On the High Road: Driving Under the Influence of Cannabis in Ontario

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A B S T R A C T

While cannabis is the most frequently found illegal drug in drivers killed or injured in motor vehicle collisions, little is know about driving under the influence of cannabis (DUIC) in the general population. We report information on the incidence of DUIC in a representative sample of the Ontario adult population. Among all drivers, 1.9% reported DUIC in the previous 12 months. Several factors influenced the likelihood of reported DUIC, including gender, age, marital status and education level. Among cannabis users, DUIC appeared to be a relatively common behaviour; 22.8% reported DUIC, and the probability of the behaviour was significantly influenced by gender and education level. As well, DUIC and drinking-driving were strongly related in this sample. These data underscore the need to obtain more information on this behaviour, including a more complete understanding of any risks involved.

A B R É G É

Le cannabis est la substance que l'on retrouve le plus souvent dans le sang des conducteurs tués ou blessés dans des accidents de la route. Cela dit, nous en savons très peu sur la conduite avec facultés affaiblies par le cannabis dans la population en général. La présente étude fournit des renseignements sur l'incidence de la conduite avec facultés affiblies par le cannabis dans un échantillon représentatif d'adultes ontariens. Sur la totalité des conducteurs, 1,9 % ont signalé avoir pris le volant sous l'influence du cannabis au cours des 12 mois précédents. Plusieurs facteurs influencent l'incidence de la conduite avec facultés affaiblies par le cannabis, notamment le sexe, l'âge, l'état civil et la scolarité. Parmi les usagers de cannabis, la conduite avec facultés affaiblies par le cannabis semblait être un comportement relativement répandu; 22,8 % des usagers ont signalé l'avoir fait, et ce comportement était grandement influencé par le sexe et la scolarité du répondant. De plus, la conduite avec facultés affaiblies par le cannabis et la conduite en état d'ébriété étaient étroitement liées au sein de l'échantillon à l'étude. Ces données soulignent l'importance de recueillir plus de renseignements sur ce type de comportement. Il faudrait entre autres mieux comprendre les risques qui y sont associés.

Cannabis is the illegal drug most frequently involved in motor vehicle collisions, and associated injuries and fatalities.[1,2] Canadian data confirm this. Cimbura et al.[3] found cannabis to be present in 3.7% of 401 Ontario drivers who were fatally injured between 1978 and 1979. A few years later (between 1982 and 1984), cannabis was detected in the blood of 10.9% of 1,169 fatally injured Ontario drivers.[4] Stoduto et al.[5] reported the results of drug screens conducted on 339 drivers admitted to a regional trauma unit in Toronto, Ontario between 1986 and 1989. Of these, 41.3% tested positive for psychoactive substances other than alcohol (alcohol was found in a smaller proportion: 34.5%). Cannabis was the substance most frequently detected, appearing in 13.9% of the cases. Although these studies may not be directly comparable, it appears that the proportion of drivers testing positive for cannabis in these Ontario samples has been increasing over time.

One difficulty in interpreting these data is the current inability to estimate precisely the extent to which a particular level of cannabis in the body impairs a person's psychomotor and cognitive skills.[6,7] This is further compounded by the fact that cannabinoids can remain in the body for long periods and be detected for days and weeks after use. Kapur[7] notes that, after cannabis use, levels of δ^9-tetrahydrocannabinol in the blood will fall by 90% over an hour, but trace amounts may be detected in the urine days to weeks later. In spite of these difficulties in interpreting research results, cannabis is now considered by many to be a causative factor in motor vehicle collisions.[1]

Little is known about the prevalence of driving under the influence of cannabis (DUIC) in the general population, the types of individuals who drive after using cannabis, or the impact of cannabis use on collision risk. Some research has attempted to identify groups most likely to engage in this behaviour. Driving under the influence of cannabis appears to be elevated among people under 25 years of age,[8] and among individuals who drive after drinking or exhibit other dangerous driving behaviours.[9] One study of clients in treatment for substance abuse found that those who reported a problem with cannabis reported fewer collisions in the year prior to entering treatment than clients seeking treatment for alcohol or stimulant abuse.[10] However, following treatment, all clients, including those who were treated for a cannabis problem, experienced significant reductions in moving violations and collisions.[11] Chipman,[12] in analyzing responses to the 1990 Ontario Health Survey, found that individuals who reported using cannabis five or more times in their life had an increased probability of injury from all causes, including motor vehicle collisions, in the previous 12 months. In general, while the evidence is much more difficult to obtain than in the case of alcohol, recent reviews have concluded that cannabis use increases collision risks. Initial attempts to reduce this behaviour, involving the use of specially trained drug-recognition officers by the police, have been reported.[13]

One suggestion that has been made is that DUIC may be part of a constellation of high-risk behaviours, or a risk-taking person-

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TABLE I

Percentage Driving Within an Hour of Smoking Cannabis During the Past 12 Months, Unadjusted and Adjusted Group Differences, Ontario Drivers, Aged 18+, 1996-1997, n=4,670

			%	±%†	Unadjusted Odds Ratios	Adjusted Odds Ratios for Factors 1-7
Total Sample			1.9	0.2	-	-
1) Gender					***	***
Women	(n=2,437)	(Comparison Group)	0.8	0.2	1.0	1.0
Men	(n=2,233)		3.0	0.4	3.8***	3.5***
2) Age (years)					***	***
18-19	(n=107)	(Comparison Group)	9.3	2.8	1.0	1.0
20-24	(n=362)		5.0	1.1	0.5	0.3**
25-34	(n=1,033)		2.1	0.4	0.2***	0.2***
35-44	(n=1,186)		1.6	0.4	0.2***	0.1***
45-64	(n=1,327)		0.7	0.2	0.1***	0.1***
65+	(n=561)		0.0	0.0	0.0***	0.0***
3) Marital Status					***	**
Married/Living with Partner	(n=2,934)	(Comparison Group)	0.9	0.2	1.0	1.0
Never Married	(n=945)		4.7	1.0	5.2***	3.1**
Previously Married	(n=762)		2.1	0.6	2.3*	1.7
4) Region					NS	NS
Toronto	(n=666)	(Comparison Group)	1.8	0.5	-	-
Central West	(n=819)		2.2	0.5	NS	NS
Central East	(n=806)		2.4	0.4	NS	NS
West	(n=814)		2.1	0.6	NS	NS
East	(n=811)		1.5	0.4	NS	NS
North	(n=754)		0.6	0.4	NS	NS
5) Education					***	***
Less Than High School	(n=871)	(Comparison Group)	2.3	0.6	1.0	1.0
Completed High School	(n=1,170)		2.2	0.5	1.0	0.5*
Some College or University	(n=1,442)		2.5	0.4	1.1	0.6
University Degree	(n=1,161)		0.7	0.2	0.3***	0.2***
6) Income					NS	NS
<$30,000	(n=789)	(Comparison Group)	2.5	0.6	-	-
$30,000 - $49,000	(n=924)		1.5	0.4	NS	NS
$50,000 - $79,000	(n=1,097)		2.3	0.6	NS	NS
$80,000+	(n=871))		2.1	0.5	NS	NS
7) Employment Status					*	NS
Full-Time	(n=2,440)	(Comparison Group)	2.3	0.3	1.0	-
Part-Time	(n=527)		2.2	0.7	1.0	NS
Other	(n=1,691)		1.3	0.3	0.6**	NS

Notes: *p<0.05; **p<0.01; ***p<0.001; † 95% confidence interval.
Asterisks in non-shaded rows indicate the significance of chi-square tests of association.
Odds greater than 1.0 indicate that driving under the influence of marijuana is more likely to occur in the group being compared to the comparison group; odds less than 1.0 indicate that driving under the influence of marijuana is less likely to occur in the group being compared to the comparison group.

ality style, observed in subgroups of adolescents and adults.[8] Substantial research points to the association of high-risk driving behaviours, including driving after drinking, with such factors as early onset of alcohol use and sexual behaviour, heavier use of alcohol, and use of cannabis.[14-16] Other studies point to the involvement of such personality factors as sensation seeking.[15,17,18] This model would suggest that, among cannabis users, the prevalence of DUIC may be quite high.

At present, with the exception of the information provided by Jonah,[8] there are little data available on the general prevalence of DUIC in Canada (or elsewhere for that matter). Assessing the prevalence of the behaviour is an important step in determining the extent to which DUIC may be a significant road safety problem.[19] In this paper

we document the prevalence of cannabis use and driving in the general population of Ontario drivers, identify the demographic characteristics associated with the behaviour, examine the prevalence of DUIC among cannabis users, and also look at the relationship between DUIC and driving after two or more drinks of alcohol.

METHOD

We combined data for this study from two repeated cross-sectional studies of Ontario adults aged 18 and older.[20,21] The 1996 and 1997 waves of the Ontario Drug Monitor employ a stratified (region) two-stage (household, respondent) probability sample and were administered by the Institute for Social Research at York

University. The response rates were 64% and 67% for the two years. Altogether 5,497 individuals were interviewed using a random digit dialling method. The data are weighted to account for non-response and sampling probability related to stratification. Further sampling details are available in technical documents.[20,21]

Based on a sub-sample of 4,735 respondents with a valid driver's licence, we used logistic regression to predict the odds of DUIC using seven categorical demographic characteristics: gender, age, marital status, region of the province, education, household income, and employment status. We also examine the association between driving under the influence of cannabis and drinking and driving among cannabis-using drivers. All estimates of

TABLE II

Percentage Driving Within an Hour of Smoking Marijuana During the Past 12 Months, Unadjusted and Adjusted Group Differences, Among Past Year Cannabis Users, Aged 18+, 1996-1997, n=367

			%	±%†	Unadjusted Odds Ratios	Adjusted Odds Ratios for Factors 1-7
Total Sample			22.8	2.6	-	-
1) Gender					***	***
Women	(n=230)	(Comparison Group)	13.4	3.5	1.0	1.0
Men	(n=137)		28.2	2.9	2.5***	4.0***
2) Age (years)					NS	NS
18-19	(n=27)	(Comparison Group)	40.8	9.0	NS	NS
20-24	(n=86)		21.5	4.2	NS	NS
25-34	(n=126)		17.2	3.1	NS	NS
35-44	(n=88)		21.7	5.0	NS	NS
45-64	(n=31)		31.8	8.7	NS	NS
3) Marital Status					NS	NS
Married/Living with Partner	(n=134)	(Comparison Group)	19.5	3.1	NS	NS
Never Married	(n=183)		24.5	6.9	NS	NS
Previously Married	(n=47)		28.8	4.7	NS	NS
4) Region					NS	NS
Toronto	(n=69)	(Comparison Group)	17.5	4.0	NS	NS
Central West	(n=62)		28.7	4.9	NS	NS
Central East	(n=68)		28.0	6.4	NS	NS
West	(n=57)		28.5	7.1	NS	NS
East	(n=62)		17.6	3.5	NS	NS
North	(n=49)		9.3	4.8	NS	NS
5) Education					***	*
Less Than High School	(n=52)	(Comparison Group)	38.2	7.6	1.0	1.0
Completed High School	(n=97)		25.2	5.6	0.6	0.4*
Some College or University	(n=135)		24.5	3.8	0.5	0.6
University Degree	(n=83)		9.6	2.8	0.2***	0.1**
6) Income					NS	NS
<$30,000	(n=68)	(Comparison Group)	29.6	5.2	NS	NS
$30,000 - $49,000	(n=82)		18.4	4.8	NS	NS
$50,000 - $79,000	(n=90)		24.5	5.4	NS	NS
$80,000+	(n=73)		22.5	5.3	NS	NS
7) Employment Status					NS	NS
Full-Time	(n=220)	(Comparison Group)	24.3	3.5	NS	NS
Part-Time	(n=43)		27.0	6.3	NS	NS
Other	(n=104)		17.8	3.7	NS	NS

Notes: *p<0.05; **p<0.01; ***p<0.001; † 95% confidence interval.
Asterisks in non-shaded rows indicate the significance of chi-square tests of association.
Odds greater than 1.0 indicate that driving under the influence of marijuana is more likely to occur in the group being compared to the comparison group; odds less than 1.0 indicate that driving under the influence of marijuana is less likely to occur in the group being compared to the comparison group.

variance are computed using SUDAAN[22] because of its capacity to compute statistics from complex survey designs.

RESULTS

The proportion of respondents who report DUIC during the previous 12 months is presented in Table I. It is clear that, among the entire population of drivers, DUIC is an infrequent event (1.9%). Results from the logistic regression model predicting DUIC in the entire sample of drivers show that four of the demographic variables significantly affect the odds of DUIC. Holding other factors constant, males are three and one half times more likely than females to report DUIC (3.0% vs 0.8%). Age also has a strong effect on the odds of DUIC. While there is no significant differ-

ence between those aged 18-19 (9.3%) and 20-24 (5.0%), the odds of DUIC decrease with age for those 25 years and older. The odds of DUIC are significantly higher for those who have never been married (OR=3.1) or were previously married (OR=1.7) than among those who are married. Finally, the likelihood of DUIC is significantly lower for those who have completed high school (OR=0.5) or completed a university degree (OR=0.2) compared to those without a high school diploma. Region, income and employment status did not significantly influence the likelihood of DUIC.

Table II shows the results of regressing driving under the influence of cannabis on the same seven demographics for the subsample of cannabis users who have a valid driver's licence (n=368). Overall, almost one

quarter (23%) of cannabis users reported DUIC in the previous 12 months. Of the seven demographic variables, however, only two significantly affect the likelihood of DUIC. Sex again is a significant determinant of the odds of DUIC. Holding other factors constant, male cannabis users are four times more likely than female users to report DUIC (OR=4.0). Education also had a strong effect. Cannabis users with a university degree are significantly less likely to report DUIC than their counterparts without a high school diploma (OR=0.1).

We also examined the association between driving after cannabis use and driving after drinking among cannabis users. The association was strong and significant (χ^2 (1df)=9.1; p<0.01). That is, 47% of the individuals who reported DUIC also reported driving after drinking.

DISCUSSION

Among respondents with drivers licences in our sample, the prevalence of driving within an hour of using cannabis was low (1.9%). Projecting the estimate onto the Ontario population of 7.2 million drivers, however, indicates that approximately 138,000 people had driven under the influence of cannabis within the previous year. The persons among the driving population who were most likely to report DUIC were males, those aged below 25 years, those who had never married and those without a university degree.

Our findings are similar to those reported by Jonah,[8] who found that DUIC rates were highest among those aged under 25 years (4.3% among 16-19 year olds and 5.8% among 20-24 year olds) and decreased linearly with age. Jonah also found that these same young people were more likely to report driving within an hour of drinking two or more drinks, and other risky behaviours (e.g., aggressive driving, accident involvement, moving violations, heavy drinking, illicit drug use, driving without a seat belt, etc.) as well as collision involvement. The results of this research, therefore, also provide general support for models that suggest that high-risk behaviours tend to cluster together in individuals. Attempts to explain this clustering have ranged from suggestions of a risk-taking personality style to the development of theoretical models which take into account the influence of personality and environmental influences.[8,14-18] The present results underscore the potential value of these models for understanding DUIC, including identifying individuals most likely to engage in this high-risk behaviour.

Although the prevalence of DUIC was low among the general population of drivers, it is relatively common when only cannabis users are considered. Almost a quarter (23%) of cannabis users with a driver's licence reported DUIC. The proportion is highest among males (28%), those between the ages of 18 and 19 (41%) and those without a high school education (38%). Overall, the 23% reporting DUIC represents a marked decrease from an early study of college students in Ontario,[23] where 62% of those who smoked marijuana and held a driver's licence had driven within an hour of smoking marijuana.

The concurrent use of cannabis and alcohol and the combined effect of these substances on driving ability is an area of concern. We found DUIC and driving under the influence of alcohol to be positively correlated. Almost one half (47%) of the respondents in our sample who reported DUIC had also driven within an hour of having two or more drinks (although the present data do not permit an assessment of whether these events happened concurrently). This observation is consistent with other studies which report the frequent co-occurrence of alcohol and cannabinoids in the blood of dead and injured drivers.[3,5]

Since 1.9% of all drivers reported DUIC, we might expect, if we assumed that cannabis use had no impact on collision risk, that cannabinoids would be detected in about 1.9% of drivers killed or injured in collisions. Instead, taking the most recent Ontario data available, Stoduto et al.[5] detected cannabinoids in 13.9% of their sample of injured drivers. That is, the proportion of injured drivers who tested positive for cannabinoids is about 7 times higher than what would be expected based on the findings on DUIC in the Ontario general population sample of drivers. Such an estimate would not take into account potential confounding risk factors such as age. As well, the difficulties in interpreting blood levels of cannabinoids as noted previously[7] suggest that the proportion of drivers under the influence of cannabis at the time that the collision occurred may be less than the 13.9% who tested positive for cannabinoids. Thus, these observations underscore the need for further information on cannabis-involved driving, including the collision risks involved.

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