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Cannabis use and self-reported collisions in a representative sample of adult drivers

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Abstract

Problem: This study examines the relationships between collision involvement and several measures of cannabis use, including driving after using cannabis, among drivers, based on a population survey of Ontario adults in 2002 and 2003. *Method:* Logistic regression analyses examined self-reported collision involvement in the last 12 months by lifetime use of cannabis, past year use of cannabis, and past year driving after using cannabis, while controlling for demographic characteristics. *Results:* We found that the odds of reporting collision involvement was significantly higher among cannabis users, and among those who reported driving after cannabis use. Some evidence for a dose-response relationship was seen as well. *Discussion:* Cannabis users and people who report driving after cannabis use are also more likely to report being involved in a collision in the past year. These observations suggest that collision prevention efforts could be aimed at these groups. Additional work to determine the causal pathways involved in the relationships observed here is needed. *Impact on Industry:* None.

Keywords: Collision; Cannabis; Drivers; Driving after cannabis use; Population survey

1. Introduction

There is growing interest in the role that illicit drugs such as cannabis may play in motor-vehicle collisions (MVCs: e.g., Macdonald et al., 2003; Mann, Brands, Macdonald, & Stoduto, 2003; Transportation Research Board, 2006; Walsh, De Gier, Christopherson, & Verstraete, 2004). One of the psychoactive drugs most often found in seriously and fatally injured drivers, after alcohol, is cannabis (Dussault, Brault, Bouchard, & Lemire, 2002; Stewart, 2006; Stoduto et al., 1993). Additionally, laboratory studies demonstrate that cannabis impairs a variety of skills involved in the driving task (Ashton, 2001; Beirness, Simpson, & Williams, 2006; Kalant, 2004; Kelly, Darke & Ross, 2004; Mann, Stoduto, Macdonald, & Brands, in press; Moskowitz, 1985; Ramaekers et al., 2006).

The extent to which cannabis increases collision risk has been unclear over the years. Some studies have found an increase in collision risk associated with use of cannabis (e.g., Chipman, Macdonald & Mann, 2003; Drummer et al., 2004; Dussault et al., 2002; Laumon, Gadegbeku, Martin & Biecheler, 2005). However, others have found that cannabis use does not appear to be associated with an increase in collision risk (Bates & Blakey, 1999; Longo, Hunter, Lokan, White, & White, 2000a,b; Smiley, 1999). Recent reviews of the evidence on the contribution of cannabis use to collision risk have found that the evidence is inconclusive and more research on this topic using improved and alternative methods is needed (e.g., Beirness et al., 2006; Moskowitz, 2006; Vingilis & Macdonald, 2002).

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Recently, researchers have begun to assess the prevalence of self-reported driving after cannabis use using survey methodologies. Walsh and Mann (1999) found that the prevalence of driving under the influence of cannabis (DUIC) one or more times in the previous year in the adult population of Ontario in 1997 was relatively low (1.9% of drivers), although it was substantially higher in younger drivers. Among users of cannabis, and in particular those who seek treatment for cannabis problems, 50% or more may report DUIC at least once in the previous year (Albery, Strang, Gossop, & Griffiths, 1999; Macdonald, DeSouza, Mann, & Chipman, 2004). As well, among young drivers in North America at least, the prevalence of DUIC is similar to or higher than the prevalence of driving after drinking (Adlaf, Mann, & Paglia, 2003; Asbridge, Poulin, & Donato, 2005). More recently, Simpson, Singhal, Vanlaar, and Mayhew (2006) reported that the proportion of Canadian adult drivers who reported DUIC rose significantly from 1.5% in 2002 to 2.4% in 2005.

Survey data may also be useful for assessing the association between cannabis use and collisions, and factors that may affect that association. Recently, Asbridge et al. (2005) analysed survey data from high school students in the provinces of Nova Scotia, New Brunswick, Prince Edward Island, and Newfoundland. These investigators found that students who reported driving after cannabis use had odds of collision involvement twice as high as students who did not report driving after cannabis use. While these results are of substantial interest, it is possible that the increase in collision risk associated with driving after cannabis use may have been due to factors specific to the student population, such as inexperience with driving or with cannabis use, higher levels of risk taking, and so on, and thus a similar increase in collision risk might not be seen among adults who drive after cannabis use. To test this possibility we report an examination of the risk of collision involvement associated with cannabis use measures, including driving after cannabis use, among adult drivers in Ontario.

2. Methods

2.1. Sampling method

The data for this investigation were drawn from the Centre for Addiction and Mental Health Monitor (CAMH Monitor), a repeated cross-sectional telephone survey of Ontario adults (18 years or older) administered by the Institute for Social Research at York University. First conducted in 1996, the CAMH Monitor is designed to serve as the primary vehicle for monitoring addiction and mental health issues in Ontario. Since 2002, the CAMH Monitor includes a self-report collision item. The survey used random-digit-dialling methods via Computer Assisted Telephone Interview. The CAMH Monitor each year consists of 12 independent monthly surveys (January – December) with 200 completions expected each month. The design employed a two-stage probability selection procedure. Each month a sampling frame of all active area codes and exchanges in Ontario are provided by the ATT Long Lines Tape. Within each regional strata, a random sample of telephone numbers was selected with equal probability in the first stage of selection (i.e., households). Within selected households, one respondent age 18 or older who could complete the interview in English or French was selected according to the most recent birthday of household members. Monthly sample sizes were between 130 and 260 respondents in the 2002 and 2003 surveys. Monthly response rate ranged from 54% to 62% in 2002 and 2003. The CAMH Monitor sample is representative for Ontarians aged 18 and older since the estimates of collision percentages are based on the weighted sample size. The demographic characteristics of the samples are presented in Table 1. More information on sampling design can be found in Ialomiteanu and Adlaf (2004).

Table 1
Demographic characteristics and prevalence of self-reported collisions among Ontario adult drivers, CAMH Monitor 2002-2003

Variable	Sample		Collision involvement	
	N	% †	Prevalence (95% CI)‡	
Total sample	2,676		8.1 (7.0-9.1)	
Age (years)				***
18-34	720	26.9	12.9 (10.7-15.4)	
35-54	1,200	44.8	5.3 (4.1-6.8)	
55+	756	28.3	6.9 (5.1-9.0)	
Gender				
Female	1,394	52.1	8.0 (6.6-9.7)	
Male	1,282	47.9	8.1 (6.7-9.6)	
Region				
Toronto	378	14.1	8.5 (6.2-11.2)	
Central East	459	17.2	8.4 (6.2-11.1)	
Central West	449	16.8	10.2 (8.0-12.8)	
West	464	17.3	5.3 (3.3-8.0)	
East	467	17.4	7.9 (5.4-11.1)	
North	459	16.2	5.1 (2.6-8.8)	
Income				*
<$30,000	381	14.2	8.2 (5.3-12.9)	
$30,000-49,999	486	18.2	4.6 (2.7-7.0)	
$50,000-79,999	670	25.0	9.5 (7.4-12.0)	
$80,000+	783	29.3	9.1 (7.3-11.2)	
Don't know/Refused	356	13.3	6.6 (4.4-9.6)	
Education				**
<High school	383	14.3	4.8 (2.8-7.6)	
Completed high school	621	23.2	10.3 (8.0-12.9)	
Some post-secondary	953	35.6	8.4 (6.7-10.3)	
University degree	719	26.9	7.3 (5.6-9.4)	
Marital status				***
Married/partner	1,675	62.6	6.6 (5.5-7.8)	
Previously married	455	17.0	4.8 (2.7-7.9)	
Never married	546	20.4	14.3 (11.6-17.3)	

Notes: † N is the number of unweighted cases and % is the percentage of subgroups of each demographic variable based on unweighted data. ‡ 95% confidence interval (CI) refers to being 95% confident that the interval contains the population percentage. Significant difference between subgroups of each demographic variable (Chi-square test): *$p<0.05$ **$p<0.01$ ***$p<0.001$.

2.2. Variables

The item used to measure collision involvement is "During the past 12 months, how often, if at all, were you involved in an accident or collision involving any kind of damage or injury to you or another person or vehicle while you were driving?" (recoded as a dichotomous variable, i.e., none or at least one).

Several measures of cannabis use are examined in this study. "Lifetime use of cannabis was measured with the question, Have you ever in your lifetime used marijuana or hash?" Past year use of cannabis was assessed by asking, "How many times, if any, have you used marijuana or hash during the past twelve months?" (recoded into three categories: more than once a week, once a week or less, and never). Driving while using marijuana or hash was assessed by asking, "During the past 12 months, have you driven a motor vehicle within an hour of using marijuana or hash?" Cannabis dependence was assessed with a brief scale consisting of six questions: "Have you felt a very strong urge or desire to use marijuana during the past 12 months?" "Have you tried to stop or cut down on your use of marijuana or hash but found you couldn't?" "Have you felt sick or found yourself shaking when you cut down or stopped using marijuana or hash?" "Have you found that your usual amount of marijuana or hash had much less effect on you than it once did?" "Have you given up or neglected pleasures or interests in favour of using marijuana or hash?" "Have you kept on using marijuana or hash even though you had a health problem caused or made worse by it?"

Demographic variables included are: age (18-34, 35-54, 55+), gender (female, male), region (Toronto, Central East, Central West, West, East, North), income (<$30,000, $30,000-49,000, $50,000-79,000, $80,000+, don't know/refusal), education (<high school, completed high school, some post-secondary, university), and marital status (married/partner, previously married, never married) (see Table 1 for sample characterstics).

2.3. Statistical analysis

Statistical analyses were completed using SAS software (version 8.2). The results in this paper are based on "valid" responses (n's) such that missing data (i.e. "don't know" responses and refusals) were excluded from analyses. The percentages reported are based on the weighted sample size and are considered representative for the population surveyed (Ialomiteanu & Adlaf, 2004). The prevalence of collision involvement by cannabis use measures and demographic characteristics were examined through Chi-square tests to examine any differences between groups. To assess statistical significant difference in the prevalence between any two comparable groups, we calculated the 95% confidence interval (CI) around each difference (e.g., P_2-P_1). Thus differences were significant ($p<0.05$) if the CI did not include the value zero (Fleiss, 1981). Logistic regression analysis was used to obtain odds ratios and confidence intervals as estimates of relative risk of collision for cannabis use measures while adjusting for potential confounding effects of demographic characteristics (Hosmer & Lemeshow, 2000; Kleinbaum, 1994). All statistical tests were two-sided and results were considered significant at $p<0.05$. Model fit was evaluated using the model Chi-square (Hosmer & Lemeshow, 2000; Pampel, 2000).

3. Results

A total of 2,676 respondents in the surveys reported on collision involvement while they were driving in the previous year. These drivers were on average 46.6 years old (SD=15.8, range 18-90). Of these, 193 reported that they were involved in an accident or collision involving any kind of damage or injury while driving during the past year, and the weighted prevalence of collision involvement was 8.1% among Ontario adults in 2002-2003. Table 1 presents data on the prevalence of collision involvement by demographic variables. There were significant differences in prevalence of collision involvement by age groups ($X^2_{(2df)}=38.96$, $p<0.0001$), income ($X^2_{(4df)}=11.55$, $p<0.05$), education ($X^2_{(3df)}=9.64$, $p<0.05$), and marital status ($X^2_{(2df)}=40.73$, $p<0.001$). The prevalence of collision involvement was 12.9% among those aged 18-34, which was significantly higher than among those aged 35-54 and those aged 55 and over (95% CI_{diff}: 2.5 to 8.9 and 3.5 to 10.1). There was a significantly higher risk of collision for those with a household income of $50,000-79,999 and $80,000 or more in comparison to those with income of $30,000-49,999 (95% CI_{diff}: 2.0 to 7.9 and 1.8 to 7.3). Respondents who had completed high school, and respondents who reported some post-secondary education, had higher collision risk than those with less than high school education (95% CI_{diff}: 2.1 to 8.7 and 0.7 to 6.4). People who were never married had a significantly higher risk of collision than those who were married or had previously been married (95% CI_{diff}: 4.7 to 10.7 and 5.8 to 13.2). Gender and region of residence were not found to be significantly related to collision involvement.

Table 2 presents data on the prevalence of collision involvement and the unadjusted and adjusted odds ratio estimates of collision involvement by measures of cannabis use. A total of 1,097, or 41%, of adult drivers reported having used cannabis in their lifetime; 10.2% of those were involved in a collision in the past year, while the rate of collision involvement was 6.6% among those who never used cannabis. We also found a significantly higher rate of collision involvement among lifetime users of cannabis compared to those who have not used in their lifetime ($X^2_{(1df)}=11.60$, $p<0.001$). The adjusted odds ratio of 1.47 (95% CI: 1.08-1.99) of collision involvement for lifetime use of cannabis revealed that there was 47% higher odds of collision involvement among those who have in their lifetime used cannabis than that among those who have never used cannabis.

Table 2
Prevalence of collision involvement and odds ratio estimates for cannabis use and driving after cannabis use among Ontario adult drivers, CAMH Monitor 2002-2003

Covariates‡	N †	%	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Lifetime use of cannabis			***	
No	1,579	6.6	—	—
Yes	1,097	10.2	1.61 (1.22-2.13)**	1.47 (1.08-1.99)*
12-month use of cannabis			***	
No	2,357	7.2	—	—
Once a week or less	254	11.4	1.67 (1.11-2.53)*	1.24 (0.80-1.93)
More than once a week	65	24.7	4.25 (2.45-7.35)***	2.76 (1.50-5.08)**
Cannabis dependence past 12 months			***	
No	2,573	7.6	—	—
Yes	103	19.0	2.87 (1.75-4.69)***	1.72 (1.00-2.96)*
Drove within an hour of cannabis use past 12 months			**	
No	2,606	7.6	—	—
Yes	70	24.1	3.89 (2.30-6.59)***	2.61 (1.45-4.68)**

Notes: † N is the number of unweighted cases. ‡ OR adjusted for covariates including age, gender, region, income, education, and marital status in the logistic regression model. 95% confidence interval (CI) refers to being 95% confident that the interval contains the population OR. Chi-square test or Wald test: *p<0.05 **p<0.01 ***p<0.001.

A total of 254 adult drivers reported using cannabis once per week or less in the past year, while 65 drivers used cannabis more than once a week. There was a significant difference in collision involvement by frequency of cannabis use ($X^2_{(2df)}=34.58$, $p<0.001$), with prevalence of collision involvement being greater with more frequent cannabis use. The adjusted odds ratio of 2.76 (95% CI: 1.50-5.08) indicated that the odds of collision involvement was 2.76 times higher among those who used cannabis more than once a week during the past year than among those who did not use cannabis.

A total of 70 adult drivers reported driving a motor vehicle within an hour of using cannabis at least once during the past year, and 24.1% of them reported that they were involved in a collision. The rate of collision involvement was significantly higher among those who used cannabis before driving than those who did not ($X^2_{(1df)}=29.49$, $p<0.001$). The adjusted odds ratio of 2.61 (95% CI: 1.45-4.68) indicated that the odds of collision involvement was 2.61 times higher among those who drove within an hour of using cannabis than those who did not.

A total of 103 drivers reported having at least one symptom of cannabis dependence and 19.0% of them reported being involved in a collision. The rate of collision involvement was significantly higher among those with cannabis dependence than those without cannabis dependence ($X^2_{(1df)}=19.21$, $p<0.001$). The adjusted odds ratio of 1.72 (95% CI: 1.00-2.96) indicated that the odds of collision involvement was 72% higher among those with cannabis dependence than those without cannabis dependence.

4. Discussion

These results provide valuable information on cannabis use, DUIC, and the association of these behaviors with collision risk in the Ontario adult population. This study has some important limitations since it is based on cross-sectional survey data. One limitation is that we cannot be certain that non-respondents would have responded the same way as respondents in this study. However, since other research has demonstrated that non-respondents in studies of substance use and driving behavior are likely to be heavier substance users (Mann et al., 2002), it seems probable that any bias introduced by nonresponse would be a conservative one. As well, we cannot determine from the present data whether or not any of the collisions reported by those who drove after cannabis use actually involved cannabis use and driving.

Nevertheless these results are of substantial interest. Respondents who reported driving after cannabis use at least once in the previous year had collision involvement odds that were 3.89 times higher than drivers who did not drive after cannabis use. After adjusting for demographic variables, their odds of collision involvement (at 2.61) remained significantly elevated. Previously, Asbridge et al. (2005) found that DUIC was associated with an increase in self-reported collision risk among high school students in the four eastern provinces of Canada. Our study findings with adult drivers show very similar results, and indicate that the association of cannabis use and DUIC with increased risk of collision is not restricted to adolescents. Together, these studies point to the potential utility of survey data in assessing the association of cannabis and other drug use with collision risk. Epidemiological studies using case-control or similar methodologies (e.g., Drummer et al., 2004; Laumon et al., 2005) are necessary to determine the impact of cannabis on collision risk. However, they are also very difficult and costly to undertake, and to date have not provided a clear picture of the role of cannabis in collision involvement (Bates & Blakey, 1999; Beirness et al., 2006; Moskowitz, 2006). Information from these epidemiological studies can profitably be supplemented by data from other sources, such as the survey data employed here. Measures of potential interest, such as frequency of drug use or dependence symptoms as reported here, as well as many other demographic and personality measures that could affect the relationship between drug use and collision risk, can be collected much more readily in survey studies.

In general, involvement with cannabis increased collision risk, with more involvement as reflected in use of more than once per week, or with driving after cannabis use, being associated with the highest degree of collision risk. Individuals who reported driving after cannabis use had odds of collision involvement that were higher than those experienced by those who were occasional users of cannabis.

However, their odds of collision involvement were similar to those reported by individuals who were frequent users of cannabis. Several studies have found that driving after cannabis use, while relatively uncommon in the general adult population, is common among cannabis users (Macdonald et al., 2004; Walsh & Mann, 1999). Frequent users can be expected to be more likely to drive after cannabis use, and this could be one explanation for their increased collision risk.

However, these results may also reflect other causal pathways. Problem Behavior Theory (Donovan & Jessor, 1985) suggests a possible underlying causal mechanism. Those who drive after cannabis use may be generally characterized by a more deviant lifestyle, incorporating relatively frequent risk taking and rule breaking behavior (Donovan & Jessor, 1985). For these individuals, driving after cannabis use and collision involvement may both be manifestations of a general propensity for risk taking. Additional studies to determine the extent to which the increase in collision risk associated with cannabis use and DUIC may be due to this and other personality factors are needed.

Regardless of the mechanism for the increased collision risk, these results point to the potential significance of cannabis use as a means to identify individuals at increased risk for collision involvement, and thus have implications for collision prevention. As Asbridge et al. (2005) note, prevention efforts in recent years have focussed on alcohol-impaired driving, with little attention paid to the issue of driving after other drug use. Thus, development of public education materials to address the potential hazards of driving after use of cannabis (and other drugs) is supported by our results. Our results and those of Asbridge et al. (2005) also identify cannabis users as a high-risk group for collision involvement. These observations therefore may support the development of targeted prevention activities designed to reduce collision risk for this population.

While the overall prevalence of driving after cannabis use in the general population is relatively low (e.g., Walsh & Mann, 1999), among cannabis users and some subgroups of the population such as high school students and university students the prevalence is relatively high (Adlaf et al., 2003; Albery et al., 1999; Asbridge et al., 2005; Fischer, Rodopoulos, Rehm, & Ivsins, 2006; Macdonald et al., 2004). Our data and those of Asbridge et al. (2005) reveal an association of cannabis use and DUIC with increased likelihood of collision involvement among adults and adolescents. In view of indications that DUIC may be increasing (Simpson et al., 2006), more research is needed to monitor the prevalence of DUIC in the population, the factors associated with it, and clarify the role of cannabis in collision involvement.

5. Summary

Epidemiological studies have so far been inconclusive in determining the impact of cannabis on collision risk. Recent survey studies have found that DUIC appears infrequent in the North American adult population, but may be increasing. As well, DUIC seems to be relatively common among cannabis users and adolescent drivers. In a general population sample of adult drivers from Ontario, cannabis use in the preceding 12 months was associated with an increased likelihood of reporting collision involvement in the same time period. More involvement with cannabis, including reporting DUIC and reporting use more than once per week, was associated with greater odds of collision involvement. More research is needed to understand how cannabis may be involved with collisions, and what factors may account for the relationships observed here.

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