Short communication

Out-of-state cannabis purchases in the United States

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ABSTRACT

Background: Cannabis legalization at the US state level may have implications for cross-border purchases and diversion of legal products. The current study examined the association between out-of-state purchases and 1) cannabis regulations; and 2) the length of time a state has had recreational retail sales.

Methods: Data come from US respondents who participated in Wave 1 of the International Cannabis Policy Study (ICPS), conducted in August-October 2018. Respondents were aged 16–65 years who had used cannabis in the past 12 months (n = 4320). Respondents were recruited using the Nielsen Consumer Insights Global Panel. Binary logistic regression models examined likelihood of any out-of-state cannabis purchases in the prior year, including differences by cannabis regulations, and time since recreational cannabis retail sales began.

Results: Overall, 15.0 % of US cannabis users had made any out-of-state cannabis purchases in the past 12 months. Respondents in states where recreational cannabis was legal were less likely to make any out-of-state purchases than respondents in states where only medical cannabis was legal (AOR = 0.45, 95 % CI: 0.34-0.60, p < 0.001) and where all cannabis was prohibited (AOR = 0.36, 95 % CI: 0.26-0.50, p < 0.001). Among respondents in 'legal' states, a longer history of legal sales was associated with a lower likelihood of out-of-state cannabis purchases (AOR = 0.82, 95 % CI: 0.72-0.93, p = 0.002).

Conclusion: The findings demonstrate that consumers in states where recreational cannabis is legal were less likely to purchase cannabis out-of-state than consumers in states where recreational cannabis is not legal. Future research should examine which states people travel to purchase cannabis and why.

1. Introduction

Cannabis is the most widely used illicit substance in the world. Recently, several jurisdictions have legalized the recreational use of cannabis (Uruguay, Canada, some US states) or are discussing legalization (*e.g.* Luxembourg, the Netherlands, some US states) (Hall et al., 2019). In the United States, cannabis remains illicit at the federal level; however, both medical and recreational cannabis laws vary across the states. By 2019, 33 states had legalized medical cannabis, with an additional 15 permitting the use of cannabidiol (CBD) (NORML, 2019). Since Colorado and Washington legalized recreational cannabis in 2012, nine additional states and Washington D.C. have legalized.

Legalization in some jurisdictions may have implications for others in terms of cross-border purchases and diversion of legal products to illicit jurisdictions, such as in US states and in the European Union if or when countries legalize (Hansen et al., 2019; Hao and Cowan, 2017; Orens et al., 2018). For example, a study examining the effect of Oregon's legalization on legal sales in Washington State, found approximately a 40 % decrease in sales along the border post-legalization, which suggests that pre-legalization Oregonians were crossing the border to purchase cannabis (Hansen et al., 2017, 2019). Furthermore, Nebraska and Oklahoma filed a federal lawsuit against Colorado due to their claim that Colorado's legalization had increased their law enforcement costs (Healy, 2014).

The price of cannabis may be lower in legal states and provide an incentive for cross-border purchases from consumers in neighbouring states (Caulkins et al., 2016; Hall and Lynskey, 2016; Kilmer et al., 2010). Indeed, evidence from tobacco shows that proximity to neighbouring states or countries that have lower tobacco prices has been associated with higher rates of illicit tobacco use (Nagelhout et al., 2014; National Research Council and Institute of Medicine, 2015). Cannabis purchased in a legal state may also be opportunistic. For example, cross-border purchases could be examples of legal 'tourism', where non-state residents purchase and consume cannabis in the legal state. In Washington State from 2014 to 2018, researchers estimated 10 % of excise tax revenue came from out-of-state consumers (Hansen et al., 2019). Moreover, recreational cannabis tourism was a prominent discussion point when Vermont was considering legalization, as approximately one million cannabis users lived within a 2-h drive of Vermont's borders (Caulkins and Kilmer, 2016).

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States that have legalized recreational cannabis often begin retail sales up to several years after legalization, with a gradual increase in stores thereafter (Pardo, 2014). For example, in 2018, Washington State had one recreational retail store for every 1766 past-month users (four years after sales began), whereas Nevada had one store for every 4459 past-month users (one year after sales began) (State of Nevada Department of Taxation, 2017; Substance Abuse and Mental Health Services Administration, 2017; Washington State Liquor and Cannabis Board, 2019). Similarly, medical cannabis legalization does not equate to equal access for cannabis-seeking patients. The qualifying conditions where medical cannabis is recommended varies across the states. Increased cannabis access, medical or recreational, in a neighbouring state may provide incentives to purchase out-of-state.

Previous literature has explored cross-border cannabis purchases in specific US states (Caulkins and Kilmer, 2016; Hao and Cowan, 2017; Hansen et al., 2019). To our knowledge, this is the first study to explore out-of-state purchasing in all 50 US states at a time of changing cannabis legislation. The current study examined the US results from the 2018 International Cannabis Policy Study (ICPS). The aims of the study were to 1) examine the association between US cannabis regulations and out-of-state purchases; and 2) examine the association between the length of time a state has had recreational retail sales and out-of-state purchases. This study offers a unique look at out-of-state purchasing across all US states, including examining the effect of legal recreational retail sales, at a time where cannabis regulations were changing across the US.

2. Methods

Data were from the ICPS, a prospective cohort survey conducted annually with participants from three jurisdictions: Canada (all provinces); US states that have legalized recreational cannabis (US 'legal' states) and those that have not (US 'illicit' states). The current study reports data from Wave 1, conducted between August 27, 2018 and October 7, 2018 with participants from US 'legal' states and US 'illicit' states. At Wave 1, US 'legal' states included Alaska, California, Colorado, Maine, Massachusetts, Nevada, Oregon, Vermont, Washington D.C, and Washington State. Respondents aged 16–65 years were recruited using the Nielsen Consumer Insights Global Panel (http://www.nielsen.com/ca/en/about-us.html), and data were collected *via* self-completed web-based surveys. The Nielsen panels use both probability and nonprobability sampling methods. For the current project, Nielsen drew stratified random samples from the online panels, based on known proportions in each age group. To account for differential response rates, Nielsen modified these sampling proportions to place greater weight on sub-groups with lower response rates. A full description of the study design and methodology can be found in the technical report [available at: http://cannabisproject.ca/methods/].

2.1. Measures

Survey measures were drawn or adapted from national surveys or selected based on previous research. In all cases, participants had the option of selecting 'Don't Know' or 'Refuse'.

2.1.1. Socio-demographic measures

Socio-demographic measures included sex at birth, age, ethnicity, highest level of education, and state of residence. Income adequacy was assessed through "Thinking about your family's income, how difficult or easy is it to make ends meet?" Responses were recoded into: "Very difficult", "Difficult", "Neither easy nor difficult", "Easy", "Very Easy", and "Not reported". Cannabis use status was assessed through questions, "How often do you use cannabis?" and "When was the last time you used cannabis?" Responses were recoded into: "Less than monthly user", "Monthly user", "Weekly user", "Daily or almost daily user".

2.1.2. In and out of state purchases

Participants were asked: "Of the cannabis products you purchased in the past 12 months, did you buy them within or outside of the state where you currently live?" with response options: "All were bought in state", "Some were bought in state", "All were bought out of state", and "Don't know". For statistical analyses, responses were recoded into: "Any out-of-state purchases" and "Other".

2.1.3. Recreational and medical cannabis laws

Participants were categorized according to cannabis regulations in their state of residence. Participants in states where both recreational and medical cannabis were legal were categorized to "Legal recreational cannabis". Participants in states where only medical cannabis was legal were categorized to "Legal medical cannabis only". Participants in states where neither recreational nor medical cannabis was legal or only CBD-only products were permitted were categorized to "No legal cannabis".

2.1.4. Time since recreational retail sales

US 'legal' states were recoded to a continuous variable according to the time (in years) since their state began recreational retail sales to the time of the survey.

2.2. Data analysis

A total of 1,428,857 respondents were sent an email invitation to the survey, 44,364 respondents accessed the survey link, and 28,471 (2 %) completed the entire survey. Due to data integrity questions, data quality or residence in District of Columbia (inadequate sample size), 734 respondents were excluded. For the current analysis, the final sample included US respondents who had used cannabis in the past 12 months (n = 4320). Respondents were excluded on a case-wise basis for measures with missing data (n = 199).

Post-stratification sample weights were constructed based on US Census estimates. Respondents from the US legal states were classified into age-by-sex-by-legal state, education, and region-by-race groups, while those from the illegal states were classified into age-by-sex, education, and region-by-race groups. Correspondingly grouped population count and proportion estimates were obtained from the U.S. Census Bureau (US Census Bureau, Population Division, 2017; US Census Bureau, 2017). A raking algorithm was applied to the full analytic sample to compute weights that were calibrated to each jurisdiction. Estimates are weighted unless otherwise specified. First, a binary logistic regression model was used to examine any cannabis regulation differences in any out-of-state cannabis purchases. Second, a binary logistic regression model was used to examine any time differences since legal retail sales in any out-of-state cannabis purchases. Two sensitivity analyses were conducted to assess potential bias due to misclassification. First, both binary logistic regression models were repeated excluding participants who answered 'don't know' to the out-of-state cannabis purchases question. Second, we re-classified the recreational and medical cannabis laws according to the categorizations used by Williams et al. (2016),Pacula et al., 2015 and Veligati et al. (2020) and repeated the first binary logistic regression analysis. In both analyses, the results did not meaningfully change from what is presented in the main text. The model estimates were reported with 95 % confidence intervals (95 % CIs) and adjusted for sex, age, ethnicity, education, income adequacy and cannabis use status. Analyses were conducted using PROC SURVEY commands in SAS 9.4. The project was reviewed by and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE#22392).

3. Results

Supplementary Table 1 displays cannabis regulation and socio-demographic variables by cannabis purchases made within and out-of-
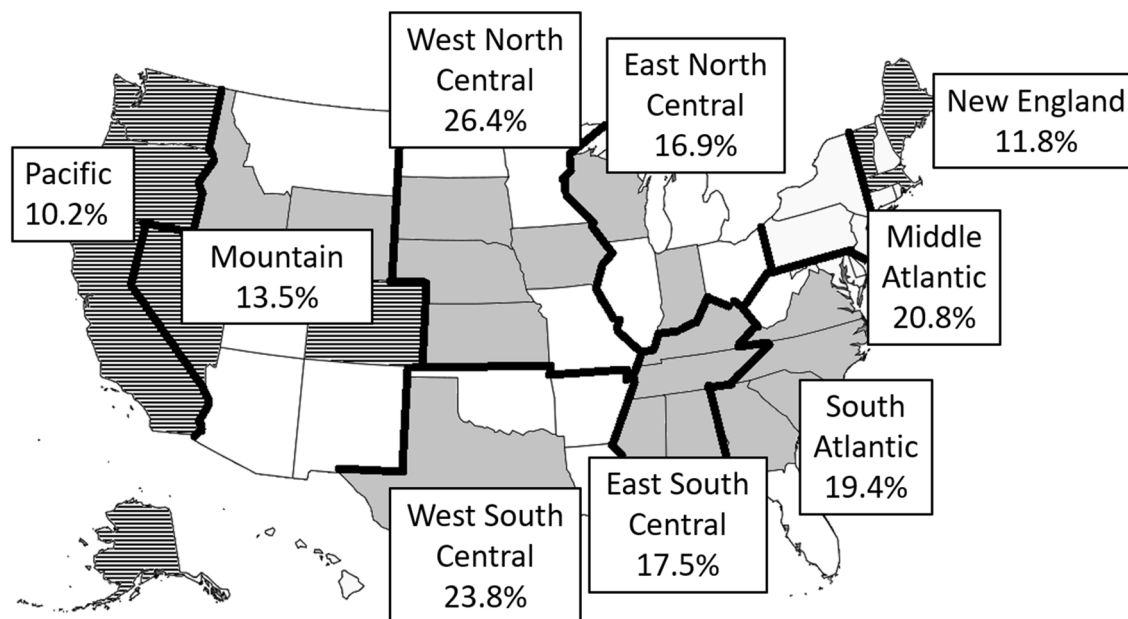
Fig. 1. Any out-of-state cannabis purchases among past 12-month cannabis users in the United States by US Census division.
States with legal recreational cannabis are represented by stripes, states with legal medical cannabis only are represented in white, and states with no legal cannabis are represented in grey.

state in the past 12 months. Overall, 15.0 % (n = 616) of all US respondents had made any out-of-state cannabis purchases in the past 12 months. Fig. 1 displays the proportion of US respondents that made any out-of-state cannabis purchases in the past 12 months across US census division.

3.1. Cannabis regulations

A binary logistic regression model was fitted to examine correlates of cannabis purchased out-of-state in the past 12 months, among US respondents (Table 1, left column). Respondents in states where recreational cannabis was legal were significantly less likely to make any out-of-state cannabis purchases in the past 12 months than respondents in states where only medical cannabis was legal (AOR = 0.45, 95 % CI: 0.34-0.60, p < 0.001) and respondents in states with no legal cannabis (AOR = 0.36, 95 % CI: 0.26-0.50, p < 0.001). No significant association was found between respondents in states where only medical cannabis was legal and in states with no legal cannabis. Respondents with a bachelor's degree or higher were significantly more likely to make any out-of-state cannabis purchases than respondents with education less than high school (AOR = 2.40, 95 % CI: 1.20–4.82, p = 0.014). Respondents aged 26–35 (AOR = 1.76, 95 % CI: 1.20–2.58, p = 0.004) and 36–45 (AOR = 1.73, 95 % CI: 1.13–2.66, p = 0.012) were significantly more likely to make any out-of-state purchases than respondents aged 46-55. The remaining covariates were not significantly associated with any out-of-state cannabis purchases.

3.2. Legal recreational retail sales

A binary logistic regression model was fitted to examine correlates of cannabis purchased out-of-state in the past 12 months, among respondents in US 'legal' states (Table 1, right column). A longer history of legal sales was significantly associated with a lower likelihood of out-of-state cannabis purchases in the past 12 months (AOR = 0.82, 95 % CI: 0.72-0.93, p = 0.002). Male respondents in US 'legal' states were significantly more likely to make any out-of-state cannabis purchases than female respondents (AOR = 1.62, 95 % CI: 1.05–2.49, p = 0.029). Among respondents in US 'legal' states, those who reported that it was 'difficult' to make ends meet were significantly less likely to make any

out-of-state cannabis purchases than respondents who reported that it was 'very difficult' (AOR = 0.32, 95 % CI: 0.12-0.87, p = 0.025). The remaining covariates were not significantly associated with out-of-state cannabis purchases.

4. Discussion

Respondents in states where recreational cannabis was legal were less likely to make any out-of-state cannabis purchases than respondents in states where recreational cannabis was not legal. Cannabis consumers may have several motivations for purchasing cannabis in other states where cannabis is legal, including reduced fear of prosecution. Consumers may also be motivated by lower prices in states where recreational cannabis is legal (Smart et al., 2017; Orens et al., 2018; Oregon Liquor Control Commission, 2019) and by greater product availability or perceptions that legal cannabis products may be higher quality or less harmful than products on the illicit market (Caulkins et al., 2018; Orens et al., 2018). Indeed, US regions with more 'legal' states reported less out-of-state cannabis purchasing than regions with more 'illicit' states. For example, the Pacific region (Alaska, Hawaii, Washington State, Oregon and California) had the lowest proportion of any out-of-state cannabis purchases. In contrast, the West North Central region (North Dakota, South Dakota, Nebraska, Kansas, Minnesota, Iowa, and Missouri) had the highest proportion of any out-of-state cannabis purchases.

A longer history of recreational retail sales in US 'legal' states was associated with decreased reporting of any out-of-state cannabis purchases. Colorado was the first state to begin retail sales in January 2014, and the current study shows that Colorado had the lowest proportion of any out-of-state purchases. Colorado had a regulated medical retail market prior to recreational legalization, which may have influenced the efficiency of the implementation of a recreational market, reducing the need to purchase out-of-state. Legal states often require several years to established retail stores and access to legal stores can vary throughout a state. To date, there are no retail sales in Vermont, and all other 'legal' states allow local governments to ban the retail sales of recreational cannabis. For example, two years after retail sales began in Washington State, one third of residents lived in areas where local government had banned retail sales of recreational cannabis

Table 1

Weighted binary logistic regression analysis for any out-of-state purchases by recreational and medical cannabis regulations (left column, n = 4121) and among US 'legal' states only (right column, n = 2205).

	Any out-of-state purchasing (*vs.* other) n = 4121		Any out-of-state purchasing (*vs.* other) n = 2205	
	AOR (95 % CI)	*p-value*	AOR (95 % CI)	*p-value*
Recreational and medical cannabis laws (vs. no legal cannabis)				
Legal recreational cannabis	0.36 (0.26-0.50)	< 0.001	–	–
Legal medical cannabis only	0.79 (0.59–1.07)	0.132	–	–
Time since recreational retail sales (US 'legal' states only)	–	–	0.82 (0.72-0.93)	0.002
Cannabis use status (vs. less than monthly user)				
Daily or almost daily user	0.98 (0.72–1.35)	0.914	0.97 (0.53–1.79)	0.925
Weekly user	0.98 (0.67–1.42)	0.904	1.14 (0.58–2.23)	0.703
Monthly user	1.24 (0.89–1.74)	0.202	1.07 (0.55–2.06)	0.853
Sex at birth (vs. female)				
Male	1.07 (0.85–1.36)	0.561	1.62 (1.05–2.49)	0.029
Age group (vs. 56–65)				
16-25	0.81 (0.47–1.39)	0.442	0.66 (0.20–2.13)	0.484
26–35	1.36 (0.94–1.95)	0.100	1.21 (0.64–2.30)	0.553
36–45	1.34 (0.87–2.01)	0.167	1.42 (0.68–2.94)	0.351
46-55	0.77 (0.52–1.15)	0.200	0.60 (0.28–1.30)	0.196
Ethnicity (vs. white)				
Other	1.11 (0.79–1.58)	0.549	1.01 (0.51–1.99)	0.988
Education (vs. less than high school)				
High school diploma	0.90 (0.45–1.83)	0.779	1.22 (0.23–6.51)	0.819
Some college or technical vocation	1.27 (0.62–2.58)	0.511	1.64 (0.29–9.38)	0.578
Bachelor's degree or higher	2.40 (1.20–4.82)	0.012	2.73 (0.49–15.65)	0.258
Income adequacy (vs. very difficult)				
Difficult	0.92 (0.53–1.60)	0.772	0.32 (0.12-0.87)	0.025
Neither easy nor difficult	1.19 (0.70–2.04)	0.517	0.96 (0.37–2.48)	0.928
Easy	1.30 (0.75–2.26)	0.348	1.01 (0.38–2.73)	0.983
Very easy	1.29 (0.73–2.30)	0.386	1.16 (0.42–3.23)	0.773
Not reported	1.51 (0.32–7.00)	0.601	0.17 (0.02–1.72)	0.134

AOR: Adjusted Odds Ratio; CI: Confidence Interval.

(Dilley et al., 2017).

4.1. Limitations

This study has several limitations. Respondents are asked to recall cannabis purchases over a 12-month period, which may introduce re-call bias. In addition, self-report data are subject to social desirability bias. Recreational cannabis use in the US remains illicit at the federal level; therefore, cannabis use may be underreported, or purchase sources misrepresented. However, the survey included a data integrity question wherein those who reported not answering all questions honestly were excluded. In addition, the survey was self-administered online, which can reduce social desirability bias by providing greater anonymity compared to interviewer assisted surveys (Krumpal, 2013). Further limitations are the use of non-probability-based sampling methods and a 2 % completion rate among those who were invited; therefore, the findings do not provide nationally representative esti-mates. However, post-stratification survey weights were used to adjust for sociodemographic differences. Finally, the survey only asked par-ticipants whether they had purchased cannabis within or out-of-state, not the state they purchased from, nor where they consumed the same product. Therefore, we cannot know for certain whether the behaviours described in this study were illicit or legal.

5. Conclusion

The current study provides one of the few examinations of out-of-state purchasing across the United States at a time when cannabis legislation was varied and changing. The findings demonstrate that less out-of-state cannabis purchasing occurs in states where recreational cannabis is legal. Out-of-state purchasing, if purchased in legal states, may provide greater tax-revenue for legal states (Hansen et al., 2019); however, cannabis use by residents of illicit states may increase nega-tive effects, such as increased possession arrests (Hao and Cowan, 2017), and undermine state legislation. Future research is needed on the states where people are travelling to purchase cannabis and why. In addition, further research is needed on what types of cannabis people are purchasing, including non-flower products, which now accounts for a greater market share in states where recreational cannabis is legal.

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Contributors

EW was primarily responsible for the data analysis and manuscript writing; DH was primarily responsible for study design, data collection, and contributed to the writing. All authors approve of this manuscript for submission.

Declaration of Competing Interest

No conflict declared.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.drugalcdep.2019. 107822.

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