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Research

Association between legalization of recreational cannabis and fatal motor vehicle collisions in the United States: an ecologic study

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Abstract

Background: With the recent legalization of recreational cannabis in Canada, cannabis-impaired driving is an important public safety concern. Our aim was to examine the association between recreational cannabis legalization and fatal motor vehicle collisions using data from the United States, which present a timely natural experiment of cannabis legalization.

Methods: We conducted an ecologic study using the number of fatal motor vehicle collisions and the associated number of deaths for US jurisdictions with legalized recreational cannabis (2007–2018) retrieved from the US Fatality Analysis Reporting System. We examined jurisdiction-specific rates of fatal motor vehicle collisions and associated deaths before and after recreational cannabis legalization using Poisson regression and meta-analyzed estimates across jurisdictions using DerSimonian and Laird random-effects models.

Results: After adjustment for calendar year, legalization was associated with increases in rates of fatal motor vehicle collisions (incidence rate ratio [IRR] 1.15, 95% confidence interval [CI] 1.06–1.26) and associated deaths (IRR 1.16, 95% CI 1.06–1.27). Differences between the first 12 months after legalization relative to subsequent months were inconclusive for rates of fatal motor vehicle collisions (IRR 0.92, 95% CI 0.84–1.02) and associated deaths (IRR 0.92, 95% CI 0.84–1.01).

Interpretation: Recreational cannabis legalization in the US was associated with a relative increased risk of fatal motor vehicle collisions of 15% and a relative increase in associated deaths of 16%, with no conclusive difference between the first and subsequent years after legalization. These findings raise concern that there could be a similar increase in fatal motor vehicle collisions and associated deaths in Canada following recreational cannabis legalization.

Canada legalized recreational cannabis nationally on Oct. 17, 2018. By 2019, more than 5.1 million Canadians (16.8% of the population aged ≥ 15 yr) reported cannabis use in the previous 3 months (compared to 14.9% before legalization).[1] Although legalization better aligned the law with Canadian values and practices, it raised public health concerns regarding impaired driving.[2] Of people who reported any cannabis use in the previous 3 months, 13.2% reported driving within 2 hours of consuming cannabis; this proportion increased to 28.8% among daily or almost daily cannabis users.[1] The relation between cannabis use and impaired driving is complicated by varied methods of consumption (e.g., smoking, vaping, edibles), individual factors (e.g., metabolism, frequency of use) and time since consumption, as well as challenges in the reliable assessment of cannabis impairment.[3] However, cannabis is known to affect psychomotor skills necessary for driving, including critical tracking, divided attention and reaction time.[4]

Despite this knowledge, few studies have examined the impact of large-scale public policies that increased access to cannabis on impaired driving and related outcomes. Given the varied approaches taken to cannabis regulation by different jurisdictions in the United States,[5] data from the US present a timely natural experiment to assess the impact of recreational cannabis legalization. Our objective was to examine the association between recreational cannabis legalization and the rate of fatal motor vehicle collisions in the US to inform impaired-driving policy and public health prevention measures in Canada.

Methods

Design and setting

We performed an ecologic study to examine the association between recreational cannabis legalization and fatal

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motor vehicle collisions and associated deaths in the US between 2007 and 2018. Legalization was in effect in 11 jurisdictions (10 states and the District of Columbia) before 2019 (Table 1).[29]

Data sources

We retrieved the number of fatal motor vehicle collisions and of deaths due to motor vehicle collisions (as each collision could result in more than 1 fatality) by month for US jurisdictions with legalized recreational cannabis from the US Fatality Analysis Reporting System (FARS).[30] The FARS database includes data on collisions that occur on public roadways and result in at least 1 death within 30 days. We selected 2007 as the start of our study period to include at least 5 years before the first year in which legalized recreational cannabis was in effect in any jurisdiction (2012). Although recreational cannabis legalization came into effect in other states after 2019, we did not include those jurisdictions because the most recent year of FARS data available at the time of analysis (September 2020) was 2018.

The FARS database is the only source of national-level statistics on police-reported fatalities in the US, with data collected through collaborative agreements between the National Highway Traffic Safety Administration and each state.[31] Data collection forms for FARS are completed by personnel trained by the National Highway Traffic Safety Administration using multiple source documents (e.g., police, medical and administrative reports) and entered into a standardized, validated database.[31,32]

Exposure definitions

We defined exposure using a time-dependent approach with 2 categories: legalized recreational cannabis and no legalized recreational cannabis (reference group). We defined legalization for each jurisdiction as the date on which recreational cannabis legalization was in effect, rounded up or down to the nearest full month. Each jurisdiction contributed person-time of observation (determined with the use of the annual population of each jurisdiction for each year between 2007 and 2018)[30] and data on fatal motor vehicle collisions to both categories (legalized and nonlegalized) in the analysis.

Statistical analysis

We estimated the rates of fatal motor vehicle collisions and associated deaths within each jurisdiction before and after recreational cannabis legalization. Rates were estimated per 100 000 person-years for years during which recreational

Table 1: United States jurisdictions with regulations for legalized recreational cannabis in effect before 2019

Jurisdiction	Date legalization in effect	First month legalization in effect for primary analysis*	Date commercial dispensaries open	First month commercial dispensaries open for sensitivity analysis*	Cannabis-specific impaired driving law[6]
Alaska[7,8]	Feb. 24, 2015	March 2015	Oct. 29, 2016	November 2016	None
California[9,10]	Nov. 9, 2016	November 2016	Jan. 1, 2018	January 2018	None
Colorado[11,12]	Dec. 10, 2012	December 2012	Jan. 1, 2014	January 2014	Reasonable inference for impairment ≥ 5 ng/mL THC†
District of Columbia[13]	Feb. 26, 2015	March 2015	No commercial dispensaries	NA	None
Maine[14,15]	Jan. 30, 2017	February 2017	Oct. 9, 2020	NA	None
Massachusetts[16,17]	Dec. 15, 2016	December 2016	Nov. 20, 2018	December 2018	None
Michigan[18–20]	Dec. 6, 2018	December 2018	Dec. 1, 2019‡	NA	Zero tolerance (no detectable presence of cannabis permitted)
Nevada[21,22]	Jan. 1, 2017	January 2017	July 1, 2017	July 2017	Per se limit ≥ 2 ng/mL THC§
Oregon[23–25]	July 1, 2015	July 2015	Oct. 1, 2015¶	October 2015	None
Vermont[26]	July 1, 2018	July 2018	No commercial dispensaries	NA	None
Washington[27,28]	Dec. 6, 2012	December 2012	July 8, 2014	July 2014	Per se limit ≥ 5 ng/mL THC§

Note: NA = no data available for legalized (or commercial dispensaries open) months before 2019, THC = tetrahydrocannabinol.
*Rounded up or down to the nearest full month of legalization (or commercial dispensaries opening, for sensitivity analysis).
†Reasonable inference requires that the jurisdiction must prove with other evidence, in addition to exceeding the legal THC limit, that the driver was impaired.
‡On Dec. 1, 2019, existing medical cannabis dispensaries in Michigan were permitted to transfer up to 50% of their medical cannabis inventory to recreational cannabis inventory. Until November 2021, retailers must hold a medical cannabis licence in order to apply for a recreational cannabis licence.
§Per se limits do not require that the jurisdiction prove that drivers were impaired in order to charge them with driving under the influence if their THC level exceeded the legal limit.
¶On Oct. 1, 2015, existing medical cannabis dispensaries in Oregon were permitted to sell recreational cannabis. The first licences were issued to recreational cannabis retailers on Oct. 1, 2016.

cannabis was legal and not legal for each included jurisdiction. We then determined crude and adjusted incidence rate ratios (IRRs) and 95% confidence intervals (CIs) for each jurisdiction using a generalized linear model with a log link and Poisson distribution by means of the proc genmod procedure in SAS (version 9.4) (SAS Institute) for the associations between recreational cannabis legalization and fatal motor vehicle collisions and fatalities due to motor vehicle collisions. We adjusted models for calendar year, which was modelled as a continuous variable, to account for underlying time trends (e.g., baseline trends in substance use and driving, impaired-driving policies). We then meta-analyzed jurisdiction-specific estimates using DerSimonian and Laird random-effects models with inverse variance weighting. We conducted the meta-analysis in R (R Foundation for Statistical Computing) using the meta package.

We performed 2 secondary analyses. In the first, we defined exposure using the date when commercial cannabis dispensaries opened (rounded up or down to the nearest full month) instead of the date that legalization came into effect. Commercial dispensaries were open in 7 states before 2019 (Alaska, California, Colorado, Massachusetts, Nevada, Oregon and Washington). The remaining jurisdictions did not plan to allow dispensaries or opened (or planned to open) dispensaries after the study period.

In the other secondary analysis, we subcategorized data from the months during which cannabis was legal (or the months during which commercial dispensaries were opened) into the first 12 months and subsequent months to assess whether any observed increased risk was short term. We then compared rates from the first 12 months and subsequent months to each other and to those from nonlegalized periods.

In sensitivity analyses, we used a fixed-effects rather than a random-effects model. We also examined temporal trends in the incidence of fatal motor vehicle collisions and associated deaths before legalization to visually assess whether these were log-linear. We assessed colinearity between calendar year and legalization and open dispensaries using the variance inflation factor.

Ethics approval

Ethics approval was not required for this research as it used publicly available data.

Results

A total of 73 982 fatal motor vehicle collisions resulting in 80 402 deaths occurred between 2007 and 2018 in the 11 US jurisdictions that had recreational cannabis legalization in effect before 2019 (Table 2). Of these collisions,

Table 2: Fatal motor vehicle collisions and associated deaths from 2007 to 2018 in United States jurisdictions with legalized recreational cannabis

Event	No. of events	Person-years of observation	Rate per 100 000 person-years (95% CI)	IRR (95% CI)	
				Crude	Adjusted*
Recreational cannabis legalization (11 jurisdictions)†‡					
Fatal motor vehicle collision	73 982	924 545 813	8.00 (7.94–8.06)		
No legalization	56 866	717 561 813.4	7.92 (7.86–7.99)	1.00 (reference)	1.00 (reference)
Legalization	17 116	206 983 999.6	8.27 (8.15–8.39)	1.05 (0.99–1.12)	1.15 (1.06–1.26)
Death from motor vehicle collision	80 402	924 545 813	8.70 (8.64–8.76)		
No legalization	61 822	717 561 813.4	8.62 (8.55–8.68)	1.00 (reference)	1.00 (reference)
Legalization	18 580	206 983 999.6	8.98 (8.85–9.11)	1.04 (0.98–1.11)	1.16 (1.06–1.27)
Opening of recreational cannabis dispensaries (7 jurisdictions)†§					
Fatal motor vehicle collision	60 518	774 128 598	7.82 (7.76–7.88)		
No open dispensaries	50 275	653 841 729.2	7.69 (7.62–7.76)	1.00 (reference)	1.00 (reference)
Open dispensaries	10 243	120 286 868.8	8.52 (8.35–8.68)	1.08 (1.03–1.14)	1.18 (1.06–1.32)
Death from motor vehicle collision	65 835	774 128 598	8.50 (8.44–8.57)		
No open dispensaries	54 685	653 841 729.2	8.36 (8.29–8.43)	1.00 (reference)	1.00 (reference)
Open dispensaries	11 150	120 286 868.8	9.27 (9.10–9.44)	1.08 (1.03–1.14)	1.18 (1.06–1.32)

Note: CI = confidence interval, IRR = incidence rate ratio.
*Adjusted for calendar year, modelled as a continuous variable.
†See Appendix 1, Supplemental Tables S1–S4 (available at www.cmajopen.ca/content/9/1/E233/suppl/DC1) for jurisdiction-specific event rates.
‡The variance inflation factor for calendar year and legalization status ranged from 1.02 in Michigan to 4.03 in Colorado and Washington (Appendix 1, Supplemental Table S5).
§The variance inflation factor for calendar year and open dispensary status ranged from 1.02 in Michigan to 3.76 in Colorado (Appendix 1, Supplemental Table S5).

17 116, resulting in 18 580 deaths, occurred during periods when recreational cannabis was legal (Table 2; Appendix 1, Supplemental Tables S1–S4, available at www.cmajopen.ca/content/9/1/E233/suppl/DC1).

After adjustment for calendar year, legalization was associated with increased rates of fatal motor vehicle collisions (IRR 1.15, 95% CI 1.06–1.26) (Figure 1A) and deaths from motor vehicle collisions (IRR 1.16, 95% CI 1.06–1.27) (Figure 1B). When we used the date commercial dispensaries opened rather than the date legalization came into effect in the analyses, the findings were similar for the risk of motor vehicle collisions (IRR 1.18, 95% CI 1.06–1.32) (Figure 2A) and associated deaths (IRR 1.18, 95% CI 1.06–1.32) (Figure 2B).

After adjustment for calendar year, the difference in the first 12 months versus subsequent months after legalization was inconclusive for rates of fatal motor vehicle collisions (IRR 0.92, 95% CI 0.84–1.02) and deaths from motor vehicle collisions (IRR 0.92, 95% CI 0.84–1.01) (Table 3). When we used the date dispensaries opened rather than the date legalization came into effect in the analyses, we likewise found an inconclusive difference in rates of fatal motor vehicle collisions (IRR 0.88, 95% CI 0.76–1.02) and associated deaths (IRR 0.88, 95% CI 0.76–1.01) in the first 12 months versus subsequent months (Table 3).

Sensitivity analysis

Sensitivity analyses that used fixed-effects models showed results similar to those of the random-effects models for both rates of fatal motor vehicle collisions and deaths associated with recreational cannabis legalization (Figure 1) and the

A

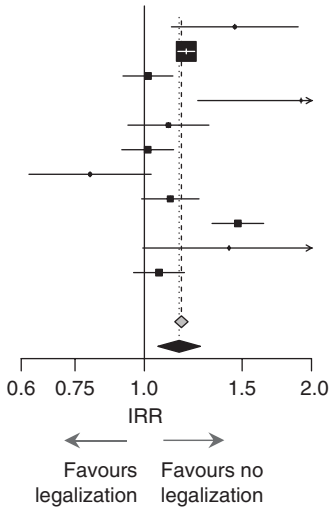
Jurisdiction	Legalization Events	Legalization Person-years	No legalization Events	No legalization Person-years	Adjusted IRR (95% CI)*
Alaska	278	2 834 487.0	479	5 827 578.0	1.45 (1.12–1.89)
California	7475	85 635 367.5	29 150	372 247 029.5	1.19 (1.15–1.23)
Colorado	3168	33 356 368.5	2638	29 726 994.5	1.01 (0.92–1.13)
District of Columbia	106	2 637 787.0	199	5 049 204.0	1.92 (1.25–2.94)
Maine	277	2 562 985.4	1447	13 368 228.6	1.10 (0.93–1.31)
Massachusetts	703	14 329 616.2	3436	65 799 402.8	1.01 (0.91–1.13)
Michigan	61	832 992.9	10 661	118 469 766.1	0.80 (0.62–1.03)
Nevada	592	6 032 431.0	2678	27 451 576.0	1.11 (0.99–1.25)
Oregon	1520	14 441 442.5	2825	32 880 250.5	1.47 (1.32–1.64)
Vermont	37	313 149.5	676	7 183 101.5	1.42 (0.99–2.03)
Washington	2899	44 007 372.0	2677	39 558 682.0	1.06 (0.96–1.18)
Fixed-effects model					**1.17 (1.13–1.20)**
Random-effects model					**1.15 (1.06–1.26)**

Heterogeneity: I^2 = 82% (68%–89%), τ^2 = 0.0147

B

Jurisdiction	Legalization Events	Legalization Person-years	No legalization Events	No legalization Person-years	Adjusted IRR (95% CI)*
Alaska	304	2 834 487.0	523	5 827 578.0	1.48 (1.15–1.90)
California	8136	85 635 367.5	31 765	372 247 029.5	1.20 (1.16–1.24)
Colorado	3439	33 356 368.5	2904	29 726 994.5	1.03 (0.93–1.13)
District of Columbia	110	2 637 787.0	218	5 049 204.0	1.94 (1.28–2.94)
Maine	294	2 562 985.4	1565	13 368 228.6	1.07 (0.91–1.26)
Massachusetts	740	14 329 616.2	3645	65 799 402.8	1.02 (0.91–1.13)
Michigan	63	832 992.9	11 532	118 469 766.1	0.76 (0.59–0.98)
Nevada	641	6 032 431.0	2916	27 451 576.0	1.10 (0.98–1.24)
Oregon	1680	14 441 442.5	3112	32 880 250.5	1.51 (1.36–1.67)
Vermont	42	313 149.5	743	7 183 101.5	1.46 (1.04–2.04)
Washington	3131	44 007 372.0	2899	39 558 682.0	1.06 (0.96–1.17)
Fixed-effects model					**1.17 (1.14–1.21)**
Random-effects model					**0.16 (1.06–1.27)**

Heterogeneity: I^2 = 85% (75%–91%), τ^2 = 0.0176



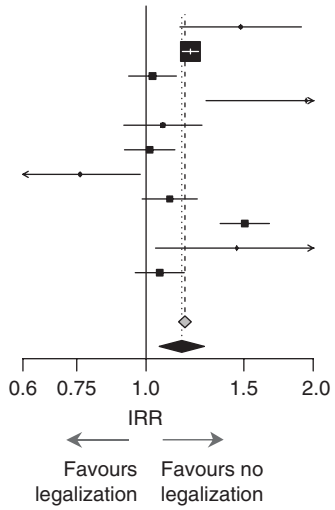


Figure 1: Forest plot of fatal motor vehicle collisions (A) and associated deaths (B) from 2007 to 2018 in United States jurisdictions with legalized recreational cannabis. *Adjusted for calendar year, modelled as a continuous variable. Note: CI = confidence interval, IRR = incidence rate ratio.

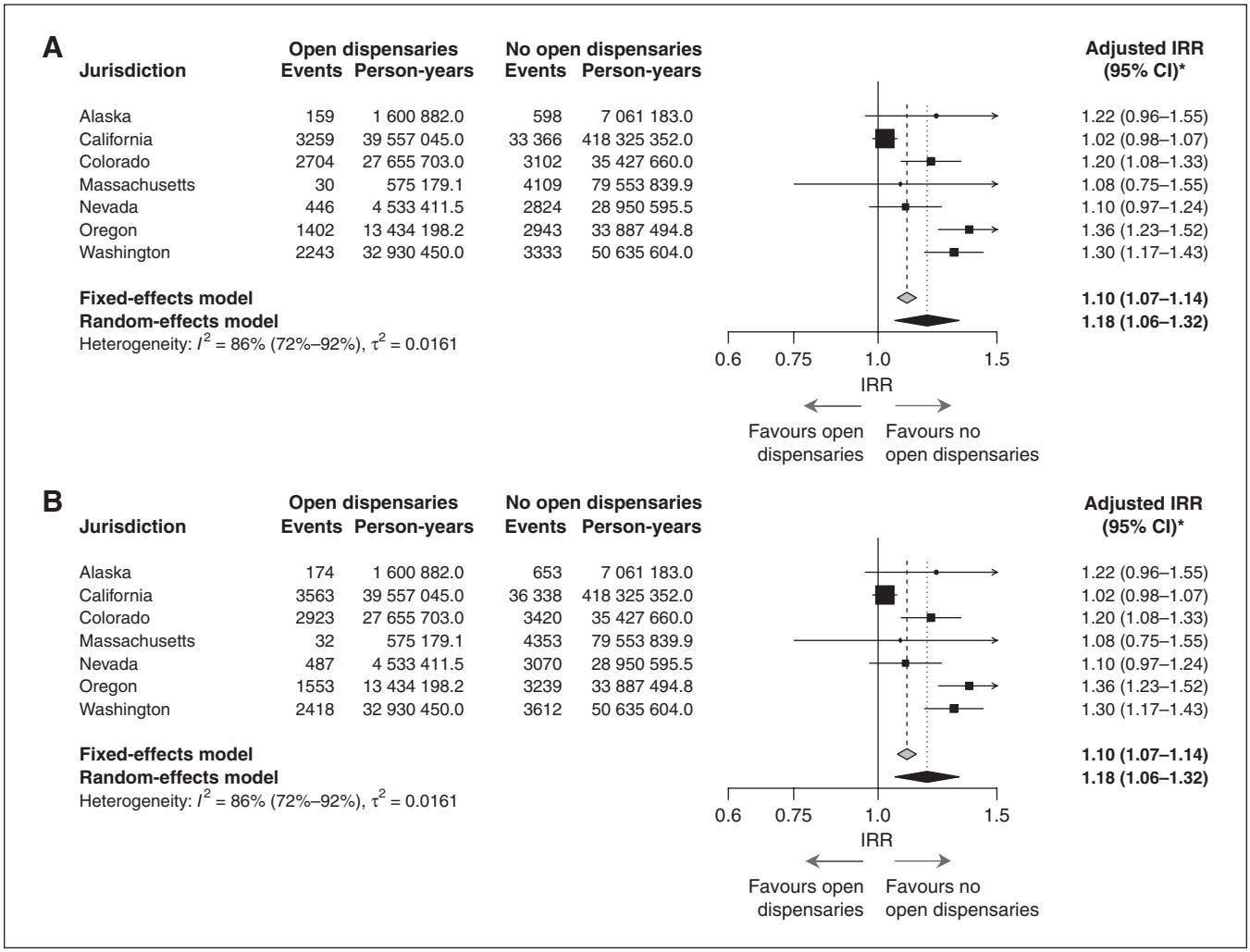


Figure 2: Forest plot of fatal motor vehicle collisions (A) and associated deaths (B) from 2007 to 2018 in United States jurisdictions with open recreational cannabis dispensaries. *Adjusted for calendar year, modelled as a continuous variable. Note: CI = confidence interval, IRR = incidence rate ratio.

opening of dispensaries (Figure 2). Temporal trends in the incidence of fatal motor vehicle collisions and associated deaths before legalization were roughly log-linear, although mild departures were present in some jurisdictions. The variance inflation factor between calendar year and legalization for fatal collisions ranged from 1.02 in Michigan to 4.03 in Colorado and Washington (Appendix 1, Supplemental Table S5). The IRR for calendar year and fatal motor vehicle collisions ranged from 0.90 (95% CI 0.85–0.96) in the District of Columbia to 1.003 (95% CI 0.99–1.01) in Michigan, with a similar range for associated deaths. Similar findings were obtained for the variance inflation factor for opening of dispensaries.

Interpretation

We found that recreational cannabis legalization in US jurisdictions was associated with a relative increased risk of fatal motor vehicle collisions of 15% and a relative increase in associated deaths of 16%. From the FARS database, in 2018, an estimated 30 270 motor vehicle fatalities occurred in jurisdictions without legalized recreational cannabis. Our results suggest that legalization on a national scale could result in an additional 4843 motor vehicle fatalities per year in the US.

Previous literature concerning the association between cannabis legalization and impaired driving is limited. A small number of observational studies suggest that medical or recreational cannabis legalization may increase the proportion of drivers with detectable levels of cannabis in analyses of blood or urine; however, these observations may be confounded by increases in enforcement activities and in cannabis testing and reporting following legalization.[33–36] Likewise, an increase in detectable levels of cannabis (e.g., owing to increased use following legalization) would not necessarily correspond directly to increases in impaired driving.[3] Another study showed an increase in self-reported driving under the influence of cannabis following legalization.[37] However, people may be more likely to report cannabis use and temporally associated driving when cannabis use is legal.

Table 3: Fatal motor vehicle collisions and associated deaths from 2007 to 2018 in United States jurisdictions with legalized recreational cannabis, comparing the first 12 months to subsequent months

Event	No. of events	Person-years of observation	Rate per 100 000 person-years (95% CI)	IRR (95% CI)	
				Crude	Adjusted*
Recreational cannabis legalization					
Fatal motor vehicle collision	73 982	924 545 813	8.00 (7.94–8.06)		
No legalization	68 180	855 020 030.8	7.92 (7.86–7.99)	1.00 (reference)	1.00 (reference)
First 12 mo after legalization†	5802	69 525 782.3	8.35 (8.13–8.56)	1.01 (0.93–1.11)	1.12 (1.01–1.23)
Subsequent months after legalization‡	11 314	137 458 217.3	8.23 (8.08–8.38)	1.06 (1.00–1.13)	1.22 (1.11–1.35)
First 12 mo v. subsequent months‡	–	–	–	0.96 (0.88–1.05)	0.92 (0.84–1.02)
Death from motor vehicle collision	80 402	924 545 813	8.70 (8.64–8.76)	–	
No legalization	61 822	717 561 813.4	8.62 (8.55–8.68)	1.00 (reference)	1.00 (reference)
First 12 mo after legalization†	6290	69 525 782.3	9.05 (8.83–9.27)	1.00 (0.92–1.10)	1.11 (1.00–1.24)
Subsequent months after legalization‡	12 290	137 458 217.3	8.94 (8.78–9.10)	1.06 (1.00–1.12)	1.23 (1.11–1.37)
First 12 mo v. subsequent months‡	–	–	–	0.96 (0.89–1.04)	0.92 (0.84–1.01)
Opening of recreational cannabis dispensaries					
Fatal motor vehicle collision	60 518	774 128 598	7.82 (7.76–7.88)		
No open dispensaries	50 275	653 841 729.2	7.69 (7.62–7.76)	1.00 (reference)	1.00 (reference)
First 12 mo of open dispensaries†	4968	60 437 733.9	8.22 (7.99–8.45)	1.03 (0.95–1.13)	1.13 (1.03–1.24)
Subsequent months of open dispensaries‡	5275	59 849 134.9	8.81 (8.58–9.05)	1.13 (1.08–1.18)	1.34 (1.24–1.46)
First 12 mo v. subsequent months‡	–	–	–	0.92 (0.82–1.04)	0.88 (0.76–1.02)
Death from motor vehicle collision	65 835	774 128 598	8.50 (8.44–8.57)		
No open dispensaries	54 685	653 841 729.2	8.36 (8.29–8.43)	1.00 (reference)	1.00 (reference)
First 12 mo of open dispensaries†	5426	60 437 733.9	8.98 (8.74–9.22)	1.03 (0.95–1.13)	1.13 (1.03–1.25)
Subsequent months of open dispensaries§	5724	59 849 134.9	9.56 (9.32–9.82)	1.12 (1.07–1.17)	1.35 (1.25–1.45)
First 12 mo v. subsequent months§	–	–	–	0.92 (0.82–1.03)	0.88 (0.76–1.01)

Note: CI = confidence interval, IRR = incidence rate ratio.
*Adjusted for calendar year, modelled as a continuous variable.
†Includes up to 12 months for each jurisdiction (some jurisdictions contributed less than 12 mo, depending on their dates of legalization or opening of dispensaries).
‡Excludes Michigan and Vermont (no subsequent months of legalization available).
§Excludes California and Massachusetts (no subsequent months of open dispensaries available).

Several previous studies in which ecologic approaches were used did not rely on the measurement and reporting of the presence of cannabis or data on self-reported impaired driving. Aydelotte and colleagues[38] used a difference-in-differences approach to compare changes in fatal motor vehicle collisions associated with legalization, using FARS data (2007–2017) from Colorado and Washington and 9 control states. Although their results were not conclusive, their analysis suggested a potential increase in fatal collisions of 1.2 per billion vehicle miles travelled (95% CI –0.6 to 2.1) in Colorado and Washington in the 5 years after recreational cannabis legalization. When they used the date of opening of commercial dispensaries, legalization was associated with an increase in fatal collisions of 1.8 per billion vehicle miles travelled (95% CI 0.4–3.7). Santaella-Tenoirio and colleagues[39] examined similar data (2005–2017) from Colorado and Washington, which they compared to synthetic reference groups (created from a pool of comparison states whose fatality rates best resembled those of the exposed states before legalization). They found an increase in motor vehicle fatalities in Colorado (1.5/billion vehicle miles travelled, $p = 0.047$) but not in Washington (0.08/billion vehicle miles travelled, $p = 0.7$) following legalization of recreational cannabis retail sales. They hypothesized that higher retail density, cannabis use and cannabis tourism in Colorado relative to Washington may have contributed to the observed increase in fatalities from collisions in Colorado.

Two additional ecologic studies included data from other states with recreational cannabis legalization. Kamer and colleagues[40] used a difference-in-differences approach to compare motor vehicle fatalities in the FARS database (2008–2018) in Colorado, Washington, Oregon and Alaska to those in the 20 states without legalized recreational or medical

cannabis as of the beginning of 2018. After adjusting for covariates, they found an increase in motor vehicle fatalities of 2.1 per billion vehicle miles travelled (95% CI 1.3–3.0) following the opening of recreational cannabis retail stores. Lane and colleagues[41] used data from the Centers for Disease Control and Prevention's Wide-ranging Online Data for Epidemiologic Research Web application and RoadSafetyBC to examine changes in traffic fatalities between 2009 and 2016 in 3 states with recreational cannabis legalization (Colorado, Washington and Oregon), using neighbouring jurisdictions without legalization as comparators. They conducted an interrupted time-series analysis of traffic fatality rates using generalized least squares regression models adjusted for seasonality and autocorrelation to test the association between legalization and traffic fatalities. They found a pooled step increase of 1.08 traffic fatalities per million residents ($p < 0.001$), which suggested an increase in traffic fatalities less than 1 year after legalization, followed by a reduction in trend of 0.06 per month ($p < 0.001$).

Our analysis extends the findings of these previous studies by including an additional 7 jurisdictions with recreational cannabis legalization through 2018. Overall, our results support previous literature suggesting that recreational cannabis legalization is associated with increased impaired driving. Although our findings suggest that there may be some variability between jurisdictions in increased risk, IRRs for 10 of the 11 jurisdictions were greater than 1.0 (range 1.01–1.92) for fatal motor vehicle collisions following legalization. Michigan was the only jurisdiction with a point estimate that suggested a lower risk after legalization (IRR 0.80); however, recreational cannabis was legal for only 1 month in that state before 2019. Among jurisdictions with recreational cannabis dispensaries, all point estimates suggested increased rates of fatal motor vehicle collisions after the opening of dispensaries (IRR range 1.02–1.36).

In contrast to the findings of Lane and colleagues,[41] our findings suggest that the increase in fatal motor vehicle collisions may be sustained over time. We found no evidence of a transient increase in rates of fatal collisions and associated deaths in the first 12 months following legalization or the opening of commercial dispensaries compared to subsequent months. However, our estimates suggest that there may be lower rates of fatal collisions and associated deaths in the first 12 months after legalization relative to subsequent months. This may be due to relatively limited cannabis availability in many jurisdictions during the first years after legalization and opening of dispensaries (e.g., fewer stores open, product shortages owing to high demand), which might deter new cannabis users in particular.

In Canada, 1922 motor vehicle fatalities were reported in 2018;[42] a relative increase of 16% would correspond to 308 additional deaths yearly. However, the national approach taken to recreational cannabis legalization may mitigate increases in impaired driving in Canada. For example, Bill C-46 (enacted in 2018) established national per se driving limits for tetrahydrocannabinol (THC), with corresponding minimum penalties for exceeding these limits.[43] Although these limits are controversial owing to a lack of direct correlation between THC levels and driving impairment,[44,45] public awareness of the establishment of legal limits alone has the potential to decrease substance-impaired driving.[46,47] Of the 11 US jurisdictions included in our analyses, 7 did not have a threshold limit for THC.[6] Overall, our analysis suggests that Canada should remain vigilant regarding the potential for increases in cannabis-impaired driving.

Limitations

Our study was observational, and there were several factors that varied between jurisdictions and were likely to influence fatal motor vehicle collisions (e.g., substance use, population density, speed limits). Our jurisdiction-specific analyses were self-controlled and adjusted for calendar year to account for temporal trends; however, confounding remains possible. Although we found increased rates of fatal motor vehicle collisions and associated deaths following legalization, there was an amplification of the effect after we controlled for calendar year.

In contrast to other investigators, we did not select neighbouring or matched control jurisdictions as comparators; rather, we used the prelegalization period (minimum of 5 yr) for each jurisdiction to serve as the comparator for the period following legalization. Natural trends in the incidence of fatal motor vehicle collisions and associated deaths were roughly log-linear before legalization in most jurisdictions. Although mild departures from linearity were present in some jurisdictions, to facilitate analyses across jurisdictions, we selected the modelling approach that was most appropriate for the most jurisdictions. Given the growing number of US jurisdictions with legalized cannabis, this approach minimizes the effect of spillover or contamination (i.e., residents of neighbouring states without legalization consuming cannabis purchased in states with legalized cannabis) on the analyses of association.

Conclusion

Our findings suggest that there is the potential for an important increase in fatal motor vehicle collisions following the legalization of recreational cannabis in Canada. Although differences between the US and Canada may mitigate potential increases in impaired driving, the observed 15% relative increase in fatal motor vehicle collisions and 16% relative increase in associated deaths could result in 308 additional road fatalities annually in Canada.

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