugs.

Experiences and Awareness

As part of the interview, drivers were asked about the likelihood of a person being stopped by the police if the person drove after drinking too much or after using drugs. Drivers were asked to respond using a scale from 1 to 7, where 1 represented 'not at all likely' and 7 represented 'extremely likely'. Drivers thought it somewhat more likely that a driver would be stopped by the police after drinking too much (M=4.41, SD=1.78) than driving after using drugs (M=3.94, SD=1.91) ($t(5641)=28.7$, $p<.001$).

There was no difference between drivers who had been drinking and those who had not been drinking in terms of their perceived likelihood that someone who had consumed too much alcohol would be stopped by the police ($t(5386)=1.29$, $p>.11$). On the other hand, the perceived likelihood of a person being stopped after using drugs was higher among drivers who tested positive for drugs than those who were drug-negative ($t(5092)=3.25$, $p<.001$).

Drivers who agreed to provide an oral fluid sample were asked to complete a self-report questionnaire during the 2 to 3 minutes while the sample was being collected. The questions varied somewhat across jurisdictions but generally asked about awareness of impaired driving laws and alcohol and drug use. The responses to questions common across all jurisdictions are presented in the following paragraphs.

Drivers were asked about the maximum allowable level of alcohol for drivers who were in the graduated driver licensing program. Overall, 73.4% of drivers were aware that novice drivers were restricted to a zero BAC. Among novice drivers, 79.4% knew they were not allowed to have any alcohol in their system when driving.

When asked how many drinks it takes them to reach an alcohol level of 50 mg/dL, 22.4% of respondents selected the answer "I'm not sure" and 19.9% indicated they didn't know. Just under half of respondents (47.5%) indicated one or two drinks; 7.1% indicated 3 drinks; and 2.6% indicated it would require 4 or more drinks to attain a BAC of 50 mg/dL.

Drivers were asked what being a Designated Driver meant to them, with three options from which they were to select one.[14] Overall, most respondents (97%) indicated that it meant "drinking no alcohol or using no drugs at all", while 2.5% selected "drinking some alcohol or having a few hits on a joint but not enough to be impaired", and less than 1% indicated that it meant "drinking less alcohol or using less drugs than my passengers".

Alcohol and cannabis use

The reported use of alcohol was common; 73.0% of drivers who completed the questionnaire reported consuming alcohol in past 12 months; 27.2% of drinkers reported consuming five or more drinks on an occasion at least monthly.

Among drivers who reported consuming alcohol, those who tested positive for alcohol reported drinking more frequently than those who had a zero BAC. Drinking drivers were more likely than non-drinking drivers to drink on four or more days per week (15.8% vs 5.1%, respectively) ($\chi^2(3, N=3045)=61.8$, $p<.001$). Drinking drivers were also more likely than non-drinking drivers to consume five or more drinks on an occasion at least once per week (16.9% vs 8.1%, respectively) ($\chi^2(1, N=2957)=13.6$, $p<.001$).

[14] This question was not asked in Manitoba.

By far the majority of drivers indicated that they did not use cannabis (77.9%). Of those who used cannabis, 2.4% reported daily use and a further 4.9% used at least weekly. Smoking was the most common form of cannabis used on the last occasion of use (83.3%) followed by edibles (7.3%) and concentrates (6.1%).

Drivers who tested positive for cannabis reported considerably greater frequency of cannabis use than drivers who tested negative at roadside ($\chi^2(6, N=701)=94.7, p<.001$). Among drivers who tested positive for cannabis, 23.7% reported daily use of cannabis; among drivers who reported using cannabis but tested negative, 6.4% reported daily use.

DISCUSSION

Roadside surveys provide a means to obtain an objective, scientifically valid estimate of the prevalence of alcohol and drug use by drivers within specified geographic and temporal parameters. Using a well-developed, standard technique, the roadside survey is a valuable tool for determining the magnitude and characteristics of drinking and driving as well as driving after drug use. In addition, by using comparable methods, roadside surveys provide a means to monitor changes in these behaviours over time and can be a powerful tool to help evaluate the impact of programs and policies.

The five jurisdictional roadside surveys described in this report were undertaken in the two years leading up to the legalization of cannabis and, hence, serve as a pre-legalization baseline of the prevalence of the use of cannabis by drivers. In addition, the surveys provide objective information about the extent and circumstances of the use of cannabis by drivers as well as information on the characteristics of those who drive after using cannabis.

Overall, 10.2% of drivers tested positive for a potentially impairing drug; 7.6% tested positive for cannabis. The use of drugs (and cannabis in particular) by drivers exceeded the use of alcohol (4.4%) by a considerable margin. Historical data from other comparable surveys shows that alcohol use by drivers has decreased substantially. For example, a roadside survey in British Columbia in 1998 revealed that 14.9% of drivers had been drinking (Beirness et al., 1999). The 71% decrease in the percentage of drinking drivers over the past 20 years is testament to the success of the comprehensive range of programs, policies, legislation, and public education campaigns designed to encourage responsible behaviours and social change over this period of time.

Relatively few previous roadside surveys have examined drug use by drivers. However, recent surveys in British Columbia indicate that overall drug use by drivers has increased. For example, cannabis use by drivers has increased from 3.3% in 2010 to 6.0% in 2018 – an 82% increase (Beirness, 2018; Beirness & Beasley, 2011). The opposite trends in the prevalence of alcohol and drug use by drivers are of concern as it appears that some of the gains made in terms of drinking and driving are being eroded by increases in the use of cannabis by drivers, even prior to legalization. It is possible that some drivers might be substituting cannabis for alcohol, believing that cannabis does not adversely affect their driving or that the police do not have the means to detect cannabis or cannabis-related impairment (Porath-Waller et al., 2013).

The prevalence of cannabis was most prominent among drivers aged 20 to 24 and diminished thereafter. Alcohol use by drivers was most prevalent among those aged 25 to 34 and remained just below this level in older age groups. Cannabis use exceeds alcohol use among drivers up to age 45. Thereafter, alcohol use surpasses cannabis. An exception to this pattern was noted in the 2018 survey in British Columbia, where the oldest age group of drivers (i.e., 55 years of age and over) were most likely to test positive for cannabis (Beirness, 2018). Traditionally, this age group has been the highest users of prescription medications. The substantial increase in the prevalence of cannabis among this age group, however, might reflect a substitution of cannabis for prescription medications and/or a perception of cannabis as being less impairing. Although the elevated rates of cannabis use among older drivers is unique to British Columbia, it warrants close monitoring and further investigation to determine its cause and potential impact on the safety of this group that is already at high risk of crash involvement.

The youngest age group of drivers (i.e., 16 to 19) was least likely to test positive for alcohol. In fact, in the Ontario survey in 2017, there were no drivers in this age group who had been drinking (Beirness & Beasley, 2018). This finding may well be a reflection of the success of the "zero alcohol" restriction for novice drivers. Anecdotal reports suggest that young people have largely embraced the anti-drinking-driving message and are taking positive steps to avoid this risky behaviour. Nevertheless, the fact that 20% of novice drivers were unaware of the zero alcohol restriction indicates the need to repeatedly reinforce the message, particularly among the large group of novice drivers who are of legal age to drink.

The relatively high rate of compliance of young drivers with the "don't drink and drive" message is, however, countered by the extent of their use of cannabis when driving. Among drivers aged 16 to 19, 10.4% tested positive for cannabis; among those aged 20 to 24, 12.7% were positive for cannabis. Greater efforts are required to encourage young drivers to embrace the zero tolerance for drugs message to the extent that they have for alcohol.

The reported frequency of alcohol or cannabis use was higher among drivers who tested positive for alcohol or cannabis, respectively. This indicates the probability of driving under the influence of alcohol or cannabis is related to the frequency with which these substances are used. Hence, targeting high-frequency users for prevention messaging could prove a useful strategy for reducing the overall risks associated with driving after the use of these substances.

The pattern of cannabis and driving differed somewhat from that generally associated with drinking and driving. For example, the prevalence of alcohol use by drivers typically increases on weekend nights, particularly during late night hours. Cannabis use by drivers during late night hours (i.e., after 1:00 AM) was particularly prominent. However, drivers testing positive for cannabis were as common on weekday nights as on weekends. This suggests that prevention and enforcement efforts should be adjusted and/or expanded to include these days.

In this set of five jurisdictional roadside surveys, it was apparent that the overall prevalence of drug use by drivers has surpassed alcohol. Cannabis accounts for the greatest proportion of drug use by drivers. The surveys also demonstrate that the characteristics of the drivers involved and the patterns of the driving after using cannabis differ somewhat from those of drinking drivers. This information is of considerable value in helping to target enforcement activities and in developing countermeasure programs. It should be noted, however, that there remains a good deal to learn about patterns of cannabis use, especially in relation to transportation choices and decisions. Moreover, social norms surrounding cannabis use are likely to evolve as it emerges from the shadows of illegality into other, more open and accepting avenues of society and culture. Going forward, it will be critical to monitor these changes and how they impact road safety.

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